

# Standard Specifications for Construction of Airports

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**Illinois Department of Transportation**

Office of Intermodal Project Implementation / Division of Aeronautics  
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## Part 1 – General Contract Provisions

### Section 10 Definition of Terms

**10-01 Definitions.** When the following terms are used in these specifications, in the contract, or in any documents or other instruments pertaining to construction where these specifications govern, the intent and meaning shall be defined as follows:

Paragraph Number	Term	Definition
10-01	AASHTO	The American Association of State Highway and Transportation Officials.
10-02	Access Road	The right-of-way, the roadway and all improvements constructed thereon connecting the airport to a public roadway.
10-03	Administrator	Administrator of the Federal Aviation Administration of the U.S. Department of Transportation, or their duly authorized representative.
10-04	Advertisement	A public announcement, as required by local law, inviting bids for work to be performed and materials to be furnished.
10-05	Advisory Circulars (AC)	As referred to in this document, these publications shall be the current Federal Aviation Administration Advisory Circulars required for use in AIP funded and PFC approved projects as published on the FAA Office of Airports website.
10-06	Aggregate Gradation	For aggregates tested under the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 11-08, <i>Aggregate Gradation Control System (AGCS)</i> : CA = Coarse Aggregate CM = Coarse Aggregate, Modified CA and CM gradations may be used interchangeably (e.g., CA16 and CM16). FA = Fine Aggregate FM = Fine Aggregate, Modified FA and FM gradations may be used interchangeably (e.g., FA06 and FM06).
10-07	Airport	Airport means an area of land or water which is used or intended to be used for the landing and takeoff of aircraft; an appurtenant area used or intended to be used for airport buildings or other airport facilities or rights of way; airport buildings and facilities located in any of these areas, and a heliport.
10-08	Airport Improvement Program (AIP)	A grant-in-aid program, administered by the Federal Aviation Administration (FAA).
10-09	Airport Management	The person and/or representatives responsible for the daily management and operation of the airport.
10-10	Air Operations Area (AOA)	The term air operations area (AOA) shall mean any area of the airport used or intended to be used for the landing,

Paragraph Number	Term	Definition
		takeoff, or surface maneuvering of aircraft. An air operation area shall include such paved or unpaved areas that are used or intended to be used for the unobstructed movement of aircraft in addition to its associated runway, taxiway, or apron.
10-11	Apron	Area where aircraft are parked, unloaded or loaded, fueled and/or serviced.
10-12	ASTM International (ASTM)	Formerly known as the American Society for Testing and Materials (ASTM).
10-13	Award	The Department's notice to the lowest responsible and responsive bidder of the acceptance of the submitted bid subject to the approval and execution of a satisfactory contract, receipt of a payment and performance bond and compliance with such other conditions as may be specified or otherwise required by law.
10-14	Bidder	Any individual, partnership, firm, corporation, or a legally stated combination, acting directly or through a duly authorized representative, who submits a proposal for the work contemplated.
10-15	Building Area	An area on the airport to be used, considered, or intended to be used for airport buildings or other airport facilities or rights-of-way together with all airport buildings and facilities located thereon.
10-16	Calendar Day	Every day shown on the calendar.
10-17	Cataclysmic Event	An occurrence, caused exclusively by any of the irresistible forces of nature that is an unexpected, singular event without continued, persistent existence or that is irregularly predictable. The event must occur without the involvement of human causative action and must not be preventable or capable of substantial limitation in its impact by application of human care, skill, or foresight. Cataclysmic events include earthquakes, floods, flash floods of service water, caused by heavy rains and runoff water, tornadoes, or other cataclysmic phenomena of nature. A flood, defined as water elevation in excess of the channel capacity of a river, stream, other body of water is not a cataclysmic event, unless the floodwater elevation exceeds the 100-year flood elevation as defined in the contract.
10-18	Certificate of Analysis (COA)	The COA is the manufacturer's Certificate of Compliance (COC) including all applicable test results required by the specifications.
10-19	Certificate of Compliance (COC)	The manufacturer's certification stating that materials or assemblies furnished fully comply with the requirements of the contract. The certificate shall be signed by the manufacturer's authorized representative.
10-20	Change Authorization	Only change orders, contract adjustment and extra work identified on form AER 51, <i>Authorization of Contract Changes</i> and signed by the Department, represent authorized modifications to the contract.

<b>Paragraph Number</b>	<b>Term</b>	<b>Definition</b>
10-21	Change Order	Formal, written directive issued to a contractor or an agreement that amends a contract in order to address contingencies affecting the performance and completion of the contract, including but not limited to such matters as extra work, design changes or alterations to plans or special provisions or specifications for which no provision is included in the original contract. The work covered by a change order must be within the general scope of the contract. For work that would increase or decrease the total amount of the award contract, or any major contract item, by more than 25%, reference 10-77 Supplemental Agreement.
10-22	Code	The Illinois Procurement Code [30 ILCS 500].
10-23	Contract	A written agreement between the Department or Owner and the Contractor setting forth the obligations of the parties thereunder, including, but not limited to, the performance of work, the furnishing of labor, equipment and materials, and the basis of payment.  The awarded contract includes but may not be limited to: Advertisement, Contract form, Proposal, Performance bond, payment bond, Letter of Award, any required insurance certificates, Specifications, General provisions, Supplemental specifications, special provisions, plans, Manual for Documentation of Airport Materials, Airport Construction Documentation Manual, and addenda issued to bidders and any Agreements that are required to complete the construction of the work in an acceptable manner, including authorized extensions thereof, all of which constitute one (1) instrument.
10-24	Contract Adjustment	A written price adjustment that adds to or deducts from a contract in accordance with provisions included in the original contract, including, but not limited to, increased or decreases in quantities, incentives, changed conditions and the addition of missing pay items called for in the contract.
10-25	Contract Item (Pay Item)	A specific unit of work for which a price is provided in the contract.
10-26	Contract Modification	Any mutually agreed written change in the terms of the contract such as change orders and supplemental agreements.
10-27	Contract Time	The number of calendar days or working days, stated in the proposal, allowed for completion of the contract, including authorized time extensions. If a calendar date of completion is stated in the proposal, in lieu of number of calendar or working days, the contract shall be completed by that date.
10-28	Contractor	The individual, partnership, firm, corporation, or legally stated combination, that is primarily liable for the acceptable performance of the work contracted and for the payment of all legal debts pertaining to the work who acts directly or through lawful agents or employees to complete the contract work.

<b>Paragraph Number</b>	<b>Term</b>	<b>Definition</b>
10-29	Contractors Quality Control (QC) Facilities	The Contractor's QC facilities in accordance with the Contractor Quality Control Program (CQCP).
10-30	Contractor Quality Control Program (CQCP)	Details the methods and procedures that will be taken to assure that all materials and completed construction required by the contract conform to contract plans, technical specifications and other requirements, whether manufactured by the Contractor, or procured from subcontractors or vendors.
10-31	Control Strip	A demonstration by the Contractor that the materials, equipment, and construction processes result in a product meeting the requirements of the specification.
10-32	Construction Safety and Phasing Plan (CSPP)	The overall plan for safety and phasing of a construction project developed by the airport operator or developed by the airport operator's consultant and approved by the airport operator. It is included in the invitation for bids and becomes part of the project specifications.
10-33	Department	The Department of Transportation of the State of Illinois, acting as Authorized Agent, for the purposes of the prosecution of projects of the Owner when the State is the awarding authority. Formerly known as the Illinois Department of Transportation, Division of Aeronautics.
10-34	Director	The Director of the Office of Intermodal Project Implementation for the State of Illinois, Department of Transportation.
10-35	Drainage System	The system of pipes, ditches, and structures by which surface or subsurface waters are collected and conducted from the airport area.
10-36	Engineer	The Chief Engineer of Aeronautics for the State of Illinois, Department of Transportation to be responsible for engineering, inspection, and/or observation of the contract work and acting directly, or through an authorized representative.
10-37	Equipment	All machinery and equipment, together with the necessary supplies for upkeep and maintenance; and all tools and apparatus necessary for the proper construction and acceptable completion of the work.
10-38	Extra Work	An item of work not provided for in the awarded contract as previously modified by change order or supplemental agreement, but which is found by the Department to be essential and germane to the satisfactory completion of the contract within the intended scope of the contract as previously modified.
10-39	FAA	The Federal Aviation Administration of the U.S. Department of Transportation. When used to designate a person, FAA shall mean the Administrator or their duly authorized representative.
10-40	Federal Specifications	The federal specifications and standards, commercial item descriptions, and supplements, amendments, and indices



Paragraph Number	Term	Definition
		thereto are prepared and issued by the General Services Administration of the federal government.
10-41	Force Account	a. Contract Force Account - A method of payment that addresses extra work performed by the Contractor on a time and material basis. b. Owner Force Account - Work performed for the project by the Owner's employees.
10-42	Inspector	The authorized representative of the Engineer assigned to make all necessary inspections, observations, tests and/or observation of tests of the work performed or being performed, or of the materials furnished or being furnished by the Contractor.
10-43	Intention of Terms	Whenever, in these specifications or on the plans, the words "directed," "required," "permitted," "ordered," "designated," "prescribed," or words of like import are used, it shall be understood that the direction, requirement, permission, order, designation, or prescription of the Engineer and/or Resident Engineer (RE) is intended; and similarly, the words "approved," "acceptable," "satisfactory," or words of like import, shall mean approved by, or acceptable to, or satisfactory to the Engineer and/or RE, subject in each case to the final determination of the Department. Any reference to a specific requirement of a numbered paragraph of the contract specifications or a cited standard shall be interpreted to include all general requirements of the entire section, specification item, or cited standard that may be pertinent to such specific reference.
10-44	Lighting	A system of fixtures providing or controlling the light sources used on or near the airport or within the airport buildings. The field lighting includes all luminous signals, markers, floodlights, and illuminating devices used on or near the airport or to aid in the operation of aircraft landing at, taking off from, or taxiing on the airport surface.
10-45	Major and Minor Contract Items	A major contract item shall be any item that is listed in the proposal, the total cost of which is equal to or greater than 20% of the total amount of the award contract. All other items shall be considered minor contract items.
10-46	Materials	Any substance specified for use in the construction of the contract work.
10-47	Modification of Standards (MOS)	Any deviation from standard specifications applicable to material and construction methods in accordance with FAA Order 5300.1.
10-48	Notice to Proceed (NTP)	A written notice to the Contractor to begin the actual contract work on a previously agreed to date. If applicable, the Notice to Proceed shall state the date on which the contract time begins.
10-49	Owner	The term "Owner" shall mean the party of the first part or the contracting agency signatory to the contract. Where the term "Owner" is capitalized in this document, it shall mean airport Sponsor only.

<b>Paragraph Number</b>	<b>Term</b>	<b>Definition</b>
10-50	Passenger Facility Charge (PFC)	Per 14 Code of Federal Regulations (CFR) Part 158 and 49 United States Code (USC) § 40117, a PFC is a charge imposed by a public agency on passengers enplaned at a commercial service airport it controls.
10-51	Pavement Structure	The combined surface course, base courses, and subbase courses, if any, considered as a single unit.
10-52	Payment bond	The approved form of security furnished by the Contractor and their own surety as a guaranty that the Contractor will pay in full all bills and accounts for materials and labor used in the construction of the work.
10-53	Performance bond	The approved form of security furnished by the Contractor and their own surety as a guaranty that the Contractor will complete the work in accordance with the terms of the contract.
10-54	Plans	The official drawings or exact reproductions which show the location, character, dimensions and details of the airport and the work to be done and which are to be considered as a part of the contract, supplementary to the specifications. Plans may also be referred to as 'contract drawings.'
10-55	Progress Schedule	A schedule provided by the Contractor showing the sequence of work. The schedule shall also indicate the individual rates and the number of calendar days estimated for the completion of each item in order to carry the project to completion within the contract time.
10-56	Project	The agreed scope of work for accomplishing specific airport development with respect to a particular airport.
10-57	Project Engineer	The representative of the Department, whether employed directly by the Owner or employed by an engineering firm retained by the Owner, acting as the immediate supervisor of the Resident Engineer. The Project Engineer must be a Licensed Professional Engineer in the State of Illinois.
10-58	Proposal	The written offer of the bidder (when submitted on the approved proposal form) to perform the contemplated work and furnish the necessary labor and materials at the prices quoted, in accordance with the provisions of the contract documents.
10-59	Proposal guaranty	The security furnished with a proposal to guarantee that the bidder will enter into a contract if their own proposal is accepted by the Department.
10-60	Quality Assurance (QA)	Department's responsibility to assure that construction work completed complies with specifications for payment.
10-61	Quality Control (QC)	Contractor's responsibility to control materials and construction processes to complete construction in accordance with project specifications.
10-62	Quality Assurance (QA) Inspector	An authorized representative of the Engineer and/or Resident Engineer assigned to make all necessary inspections, observations, tests, and/or observation of tests of the work performed or being performed, or of the materials furnished or being furnished by the Contractor.

<b>Paragraph Number</b>	<b>Term</b>	<b>Definition</b>
10-63	Quality Assurance (QA) Laboratory	The official quality assurance testing laboratories of the Department or such other laboratories as may be designated by the Engineer. May also be referred to as Engineer's, Department's, or QA Laboratory.
10-64	Resident Engineer (RE)	The individual, partnership, firm, or corporation duly authorized by the Department to be responsible for all necessary inspections, observations, tests, and/or observations of tests of the contract work performed or being performed, or of the materials furnished or being furnished by the Contractor, and acting directly or through an authorized representative. The Resident Engineer must meet the approval and qualification requirements set forth by the Department and reside on the construction site at all times the Contractor is working.
10-65	Runway (RWY)	The area on the airport prepared for the landing and takeoff of aircraft.
10-66	Runway Safety Area (RSA)	A defined surface surrounding the runway prepared or suitable for reducing the risk of damage to aircraft. See the construction safety and phasing plan (CSPP) for limits of the RSA.
10-67	Safety Plan Compliance Document (SPCD)	Details how the Contractor will comply with the CSPP.
10-68	Shoulder	An area adjacent to the defined edge of paved runways, taxiways or aprons providing a transition between the pavement and the adjacent surface; support for aircraft and emergency vehicles deviating from the full-strength pavement, enhanced drainage; and blast protection.
10-69	Sidewalk	That portion of the pavement designed and constructed in accordance with applicable ADA provisions, primarily for use of pedestrians.
10-70	Special Provisions	Additions and revisions to the Standard and Supplemental Specifications covering conditions peculiar to an individual contract.
10-71	Specifications	The body of directions, provisions, and requirements contained herein, or in any supplement adopted by the Department, together with written agreements and all documents of any description made or to be made pertaining to the method or manner of performing the work, the quantities, or the quality of materials or workmanship to be furnished under the contract.
10-72	Sponsor	A Sponsor is defined in 49 USC § 47102(26) as a public agency that submits to the FAA for an AIP grant; or a private Owner of a public-use airport that submits to the FAA an application for an AIP grant for the airport.
10-73	Standards	The Department's standard drawings, and supplements, amendments, and indices thereto, as prepared and made available electronically by the Department.
10-74	State	The State of Illinois
10-75	Structures	Airport facilities such as bridges; culverts; catch basins, inlets, retaining walls, cribbing; storm and sanitary sewer

Paragraph Number	Term	Definition
		lines; water lines; underdrains; electrical ducts, manholes, handholes, lighting fixtures and bases; transformers; navigational aids; buildings; vaults; and, other manmade features of the airport that may be encountered in the work and not otherwise classified herein.
10-76	Subcontractor	An individual, firm, partnership or corporation who, with the written consent of the Engineer, assume obligation for performing specified pay items for the Contractor.
10-77	Subgrade	The compacted soil that forms the pavement foundation.
10-78	Superintendent	The Contractor's executive representative who is present on the work during progress, authorized to receive and fulfill instructions regarding the engineering details from the Resident Engineer, and who shall supervise and direct the construction.
10-79	Supplemental Agreement	A written agreement between the Contractor and the Department that establishes the basis of payment and contract time adjustment, if any, for the work affected by the supplemental agreement. A supplemental agreement is required if: (1) in scope work would increase or decrease the total amount of the awarded contract by more than 25%; (2) in scope work would increase or decrease the total of any major contract item by more than 25%; (3) work that is not within the scope of the originally awarded contract but is germane to it; or (4) adding or deleting of a major contract item.
10-80	Supplemental Specifications	Additions and revisions to the Standard Specifications contained herein that are adopted subsequent to issuance of this book.
10-81	Surety	The corporation, partnership, or individual, other than the Contractor, executing payment or performance bonds that are furnished to the Department by the Contractor.
10-82	Taxilane	A taxiway designed for low speed movement of aircraft between aircraft parking areas and terminal areas.
10-83	Taxiway (TWY)	The portion of the air operations area of an airport that has been designated by competent airport authority for movement of aircraft to and from the airport's runways, aircraft parking areas, and terminal areas.
10-84	Taxiway/Taxilane Safety Area (TSA)	A defined surface alongside the taxiway prepared or suitable for reducing the risk of damage to an aircraft. See the construction safety and phasing plan (CSPP) for limits of the TSA.
10-85	Utility	The privately, publicly, municipally or cooperatively owned line, facility or system for producing, transmitting or distributing communications, airfield cables or conduit, cable television, power, electricity, light, heat, gas, oil, crude products, water, steam, waste, storm water not connected with airport drainage, and other similar commodities, including publicly owned fire and police signal systems and street lighting systems, which directly or indirectly serve the public or any part thereof. The term "utility" shall also mean

Paragraph Number	Term	Definition
		the utility company, inclusive of any wholly owned or controlled subsidiary
10-86	Work	The furnishing of all labor, materials, tools, equipment, and incidentals necessary or convenient to the Contractor's performance of all duties and obligations imposed by the contract, plans, and specifications.

**10-02 Abbreviations.** Wherever the following abbreviations are used in contract documents, they are to be construed the same as the respective expressions represented. Where a conflict exists between FAA publications and this document, the FAA publication prevails. The Contractor must notify the Department for confirmation of this finding.

AC	Federal Aviation Administration Advisory Circulars
ADA	Americans with Disabilities Act
ADAAG	Americans with Disabilities Act Accessibility Guidelines
ANSI	American National Standards Institute
ATCT	Air Traffic Control Tower
ATO	Air Traffic Organization
AWG	American Wire Gauge
AWOS	Automated Weather Observing System
CPP	Contractor Progress Payment
CRSI	Concrete Reinforcing Steel Institute
CSPP	Construction Safety and Phasing Plan
CTAF	Common Traffic Advisory Frequency
DBE	Disadvantaged Business Enterprise
DOT	US Department of Transportation
EPA	United States Environmental Protection Agency
HIRL	High Intensity Runway Light
HMA	Hot Mix Asphalt
IEPA	Illinois Environmental Protection Agency
LIRL	Low Intensity Runway Light
LOC	Localizer
MHz	Megahertz
MIRL	Medium Intensity Runway Light
MITL	Medium Intensity Taxiway Light
MUTCD	Manual on Uniform Traffic Control Devices
NAS	National Airspace System
NAVAID	Navigational Aid
NEC	National Electric Code
NFPA	National Fire Protection Association
NIST	National Institute of Standards and Technology
NOAA	National Oceanic and Atmospheric Administration
NOTAM	Notice to Airmen

NTPEP	National Transportation Product Evaluation Program
O&M	Operations and Maintenance
OFA	Object Free Area
OFZ	Object Free Zone
OE/AAA	Obstruction Evaluation/Airport Airspace Analysis
OSHA	Occupational Safety and Health Administration
PAPI	Precision Approach Path Indicator
PCC	Portland Cement Concrete
PCU	PAPI Control Unit
REIL	Runway End Identifier Light
ROFA	Runway Object Free Area
SSC	Systems Support Center
SSPC	Society for Protective Coatings
SWPPP	Storm Water Pollution Prevention Plan
TOFA	Taxiway Object Free Area
UL	Underwriter Laboratories
USDA	United States Department of Agriculture
VADI	Visual Approach Descent Indicator

**END OF SECTION 10**

## Section 20 Proposal Requirements and Conditions

The language provided in this section represents model language acceptable to the FAA. The Owner may make edits to the model language that reflect established written local and state procurement versions provided such requirements do not materially alter the intent and purpose of the FAA's model language; and such alterations do not conflict with the requirements of 2 CFR part 200 or 49 USC chapter 471.

- 20-01 Advertisement (Notice to Bidders).** The Department's Transportation Procurement Bulletin (Bulletin) is the published source for this procurement action including the time and place of bidding, invitation to bids, notices, prequalification requirements, contract forms, bonds, construction plans, specifications, addendums and any other information necessary to prepare this bid.

These procedures shall be in accordance with the rules of the Department published at 44 Illinois Administrative Code 650 and 6, including the deference to federal requirements in Section 6.710. The Notice to Bidders contains additional requirements published in accordance with the rules. Bidders and the Contractor shall comply with these rules and all procedures published in the Notice to Bidders.

Per 44 IAC 6.710, procedures applicable to procurements that contemplate the use of federal-aid funds, grants or loans shall be in accordance with requirements established by the federal administration having responsibility therefor, even if in addition to or in contravention of this Part.

- 20-02 Qualification of bidders.** Each bidder shall submit evidence of competency and evidence of financial responsibility to perform the work to the Department prior to bid opening.

Each bidder shall furnish the Department satisfactory evidence of their financial responsibility. Evidence of financial responsibility, unless otherwise specified, shall consist of a confidential statement or report of the bidder's financial resources and liabilities as of the last calendar year or the bidder's last fiscal year. Such statements or reports shall be certified by a public accountant. At the time of submitting such financial statements or reports, the bidder shall further certify whether their financial responsibility is approximately the same as stated or reported by the public accountant. If the bidder's financial responsibility has changed, the bidder shall qualify the public accountant's statement or report to reflect the bidder's true financial condition at the time such qualified statement or report is submitted to the Department.

Unless otherwise specified, a bidder may submit evidence that they are prequalified with the Department.

- 20-03 Contents of proposal forms.** Electronic bids are to be submitted to the electronic bidding system (iCX-Integrated Contractors Exchange). All bids must be submitted to the iCX system prior to 10:00 a.m. on the Letting Date, at which time the bids will be publicly opened from the iCX SecureVault.

The plans, specifications, and other documents designated shall be considered a part of the proposal whether attached or not.

- 20-04 Issuance of proposal forms.** The Department reserve the right to refuse to issue a proposal form to a prospective bidder if the bidder is in default for any of the following reasons:

- a. Failure to comply with any prequalification regulations of the Department, if such regulations are cited, or otherwise included, in the proposal as a requirement for bidding.

- b. Failure to pay, or satisfactorily settle, all bills due for labor and materials on former contracts in force with the Department at the time the Department issues the proposal to a prospective bidder.
- c. Documented record of Contractor default under previous contracts with the Department.
- d. Documented record of unsatisfactory work on previous contracts with the Department.

**20-05 Interpretation of estimated proposal quantities.** An estimate of quantities of work to be done and materials to be furnished under these specifications is given in the proposal. It is the result of careful calculations and is believed to be correct. It is given only as a basis for comparison of proposals and the award of the contract. The Department or the Owner does not expressly, or by implication, agree that the actual quantities involved will correspond exactly therewith; nor shall the bidder plead misunderstanding or deception because of such estimates of quantities, or of the character, location, or other conditions pertaining to the work. Payment to the Contractor will be made only for the actual quantities of work performed or materials furnished in accordance with the contract documents. It is understood that the quantities may be increased or decreased as provided in the Section 40, paragraph 40-02 titled ALTERATION OF WORK AND QUANTITIES, without in any way invalidating the unit bid prices.

**20-06 Examination of plans, specifications, and site.** The bidder is expected to carefully examine the site of the proposed work, the proposal, plans, specifications, and contract forms. Bidders shall satisfy themselves to the character, quality, and quantities of work to be performed, materials to be furnished, and to the requirements of the proposed contract. The submission of a proposal shall be prima facie evidence that the bidder has made such examination and is satisfied to the conditions to be encountered in performing the work and the requirements of the proposed contract, plans, and specifications.

**20-07 Preparation of proposal.** The bidder shall submit their proposal on the forms furnished by the Department. All blank spaces in the proposal forms, unless explicitly stated otherwise, must be correctly filled in where indicated for each and every item for which a quantity is given. The bidder shall state the price within the electronic bid forms for which they propose for each pay item furnished in the proposal.

The bidder shall correctly execute the electronic proposal in accordance with the instructions. Anyone executing a proposal as an agent shall be prepared to file evidence of their authority to do so and that the signature is binding upon the firm or corporation.

**20-08 Responsive and responsible bidder.** A responsive bid conforms to all significant terms and conditions contained in the Department's invitation for bid. It is the Department's responsibility to decide if the exceptions taken by a bidder to the solicitation are material or not and the extent of deviation it is willing to accept.

A responsible bidder has the ability to perform successfully under the terms and conditions of a proposed procurement, as defined in 2 CFR § 200.318(h). This includes such matters as Contractor integrity, compliance with public policy, record of past performance, and financial and technical resources.

**20-09 Irregular proposals.** Proposals shall be considered irregular for the following reasons:

- a. If the proposal is on a form other than that furnished by the Department, or if the Department's form is altered, or if any part of the proposal form is detached.
- b. If there are unauthorized additions, conditional or alternate pay items, or irregularities of any kind that make the proposal incomplete, indefinite, or otherwise ambiguous.
- c. If the proposal does not contain a unit price for each pay item listed in the proposal, except in the case of authorized alternate pay items, for which the bidder is not required to furnish a unit price.
- d. If the proposal contains unit prices that are obviously unbalanced.



- e. If the proposal is not accompanied by the proposal guaranty specified by the Department.
- f. If the applicable Disadvantaged Business Enterprise information is incomplete.

The Department reserves the right to reject any irregular proposal and the right to waive technicalities if such waiver is in the best interest of the Owner and conforms to local laws and ordinances pertaining to the letting of construction contracts.

**20-10 Bid guarantee.** Each bid shall be accompanied by a bid bond in the form provided by the Department with the bid form package. The bid bond shall be made and tendered by a surety acceptable to the Department in the amount stated in the Invitation for Bids.

**20-11 Delivery of proposal.** Bids shall be sealed and submitted in the manner specified or allowed by the Invitation for Bids. All bids shall be delivered and received by the Department prior to the time and at the place specified in the Invitation for Bids. The date and time of receipt will be recorded. Bids will remain sealed and will be stored in a secure place until the date and time established for bid opening. The Department will not accept bids after the time stated in the Invitation for Bids.

**20-12 Withdrawal or revision of proposals.** An authorized agent of a bidder may change or withdraw a bid if written or in-person notice of the change or withdrawal is received by the Department before the time specified for submission of bids.

**20-13 Public opening of proposals.** Proposals shall be opened, and read, publicly at the time and place specified in the advertisement. Bidders, their authorized agents, and other interested persons are invited to attend. Proposals that have been withdrawn (by written or telegraphic request) or received after the time specified for opening bids shall be returned to the bidder unopened.

**20-14 Disqualification of bidders.** A bidder shall be considered disqualified for any of the following reasons:

- a. Submitting more than one (1) proposal from the same partnership, firm, or corporation under the same or different name.
- b. Evidence of collusion among bidders. Bidders participating in such collusion shall be disqualified as bidders for any future work of the Department until any such participating bidder has been reinstated by the Owner as a qualified bidder.
- c. If the bidder is considered to be in "default" for any reason specified in paragraph 20-04 titled ISSUANCE OF PROPOSAL FORMS, of this section.

**20-15 Discrepancies and Omissions.** A Bidder who discovers discrepancies or omissions with the project bid documents shall immediately notify the Department of the matter. A bidder that has doubt as to the true meaning of a project requirement may submit to the Department a written request for interpretation no later than ten (10) calendar days prior to bid opening.

Any interpretation of the project bid documents by the Department will be by addendum issued by the Department. The Department will not consider any instructions, clarifications or interpretations of the bidding documents in any manner other than addendum.

## REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

US Department of Transportation Federal Aviation Administration Order 5100.38.D Chg 1 Airport Improvement Program Handbook (2/26/2019)

[https://www.faa.gov/airports/aip/aip\\_handbook/media/AIP-Handbook-Order-5100-38D-Chg1.pdf](https://www.faa.gov/airports/aip/aip_handbook/media/AIP-Handbook-Order-5100-38D-Chg1.pdf)

2 CFR Part 200 – Uniform Administrative Requirements, Cost Principles, and Audit Requirements for Federal Awards

<https://www.govinfo.gov/content/pkg/CFR-2019-title2-vol1/xml/CFR-2019-title2-vol1-part200.xml>

**END OF SECTION 20**

### Section 30 Award and Execution of Contract

**30-01 Consideration of proposals.** After the proposals are publicly opened and read, they will be compared on the basis of the summation of the products obtained by multiplying the estimated quantities shown in the proposal by the unit bid prices. If a bidder's proposal contains a discrepancy between unit bid prices written in words and unit bid prices written in numbers, the unit bid price written in words shall govern.

Until the award of a contract is made, the Department reserves the right to reject a bidder's proposal for any of the following reasons:

- a. If the proposal is irregular as specified in Section 20, paragraph 20-09 titled IRREGULAR PROPOSALS.
- b. If the bidder is disqualified for any of the reasons specified Section 20, paragraph 20-14 titled DISQUALIFICATION OF BIDDERS.

In addition, until the award of a contract is made, the Department reserves the right to reject any or all proposals, waive technicalities, if such waiver is in the best interest of the Owner and is in conformance with applicable state and local laws or regulations pertaining to the letting of construction contracts; advertise for new proposals; or proceed with the work otherwise. All such actions shall promote the Owner's best interests.

**30-02 Award of contract.** The award of a contract, if it is to be awarded, shall be made within 60 calendar days of the date specified for publicly opening proposals, unless otherwise specified herein.

The Department will make award to the responsible bidder whose bid, conforming with all the material terms and conditions of the bid documents, is the lowest in price.

**30-03 Cancellation of award.** The Department reserves the right to cancel the award without liability to the bidder, except return of proposal guaranty, at any time before a contract has been fully executed by all parties and is approved by the Department in accordance with paragraph 30-07 titled APPROVAL OF CONTRACT.

**30-04 Return of proposal guaranty.** All proposal guaranties, except those of the two (2) lowest bidders, will be returned immediately after the Department has made a comparison of bids as specified in the paragraph 30-01 titled CONSIDERATION OF PROPOSALS. Proposal guaranties of the two (2) lowest bidders will be retained by the Department until such time as an award is made, at which time, the unsuccessful bidder's proposal guaranty will be returned. The successful bidder's proposal guaranty will be returned as soon as the Department receives the contract bonds as specified in paragraph 30-05 titled REQUIREMENTS OF CONTRACT BONDS.

**30-05 Requirements of contract bonds.** At the time of the execution of the contract, the successful bidder shall furnish the Department a surety bond or bonds that have been fully executed by the bidder and the surety guaranteeing the performance of the work and the payment of all legal debts that may be incurred by reason of the Contractor's performance of the work. The surety and the form of the bond or bonds shall be acceptable to the Department. Unless otherwise specified, the surety bond or bonds shall be in a sum equal to the full amount of the contract.

**30-06 Execution of contract.** The successful bidder shall sign (execute) the necessary agreements for entering into the contract and return the signed contract to the Department, along with the fully executed surety bond or bonds specified in paragraph 30-05 titled REQUIREMENTS OF CONTRACT BONDS, of this section, within 15 calendar days from the date mailed or otherwise delivered to the successful bidder.

- 30-07 Approval of contract.** Upon receipt of the contract and contract bond or bonds that have been executed by the successful bidder, the Department shall complete the execution of the contract in accordance with local laws or ordinances, and return the fully executed contract to the Contractor. Delivery of the fully executed contract to the Contractor shall constitute the Department's approval to be bound by the successful bidder's proposal and the terms of the contract.
- 30-08 Failure to execute contract.** Failure of the successful bidder to execute the contract and furnish an acceptable surety bond or bonds within the period specified in paragraph 30-06 titled EXECUTION OF CONTRACT, of this section shall be just cause for cancellation of the award and forfeiture of the proposal guaranty, not as a penalty, but as liquidated damages to the Department.

### REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

US Department of Transportation Federal Aviation Administration Order 5100.38.D Chg 1 Airport Improvement Program Handbook (2/26/2019)

[https://www.faa.gov/airports/aip/aip\\_handbook/media/AIP-Handbook-Order-5100-38D-Chg1.pdf](https://www.faa.gov/airports/aip/aip_handbook/media/AIP-Handbook-Order-5100-38D-Chg1.pdf)

2 CFR Part 200 – Uniform Administrative Requirements, Cost Principles, and Audit Requirements for Federal Awards

<https://www.govinfo.gov/content/pkg/CFR-2019-title2-vol1/xml/CFR-2019-title2-vol1-part200.xml>

**END OF SECTION 30**

## Section 40 Scope of Work

**40-01 Intent of contract.** The intent of the contract is to prescribe a complete outline of work which the Contractor undertakes to do in full compliance with the contract documents. The Contractor shall perform all earthwork, construct all base and surface courses, structures, and such additional, extra, and incidental construction as may be necessary to complete the work to the finished lines, grades, and cross sections in a substantial and acceptable manner. It is further intended that the Contractor shall furnish all labor, materials, equipment, tools, transportation, supplies, and incidentals unless otherwise provided in the contract required to complete the work in accordance with the plans, specifications, and terms of the contract, and shall include the cost of these items in the unit prices bid for the work. The quantities appearing in the bid schedule of prices are estimates prepared for the establishment of pay item prices and the comparison of bids. Payment to the Contractor will be made for the actual measured quantities performed and accepted or material furnished and accepted according to the contract, and the scheduled quantities may be increased, decreased, or deleted as herein provided.

Under no circumstances shall the Contractor exceed any established pay item quantity without notification to the Engineer and receipt of written authorization as provided herein.

**40-02 Alteration of work and quantities.** The Department reserves the right to make such changes in quantities and work as may be necessary or desirable to complete, in a satisfactory manner, the original intended work. Unless otherwise specified in the Contract, the Department shall be and is hereby authorized to make, in writing, such in-scope alterations in the work and variation of quantities as may be necessary to complete the work, provided such action does not represent a significant change in the character of the work.

For purpose of this section, a significant change in character of work means: any change that is outside the current contract scope of work; any change (increase or decrease) in the total contract cost by more than 25%; or any change in the total cost of a major contract item by more than 25%.

Work alterations and quantity variances that do not meet the definition of significant change in character of work shall not invalidate the contract nor release the surety. Contractor agrees to accept payment for such work alterations and quantity variances in accordance with Section 90, paragraph 90-03 titled COMPENSATION FOR ALTERED QUANTITIES.

Should the total cost of any major contract item change by 25% or more, with the aggregate amount of altered work less than the 25% limitation hereinbefore specified, the alteration shall be subject to approval, prior to construction, by the Engineer and handled as a supplemental agreement.

Should the value of altered work or quantity variance meet the criteria for significant change in character of work, such altered work and quantity variance shall be covered by a supplemental agreement.

Supplemental agreements shall be approved by the Department and shall include all applicable Federal contract provisions for procurement and contracting required under AIP. Supplemental agreements shall also require consent of the Contractor's surety and separate performance and payment bonds. If the Owner and the Contractor are unable to agree on a unit adjustment for any contract item that requires a supplemental agreement, the Department reserves the right to terminate the contract with respect to the item and make other arrangements for its completion.

**40-03 Deleted items.** The Department may provide written notice to the Contractor to delete from the work any contract item that does not meet the definition of major contract item. Major contract items may be deleted by a supplemental agreement. Such deletion of contract items shall not invalidate any other contract provision or requirement.

Should a contract item be deleted or otherwise ordered to be non-performed, the Contractor shall be paid for all work performed toward completion of such item prior to the date of the order to delete such item. Payment for work performed shall be in accordance with Section 90, paragraph 90-05 titled PAYMENT FOR DELETED ITEMS.

**40-04 Extra work.** Should acceptable completion of the contract require the Contractor to perform an item of work not provided for in the awarded contract as previously modified by change order or supplemental agreement, the Department may issue a Change Order to cover the necessary extra work. Change orders for extra work shall contain agreed unit prices for performing the change order work in accordance with the requirements specified in the order and shall contain any adjustment to the contract time that, in the Engineer's opinion, is necessary for completion of the extra work.

When determined by the Engineer to be in the Owner's best interest, the Engineer may order the Contractor to proceed with extra work by force account as provided in Section 90, paragraph 90-06 titled PAYMENT FOR EXTRA WORK AND FORCE ACCOUNT. Extra work that is necessary for acceptable completion of the project, but is not within the general scope of the work covered by the original contract, shall be covered by a supplemental agreement as defined in Section 10, paragraph 10-77 titled SUPPLEMENTAL AGREEMENT.

If extra work is essential to maintaining the project critical path, the Resident Engineer may order the Contractor to commence the extra work under a Time and Material contract method. Once sufficient detail is available to establish the level of effort necessary for the extra work, the Owner shall initiate a change order or supplemental agreement to cover the extra work.

Any claim for payment of extra work that is not covered by written agreement (change order or supplemental agreement) shall be rejected by the Department.

All contract modifications (change order or supplemental agreement) must be reviewed and approved by the Engineer.

**40-05 Maintenance of traffic.** It is the explicit intention of the contract that the safety of aircraft, as well as the Contractor's equipment and personnel, is the most important consideration. The Contractor shall maintain traffic in the manner detailed in the Construction Safety and Phasing Plan (CSPP).

a. It is understood and agreed that the Contractor shall provide for the free and unobstructed movement of aircraft in the Air Operations Areas (AOAs) of the airport with respect to their own operations and the operations of all subcontractors as specified in Section 80, paragraph 80-04 titled LIMITATION OF OPERATIONS. It is further understood and agreed that the Contractor shall provide for the uninterrupted operation of visual and electronic signals (including power supplies thereto) used in the guidance of aircraft while operating to, from, and upon the airport as specified in Section 70, paragraph 70-16 titled CONTRACTOR'S RESPONSIBILITY FOR UTILITY SERVICE AND FACILITIES OF OTHERS.

b. With respect to their own operations and the operations of all subcontractors, the Contractor shall provide marking, lighting, and other acceptable means of identifying personnel, equipment, vehicles, storage areas, and any work area or condition that may be hazardous to the operation of aircraft, fire-rescue equipment, or maintenance vehicles at the airport in accordance with the CSPP and the Safety Plan Compliance Document (SPCD).

c. When the contract requires the maintenance of an existing road, street, or highway during the Contractor's performance of work that is otherwise provided for in the contract, plans, and specifications, the Contractor shall keep the road, street, or highway open to all traffic

and shall provide maintenance as may be required to accommodate traffic. The Contractor, at their expense, shall be responsible for the repair to equal or better than preconstruction conditions of any damage caused by the Contractor's equipment and personnel. The Contractor shall furnish, erect, and maintain barricades, warning signs, flag person, and other traffic control devices in reasonable conformity with the Manual on Uniform Traffic Control Devices (MUTCD) (<http://mutcd.fhwa.dot.gov/>), unless otherwise specified. The Contractor shall also construct and maintain in a safe condition any temporary connections necessary for ingress to and egress from abutting property or intersecting roads, streets or highways. Unless otherwise specified herein, the Contractor will not be required to furnish snow removal for such existing road, street, or highway.

- d. The Contractor shall make their own estimate of all labor, materials, equipment and incidentals necessary for providing the maintenance of aircraft and vehicular traffic as specified.
- e. When not provided for as a contract item, the cost of maintaining the aircraft and vehicular traffic specified shall not be measured or paid for directly, but shall be included in the various contract items.
- f. Aircraft ground traffic shall be maintained at the airport throughout the construction period as shown in the approved CSPP.
- g. If it will be necessary to close portions of the runways, apron and taxiways during the proposed construction, the Contractor shall notify the Airport Management through the Resident Engineer a minimum of 72 hours, unless otherwise specified, prior to the initiation of any work which requires closure of active airfield pavements for the issuance of the appropriate Notice to Airmen (NOTAM) and user coordination.

**40-06 Removal of existing structures.** All existing structures encountered within the established lines, grades, or grading sections shall be removed by the Contractor, unless such existing structures are otherwise specified to be relocated, adjusted up or down, salvaged, abandoned in place, reused in the work or to remain in place. The cost of removing such existing structures shall not be measured or paid for directly, but shall be included in the various contract items.

Should the Contractor encounter an existing structure (above or below ground) in the work for which the disposition is not indicated on the plans, the Resident Engineer shall be notified prior to disturbing such structure. The disposition of existing structures so encountered shall be immediately determined by the Resident Engineer in accordance with the provisions of the contract.

Except as provided in Section 40, paragraph 40-07 titled RIGHTS IN AND USE OF MATERIALS FOUND IN THE WORK, it is intended that all existing materials or structures that may be encountered (within the lines, grades, or grading sections established for completion of the work) shall be used in the work as otherwise provided for in the contract and shall remain the property of the Owner when so used in the work.

**40-07 Rights in and use of materials found in the work.** Should the Contractor encounter any material such as (but not restricted to) sand, stone, gravel, slag, or concrete slabs within the established lines, grades, or grading sections, the use of which is intended by the terms of the contract to be embankment, the Contractor may at their own option either:

- a. Use such material in another contract item, providing such use is approved by the Engineer and is in conformance with the contract specifications applicable to such use; or,
- b. Remove such material from the site, upon written approval of the Engineer; or
- c. Use such material for the Contractor's own temporary construction on site; or,
- d. Use such material as intended by the terms of the contract.

Should the Contractor wish to exercise option a., b., or c., the Contractor shall request the Engineer's approval in advance of such use.

Should the Engineer approve the Contractor's request to exercise option a., b., or c., the Contractor shall be paid for the excavation or removal of such material at the applicable contract price. The Contractor shall replace, at their expense, such removed or excavated material with an agreed equal volume of material that is acceptable for use in constructing embankment, backfills, or otherwise to the extent that such replacement material is needed to complete the contract work. The Contractor shall not be charged for use of such material used in the work or removed from the site.

Should the Engineer approve the Contractor's exercise of option a., the Contractor shall be paid, at the applicable contract price, for furnishing and installing such material in accordance with requirements of the contract item in which the material is used.

It is understood and agreed that the Contractor shall make no claim for delays by reason of their own exercise of option a., b., or c.

The Contractor shall not excavate, remove, or otherwise disturb any material, structure, or part of a structure which is located outside the lines, grades, or grading sections established for the work, except where such excavation or removal is provided for in the contract, plans, or specifications.

No material found or abandoned during the work shall be taken from the airport without the approval of the Resident Engineer. The airport management reserves the right to any material found or abandoned during the work. Any such material shall be turned over to the airport management at a site designated by the Resident Engineer.

**40-08 Final cleanup.** Upon completion of the work and before acceptance and final payment will be made, the Contractor shall remove from the site all machinery, equipment, surplus and discarded materials, rubbish, temporary structures, and stumps or portions of trees. The Contractor shall cut all brush and woods within the limits indicated and shall leave the site in a neat and presentable condition. Material cleared from the site and deposited on adjacent property will not be considered as having been disposed of satisfactorily, unless the Contractor has obtained the written permission of the property Owner.

The Contractor shall clean off all cement streaks or drippings, paint smears or drippings, rust stains, oil, grease, bituminous materials, dirt, and other foreign materials deposited or accumulated on or in any structure or curb and gutter due to their operation.

**40-09 Safety Plan Compliance Document (SPCD).** Prior to the preconstruction conference, the Contractor shall submit a SPCD to the Airport describing how he will comply with the requirements of the AC plus the CSPP and supplying any details that could not be determined before contract award. The SPCD must include a certification statement by the Contractor that indicates he understands the operational safety requirements of the CSPP, that the Contractor has incorporated these requirements into their overall work plan and that the Contractor will maintain the right of control for all means, methods and details of the work performed by the Contractor and any of his subcontractors within the framework of the operational safety plan. The SPCD must be reviewed, approved and signed by the Airport Sponsor.

The Contractor shall be fully aware and continuously monitor all requirements and activities for compliance with the contract documents and the current AC 150/5370-2, *Operational Safety on Airports During Construction*.

Ten (10) days prior to the commencement of each phase, the Contractor shall submit an updated SPCD for that phase that meets the requirement of the current AC150/5370-2, *Operational Safety on Airports During Construction*. The updated SPCD shall detail implementation of the construction haul routes, procedures utilized by the Contractor to eliminate conflicts between construction operations and aircraft traffic shall be included.

Changes to the CSPP may require aeronautical review by the Department through the FAA's Obstruction Evaluation/Airport Airspace Analysis (OE/AAA) System. Modification of the CSPP and/or the critical points shown in the contract documents will require airspace approval from



the Department and/or the FAA and may require the Contractor to submit FAA Form 7460 for approval.

The Contractor shall not be entitled to any extra compensation due to delays or inconveniences caused by said necessary methods, procedures, and measured to protect air traffic.

**END OF SECTION 40**

## Section 50 Control of Work

**50-01 Authority of the engineer.** The Engineer has final authority regarding the interpretation of project specification requirements. The Engineer shall determine acceptability of the quality of materials furnished, method of performance of work performed, and the manner and rate of performance of the work.

The Resident Engineer does not have the authority to accept work that does not conform to specification requirements. The Resident Engineer does not have the authority to modify the contract documents without the approval of the Department.

**50-02 Conformity with contract documents.** All work and all materials furnished shall be in reasonably close conformity with the lines, grades, grading sections, cross-sections, dimensions, material requirements, and testing requirements that are specified (including specified tolerances) in the contract, plans, or specifications.

If the Engineer finds the materials furnished, work performed, or the finished product not in reasonably close conformity with the contract documents; but that the portion of the work affected, in their opinion, will result in a finished product having a level of safety, economy, durability, and acceptable workmanship; the Engineer will advise the affected work be accepted and remain in place. In this event, the Engineer will document the determination and recommend contract price adjustments based on sound engineering judgement and, in their opinion, any tests or retests of the affected work as needed. Changes in the contract price must be covered by contract change order or supplemental agreement as applicable.

If the Engineer finds the materials furnished, work performed, or the finished product are not in reasonably close conformity with the contract documents and have resulted in an unacceptable finished product, the affected work or materials shall be removed and replaced or otherwise corrected by and at the expense of the Contractor in accordance with the Engineer's written orders.

The term "reasonably close conformity" shall not be construed as waiving the Contractor's responsibility to complete the work in accordance with the contract, plans, and specifications. The term shall not be construed as waiving the Engineer's responsibility to insist on strict compliance with the requirements of the contract, plans, and specifications during the Contractor's execution of the work, when, in the Engineer's opinion, such compliance is essential to provide an acceptable finished portion of the work.

The term "reasonably close conformity" is also intended to provide the Engineer with the authority, after consultation with the FAA, to use sound engineering judgment in their determinations to accept work that is not in strict conformity, but will provide a finished product equal to or better than that intended by the requirements of the contract documents.

All contract modifications (change order or supplemental agreement) must be reviewed and approved by the Engineer.

The Engineer will not be responsible for the Contractor's means, methods, techniques, sequences, or procedures of construction or the safety precautions incident thereto.

**50-03 Coordination of contract, plans, and specifications.** The contract, plans, specifications, and all referenced standards cited are essential parts of the contract requirements. If electronic files are provided and used on the project and there is a conflict between the electronic files and hard copy plans, the hard copy plans shall govern. A requirement occurring in one (1) is as binding as though occurring in all. They are intended to be complementary and to describe and provide

for a complete work. In case of discrepancy, calculated dimensions will govern over scaled dimensions and the following relationships apply:

<b>Hierarchy of Contract Documents</b>		
Special Provisions	Hold Over:	Plans, Recurring Special Provisions, Supplemental Specifications, and Standard Specifications
Plans	Hold Over:	Recurring Special Provisions, Supplemental Specifications, and Standard Specifications
Recurring Special Provisions	Hold Over:	Supplemental Specifications and Standard Specifications
Supplemental Special Provisions	Hold Over:	Standard Specifications
Contract Plans	Hold Over:	Standard Plans

<b>Hierarchy of Standard Specifications</b>		
Technical Specifications	Hold Over:	General Provisions, Cited Standards for Materials or Testing, Cited FAA Advisory Circulars
General Provisions	Hold Over:	Cited Standards for Materials or Testing, Cited FAA Advisory Circulars

The Contractor shall not take advantage of any apparent error or omission on the plans or specifications. In the event the Contractor discovers any apparent error or discrepancy, Contractor shall immediately notify the Engineer for an interpretation and decision, and such decision shall be final.

**50-04 Cooperation of contractor.** The Contractor shall be supplied with a minimum of five (5) hard copies or an electronic PDF of the contract documents. The Contractor shall have available on the construction site at all times one (1) hardcopy each of the contract documents. Additional hard copies of contract documents may be obtained by the Contractor for the cost of reproduction.

The Contractor shall give constant attention to the work to facilitate the progress thereof, and shall cooperate with the Resident Engineer and their inspectors and with other Contractors in every way possible. The Resident Engineer shall allocate the work and designate the sequence of construction in case of controversy between Contractors. The Contractor shall have a competent English-speaking superintendent on the work site at all times, who is fully authorized as their agent on the work. The superintendent shall be capable of reading and thoroughly understanding the contract documents and shall receive and fulfill instructions from the Resident Engineer or their authorized representative.

A weekly meeting shall be scheduled during construction to discuss work areas, scheduling, etc. The superintendent, the subcontractor's foreman, and the Resident Engineer are required to attend the meeting. The airport management and the Department may attend the meeting.

The prosecution of this project within the allotted number of calendar days is of extreme importance to the airport. The Contractor shall update the progress schedule as required for

the scheduled weekly meetings. No compensation will be made for accelerated work to meet schedule and/or contract time.

**50-05 Cooperation between contractors.** The Owner reserves the right to contract for and perform other or additional work on or near the work covered by this contract.

When separate contracts are let within the limits of any one (1) project, each Contractor shall conduct the work not to interfere with or hinder the progress of completion of the work being performed by other Contractors or Airport personnel. Contractors working on the same project shall cooperate with each other as directed.

Each Contractor involved shall assume all liability, financial or otherwise, in connection with their own contract and shall protect and hold harmless the Department and Owner from any and all damages or claims that may arise because of inconvenience, delays, or loss experienced because of the presence and operations of other Contractors working within the limits of the same project.

The Contractor shall arrange their work and shall place and dispose of the materials being used to not interfere with the operations of the other Contractors within the limits of the same project. The Contractor shall join their work with that of the others in an acceptable manner and shall perform it in proper sequence to that of the others.

The timely prosecution of the overall project is dependent upon the proper coordination between Contractors. It is to be fully understood by the Contractor that the prosecution of the overall projects and the safety and convenience of the aviation public are the governing criteria for resolving conflicts which may arise between their schedule and the schedule of other Contractors. When conflicts arise, resolution of such conflicts will be made by the Airport Management through the Resident Engineer in the best interest of the Airport. Delays, changes in scheduling, or expedition of work under this contract to coordinate the timely prosecution of work will be considered incidental to the contract and no additional compensation will be allowed.

The Contractor shall acquaint them self with all other contracts prior to bidding and shall cooperate with Airport Management and any other Contractors who may be working on the contracts.

**50-06 Construction layout and stakes.** The Resident Engineer shall establish necessary horizontal and vertical control. The establishment of survey control and/or reestablishment of survey control shall be by a State Licensed Land Surveyor. Contractor is responsible for preserving integrity of horizontal and vertical controls established by the Resident Engineer. In case of negligence on the part of the Contractor or their employees, resulting in the destruction of any horizontal and vertical control, the resulting costs will be deducted as a liquidated damage against the Contractor.

Prior to the start of construction, the Contractor will check all control points for horizontal and vertical accuracy and certify in writing to the Resident Engineer that the Contractor concurs with survey control established for the project. All lines, grades and measurements from control points necessary for the proper execution and control of the work on this project will be provided to the Resident Engineer. The Contractor is responsible to establish all layout required for the construction of the project.

Copies of survey notes will be provided to the Resident Engineer for each area of construction and for each placement of material as specified to allow the Resident Engineer to make periodic checks for conformance with plan grades, alignments and grade tolerances required by the applicable material specifications. Surveys will be provided to the Resident Engineer prior to commencing work items that cover or disturb the survey staking. Surveys and notes shall be provided in a Land XML file compatible with Autodesk AutoCAD and Autodesk Civil 3D.

Laser, GPS, string line, or other automatic control shall be checked with temporary control as necessary. In the case of error, on the part of the Contractor, their surveyor, employees or

subcontractors, resulting in established grades, alignment or grade tolerances that do not concur with those specified or shown on the plans, the Contractor is solely responsible for correction, removal, replacement and all associated costs at no additional cost to the contract.

No direct payment will be made, unless otherwise specified in contract documents, for this labor, materials, or other expenses. The cost shall be included in the price of the bid for the various items of the Contract.

**50-07 Authority and duties.**

**50-07.1 Resident engineer (RE).** As the direct representative of the Project Engineer, the Resident Engineer has immediate charge of the engineering details of each construction project. The Resident Engineer is authorized to administer the project to ensure satisfactory completion of the construction. The Resident Engineer is authorized to inspect all work done and all material furnished. Such inspection may extend to all or any part of the work and to the preparation, fabrication or manufacture of the materials to be used. The Resident Engineer is not authorized to revoke, alter or waive any provision of the contract. The Resident Engineer is not authorized to issue instructions contrary to the contract documents or to act as foreman for the Contractor.

The Resident Engineer is authorized to notify the Contractor or the Contractor's representative of any failure of the work or materials to conform to the requirements of the contract, plans, or specifications and to reject such nonconforming materials and to suspend any work in question until such issues can be referred to the Engineer for their decision.

The Resident Engineer is responsible for reviewing and verifying conformance of all shop drawings with the contract documents.

**50-07.2 Quality assurance (QA) inspectors.** QA inspectors shall be authorized to inspect all work done and all material furnished. Such QA inspection may extend to all or any part of the work and to the preparation, fabrication, or manufacture of the materials to be used. QA inspectors are not authorized to revoke, alter, or waive any provision of the contract. QA inspectors are not authorized to issue instructions contrary to the contract documents or to act as foreman for the Contractor.

QA Inspectors are authorized to notify the Contractor or their representatives of any failure of the work or materials to conform to the requirements of the contract, plans, or specifications and to reject such nonconforming materials in question until such issues can be referred to the Engineer for a decision.

**50-08 Inspection of the work.** All materials and each part or detail of the work shall be subject at all times to inspection. Such inspection may include mill, plant, or shop inspection, and any material furnished under the specifications. The Engineer shall be allowed access to all parts of the work and shall be furnished with such information and assistance by the Contractor as is required to make a complete and detailed inspection.

If the Engineer requests it, the Contractor, at any time before acceptance of the work, shall remove or uncover such portions of the finished work as may be directed. After examination, the Contractor shall restore said portions of the work to the standard required by the specifications. Should the work thus exposed or examined prove acceptable, the uncovering, or removing, and the replacing of the covering or making good of the parts removed will be paid for as extra work; but should the work so exposed or examined prove unacceptable, the uncovering, or removing, and the replacing of the covering or making good of the parts removed will be at the Contractor's expense.

Provide advance written notice to the Engineer of work the Contractor plans to perform each week and each day. Any work done or materials used without written notice, supervision and allowing opportunity for inspection by the Engineer may be ordered removed and replaced at the Contractor's expense unless the Engineer failed to inspect after having been given reasonable notice in writing that the work was to be performed. For federally assisted contracts, the work shall be subject to the inspection of representative of the federal government, but such

inspections shall in no sense make the federal government a part to the contract. Should the contract work include relocation, adjustment, or any other modification to existing facilities, not the property of the (contract) Owner, authorized representatives of the Owners of such facilities shall have the right to inspect such work. Such inspection shall in no sense make any facility owner a party to the contract, and shall in no way interfere with the rights of the parties to this contract.

**50-09 Removal of unacceptable and unauthorized work.** All work that does not conform to the requirements of the contract, plans, and specifications will be considered unacceptable, unless otherwise determined acceptable by the Engineer as provided in paragraph 50-02 titled CONFORMITY WITH CONTRACT DOCUMENTS.

Unacceptable work and defective pavement, whether the result of poor workmanship, use of defective materials, damage through carelessness, or any other cause found to exist prior to the final acceptance of the work, shall be removed immediately and replaced in an acceptable manner in accordance with the provisions of Section 70, paragraph 70-15 titled CONTRACTOR'S RESPONSIBILITY FOR WORK.

No removal work made under provision of this paragraph shall be done without lines and grades having been established by the Engineer. Work done contrary to the instructions of the Engineer, work done beyond the lines shown on the plans or as established by the Engineer, except as herein specified, or any extra work done without authority, will be considered as unauthorized and will not be paid for under the provisions of the contract. Work so done may be ordered removed or replaced at the Contractor's expense.

Upon failure on the part of the Contractor to comply with any order of the Engineer made as specified in the contract documents, the Engineer will have authority to cause unacceptable work to be remedied or removed and replaced; and unauthorized work to be removed and recover the resulting costs as a liquidated damage against the Contractor.

**50-10 Load restrictions.** The Contractor shall comply with all legal load restrictions in the hauling of materials on public roads beyond the limits of the work. A special permit will not relieve the Contractor of liability for damage that may result from the moving of material or equipment.

The operation of equipment of such weight or so loaded as to cause damage to structures or to any other type of construction will not be permitted. Hauling of materials over the base course or surface course under construction shall be limited as directed. No loads will be permitted on a concrete pavement, base, or structure before the expiration of the curing period. The Contractor, at their own expense, shall be responsible for the repair to equal or better than preconstruction conditions of any damage caused by the Contractor's equipment and personnel.

Prior to the start of construction operations, the Resident Engineer and the Contractor shall document the condition of the local roads and the airport entrance roads to be used for Contractor's access and haul routes.

Contractor's use of the existing airfield pavement and airport entrance pavements by equipment and loaded trucks shall be minimized. Any damage to existing airport pavement shall be repaired by the Contractor at their own expense.

If the Contractor uses existing airfield pavements, they shall sweep all airport pavements as directed by the Resident Engineer or Airport Management. Failure to comply with the Resident Engineer's or the Airport Management's directives will be grounds for suspension of work until such time as the unsatisfactory condition is corrected.

The Contractor shall obtain all necessary permits and temporary easements for the public roads to be used for construction hauling and construction access with the City, Township, County, Illinois Department of Transportation and/or any agency that maintains the road. The Contractor shall be responsible for any damage to the public roadways caused by construction traffic hauling to this project.

The Contractor shall provide, install and maintain any warning signs (trucks entering highway, etc.) as required by the City, Township, County or Illinois Department of Transportation and/or any agency that maintains the roadway.

- 50-11 Maintenance during construction.** The Contractor shall maintain the work during construction and until the work is accepted. Maintenance shall constitute continuous and effective work prosecuted day by day, with adequate equipment and forces so that the work is maintained in satisfactory condition at all times.

In the case of a contract for the placing of a course upon a course or subgrade previously constructed, the Contractor shall maintain the previous course or subgrade during all construction operations.

All costs of maintenance work during construction and before the project is accepted shall be included in the unit prices bid on the various contract items, and the Contractor will not be paid an additional amount for such work.

Waste and loose material capable of causing damage to aircraft landing gears, propellers or engines may not be placed on active aircraft movement areas. Material tracked on these areas or public streets shall be removed continuously during the work.

- 50-12 Failure to maintain the work.** Should the Contractor at any time fail to maintain the work as provided in paragraph 50-11 titled MAINTENANCE DURING CONSTRUCTION, the Resident Engineer shall immediately notify the Contractor of such noncompliance. Such notification shall specify a reasonable time within which the Contractor shall be required to remedy such unsatisfactory maintenance condition. The time specified will give due consideration to any exigency that exists.

Should the Contractor fail to respond to the Resident Engineer's notification, the Engineer may suspend any work necessary for the Owner to correct such unsatisfactory maintenance condition, depending on the exigency that exists. Any maintenance cost incurred by the Owner, shall be recovered as a liquidated damage against the Contractor.

- 50-13 Partial acceptance.** If at any time during the execution of the project the Contractor substantially completes a usable unit or portion of the work, the occupancy of which will benefit the Owner, the Contractor may request, through the Resident Engineer, the Engineer to make final inspection of that unit. If the Engineer finds upon inspection that the unit has been satisfactorily completed in compliance with the contract, the Engineer may accept it as being complete, and the Contractor may be relieved of further responsibility for that unit. Such partial acceptance and beneficial occupancy by the Owner shall not void or alter any provision of the contract.

- 50-14 Final acceptance.** Upon due notice from the Contractor of presumptive completion of the entire project, the Engineer and Owner will make an inspection. If all construction provided for and contemplated by the contract is found to be complete in accordance with the contract, plans, and specifications, such inspection shall constitute the final inspection. The Engineer shall notify the Contractor in writing of final acceptance as of the date of the final inspection.

If, however, the inspection discloses any work, in whole or in part, as being unsatisfactory, the Engineer will notify the Contractor and the Contractor shall correct the unsatisfactory work. All work listed on the punch list shall be considered part of the contract and shall be considered incidental to the completion of the contract. If the Contractor believes that an item listed on the punch list is beyond the scope of the contract, the Contractor shall notify the Engineer in writing prior to commencing work on the punch list item in question. Any punch list items completed by the Contractor without such written notification shall be considered incidental to the contract and shall not be eligible for payment unless determined otherwise by the Engineer, Owner and the Department.

The charging of contract time shall resume upon receipt of the punch list from the Engineer and continue until the remaining work, including applicable requirements of Section 40, paragraph 40-08 titled FINAL CLEANUP, is completed to the Engineer's satisfaction.

Upon correction of the work, another inspection will be made which shall constitute the final inspection, provided the work has been satisfactorily completed. In such event, the Engineer will make the final acceptance and notify the Contractor in writing of this acceptance as of the date of final inspection.

**50-15 Claims for adjustment and disputes.** If for any reason the Contractor deems that additional compensation is due for work or materials not clearly provided for in the contract, plans, or specifications or previously authorized as extra work, the Contractor shall notify the Engineer in writing of their intention to claim such additional compensation before the Contractor begins the work on which the Contractor bases the claim. If such notification is not given or the Engineer is not afforded proper opportunity by the Contractor for keeping strict account of actual cost as required, then the Contractor hereby agrees to waive any claim for such additional compensation. Such notice by the Contractor and the fact that the Engineer has kept account of the cost of the work shall not in any way be construed as proving or substantiating the validity of the claim. When the work on which the claim for additional compensation is based has been completed, the Contractor shall, within ten (10) calendar days, submit a written claim to the Engineer who will present it to the Owner for consideration in accordance with local laws or ordinances.

Nothing in this paragraph shall be construed as a waiver of the Contractor's right to dispute final payment based on differences in measurements or computations.

**50-16 Plans and work drawings.** Plans showing details as are necessary to give a comprehensive idea of the construction contemplated will be furnished by the Engineer.

The Contractor shall submit to the Project Engineer for review and comment, such additional shop, working, or layout drawings pertaining to the construction of the work, as may be required, and prior to the approval of such plans or drawings, any work done or materials ordered shall be at the Contractor's risk.

When the contract includes work adjacent to a highway or roadway and falsework, cofferdams, or sheeting is required, the Contractor shall submit to the Project Engineer for approval and the Highway District Engineer's approval, plans for the falsework, cofferdams, or sheeting. The plans shall be submitted sufficiently in advance of the time the Contractor intends to start work to permit checking. No such work shall be started prior to receipt by the Contractor of approval of the plans for the falsework, cofferdams, or sheeting. The Contractor shall give the Project Engineer not less than ten (10) days' notice, in writing, prior to beginning such construction. The cost of furnishing such drawings shall be incidental to the contract and no additional compensation will be allowed the Contractor for any delays resulting therefrom.

The Contractor shall prepare shop, working, or layout drawings for all parts of the work. Before commencing any work on a pay item or providing any material, the Contractor shall submit for review by the Project Engineer, all drawings relating to the construction arrangement or disposition of the work including drainage and electrical materials entering into the contract, and show the complete materials with manufacturer's specifications of same. The Contractor shall carefully check all their drawings making sure they are complete in all detail.

Submittals shall include items such as: Contractor's, manufacturer's, or fabricator's drawings; descriptive literature including (but not limited to) catalog cuts, diagrams, operating charts or curves; test reports; samples; operation and maintenance manuals (including parts list); certifications; warranties; and other such required submittals.

Prior to submission, the Contractor shall review all shop drawing submittals for accuracy, completeness, and compliance with the contract requirements. The Contractor shall stamp, sign and date each submittal indicating Contractor approval of the submittal.

When submittals require close coordination of a number of products, the Contractor shall coordinate a concurrent submittal of all such products. The Project Engineer may withhold action on a submittal requiring coordination with other submittals until all related submittals are received.



Each submittal shall be complete and in sufficient detail to allow ready determination of compliance with contract requirements. Any deviation from contract requirements shall be clearly identified on the shop drawing submittal and supporting documentation for such deviation shall be attached. The Project Engineer reserves the right to rescind inadvertent acceptance of submittals containing unidentified deviations.

Shop drawings submitted by the Contractor for materials and/or equipment to be provided as a part of the contract shall be reviewed by the Project Engineer. Shop drawings shall be fully descriptive, complete and of sufficient detail for ready determination of compliance.

Shop drawings submittals shall contain a certificate of analysis (COA) from the manufacturer stating that all materials furnished for the project conform to the contract documents requirements.

The review of the submittals by the Project Engineer with "no exceptions taken" will indicate only that the general method of construction and detailing is satisfactory. Such review will not relieve the Contractor of the responsibility for complying with the contract documents or for any error which may exist as the Contractor is responsible for the dimensions and designs of adequate connections, detail and satisfactory construction of all work. The Project Engineer shall note any "exceptions taken" to date submitted and indicate when resubmittal is required to determine compliance.

To aid the Contractor in their preparation of the shop drawing submittal, a list of submittals will be provided by the Department at the pre-construction conference. This list shall not be considered by the Contractor as being complete. The Resident Engineer or the Department at their option may request additional information if in their opinion, the information is necessary to adequately review the work.

Drawings shall be submitted within two (2) weeks after the date of the Notice to Proceed or within six (6) weeks of the notice of award whichever occurs first.

The Contractor shall submit at least eight (8) copies of each drawing to be reviewed, of which six (6) copies will be retained by the Project Engineer for their use and records. Two (2) copies of each drawing will be returned to the Contractor.

The following information shall be clearly marked on each shop, working, and layout drawing, catalog cut, pamphlet specifications sheet, etc., submitted.

Project Location:	Airport Name
Project Title:	Project Title
Project Numbers:	Illinois Project Number SBG Project Number
Contract Item (Pay Item):	Pay Item Number & Description
Submitted By:	Contractor/Subcontractor Name
Date:	Current Date

The Project Engineer shall return incomplete or vague material shop drawing submittals for completion prior to review.

Shop drawing submittals shall contain a certificate of analysis (COA) from the producer stating that all materials furnished for the project conform to the requirements of the contract documents. COAs from the producer shall be dated no more than six (6) months prior to the date it is submitted to the Project Engineer. COAs from producers to verify submitted material conforms to the requirements of the contract shall be submitted on company letterhead and include the project name, location and project numbers. Submittals not including this information

shall not be reviewed and returned as incomplete. Incomplete shop drawing submittals causing re-submittal shall not be allowed as justification for additional contract time.

The Project Engineer will review each submittal; mark corrections or modifications required and return it to the Contractor. The Project Engineer will stamp each submittal with an action stamp and will mark the stamp appropriately to indicate action taken as follows. Submittals marked "Resubmit with Corrections" or "Rejected" shall not be used at the project site. ALL SUBMITTALS MUST ULTIMATELY RECEIVE "NO EXCEPTIONS TAKEN" STAMP FROM THE PROJECT ENGINEER TO BE ELIGIBLE FOR PAYMENT. Submittals stamped "Exceptions Taken as Noted" are not considered approved shop drawings.

- a. "No Exceptions Taken": Means fabrication/installation may be undertaken. Submittals stamped as such do not authorize changes to the contract price.
- b. "Exceptions Taken as Noted": Same as "No Exceptions Taken" provided the Contractor complies with the corrections noted on the submittal by the Engineer. The Contractor is still obligated to resubmit the submittal including the corrections made by the Project Engineer so ultimately a shop drawing stamped "No Exceptions Taken" may be forwarded to the Engineer. Submittals not stamped Approved are not considered approved shop drawings.
- c. "Resubmit with Corrections": Fabrication and/or installation may not be undertaken. Make appropriate revisions and resubmit limiting corrections to items marked.

The shop drawing review process shall not be a mechanism to implement contract modifications, which can only be accomplished via a change order or supplemental agreement.

**50-17 Material documentation responsibilities of the contractor.** The Standard Specifications for Construction of Airports make provisions for inspection of materials and construction and establish that it is the Contractor's responsibility to provide materials that meet specification requirements and to produce work strictly in accordance with the intent of the contract documents. It requires the close cooperation and communication between the Contractor, the Resident Engineer and the producer/supplier to assure proper inspection coverage. The Contractor's responsibilities include but aren't limited to:

- a. As far in advance as possible, the Contractor shall furnish the Resident Engineer information as to the producers (not the suppliers) of all materials and all components that will be used on the project.
- b. The Contractor shall order materials as early as possible and notify the District Office or the Bureau of Materials Research so that proper arrangements may be made for inspection if the material is source inspected and approved under Department jurisdiction. When contacting the Department, the Contractor shall reference the MISTIC contract number for the contract.
- c. The Contractor shall notify the supplier that State inspection is required and INFORM THE SUPPLIER NOT TO SHIP WITHOUT INSPECTION.
- d. When ordering, the Contractor shall give the supplier the correct MISTIC Contract Number (A####- 1), kind of material and by specification identification. He shall instruct the supplier that this information should appear on the delivery ticket. A copy of the delivery ticket and any evidence of inspection shall be forwarded to the Resident Engineer.
- e. The Contractor shall submit to the Resident Engineer a catalog cut/specification sheet for the material and a certificate of analysis (COA) from the producer that the material will meet the project specifications. These submittals should be made as far in advance of installation as possible.
- f. The Contractor should instruct the supplier to provide materials that are sufficient to ensure that tests made at the job site will fall within the specification limits.

- g.** Department inspectors usually are assigned to the plants, quarries or other supply sources as needed. The Contractor should plan the work so that the Department has sufficient notice to assign an inspector if that material inspection is required.

The Resident Engineer reserves the right to request additional evidence of inspection or documentation of questionable materials.

**END OF SECTION 50**

## Section 60 Control of Materials

**60-01 Source of supply and quality requirements.** The materials used in the work shall conform to the requirements of the contract, plans, and specifications. Unless otherwise specified, such materials that are manufactured or processed shall be new (as compared to used or reprocessed).

In order to expedite the inspection and testing of materials, the Contractor shall furnish documentation to the Engineer as to the origin, composition, and manufacture of all materials to be used in the work. Documentation shall be furnished promptly after execution of the contract but, in all cases, prior to delivery of such materials.

As a minimum, the Contractor shall provide, upon delivery, statements (shipment tickets, source, certificate of analysis (COA), sample, etc.) as required by the current Illinois Department of Transportation, Bureau of Airport Engineering Manual for Documentation of Airport Materials or as requested by the Engineer of Airport Construction and Materials.

No materials shall be incorporated into the work nor shall any payment be made on any materials until the proper material documentation in accordance with the Standard Specifications, Supplemental Specifications, applicable Recurring Special Provisions and Contract Special Provisions has been submitted and reviewed with no exceptions taken by the Resident Engineer or the Project Engineer.

All steel and manufactured products shall have proof of domesticity documentation accompanying the material.

Any and all steel products used in the performance of the contract is required to adhere to the Illinois Steel Products Procurement Act, which requires that all steel items be of 100% domestic origin and manufacture. Any products listed under the Federal Aviation Administration's (FAA) nationwide approved list of *Equipment Meeting Buy American Requirements* shall be deemed as meeting the requirements of the Illinois Steel Products Procurement Act.

The Contractor must assure that only domestic steel and domestically manufactured products will be used by the Contractor, subcontractors, producers, and suppliers in the performance of the contract. The North American Free Trade Agreement (NAFTA) specifically excluded federal grant programs such as the AIP. Therefore, NAFTA does not change the requirement to comply with the Buy American requirement in the Act. Exceptions to this are for products, other than steel, that:

- a. the FAA has determined, under the Aviation Safety and Capacity Expansion Act of 1990, are not produced in the United States in sufficient and reasonably available quantities or of a satisfactory quality;
- b. the FAA has determined, under the Aviation Safety and Capacity Expansion Act of 1990, that domestic preference would be inconsistent with the public interest;
- c. the FAA has determined that inclusion of domestic material will increase the cost of the overall project contract by more than 25%; or
- d. the FAA has determined, under the Aviation Safety and Capacity Expansion Act of 1990,
  - (1) the cost of components and subcomponents produced in the United States is more than 60% of the cost of all components of the facility or equipment, and
  - (2) final assembly of the facility or equipment has occurred in the United States.

The Contractor can review items already approved under the FAA nationwide approved list of "Nationwide Buy American Waivers Issued" on the FAA website, which do not require a specific FAA waiver. The contractor/manufacturer is urged to submit waiver requests as early as possible.

All waivers are the responsibility of the Contractor, must be obtained prior to the Notice to Proceed, and must be submitted to the Department for review and approval before being forwarded to the FAA. Any products used on the project that cannot meet the domestic requirement, and for which a waiver prior to the Notice to Proceed was not obtained, will be rejected for use and subject to removal and replacement with no additional compensation.

At the Engineer's option, materials may be approved at the source of supply before delivery. If it is found after trial that sources of supply for previously approved materials do not produce specified products, the Contractor shall furnish materials from other sources.

The Contractor shall furnish airport lighting equipment that meets the requirements of the specifications; and is listed in the current Federal Aviation Administration Advisory Circular (AC) 150/5345-53, *Airport Lighting Equipment Certification Program and Addendum*, that is in effect on the date of advertisement.

All other equipment and materials covered by other referenced specifications shall be subject to acceptance through a certificate of analysis (COA) with the applicable specification when requested by the Engineer.

**60-02 Samples, tests, and cited specifications.** All materials used in the work shall be inspected, tested, and approved by the Engineer before incorporation in the work unless otherwise designated. Any work in which untested materials are used without approval or written permission of the Engineer shall be performed at the Contractor's risk. Materials found to be unacceptable and unauthorized will not be paid for and, if directed by the Engineer, shall be removed at the Contractor's expense.

Unless otherwise designated, quality assurance tests will be made by and at the expense of the Engineer in accordance with the cited standard methods of ASTM, American Association of State Highway and Transportation Officials (AASHTO), federal specifications, Commercial Item Descriptions, and all other cited methods, which are current on the date of advertisement for bids.

The testing organizations performing on-site quality assurance (QA) or quality control (QC) field tests shall have copies of all referenced standards on the construction site for use by all technicians and other personnel. Unless otherwise designated, samples for quality assurance will be taken by a qualified representative of the Engineer. All materials being used are subject to inspection, test, or rejection at any time prior to or during incorporation into the work. Copies of all tests will be furnished to the Contractor's representative at their request after review and approval of the Engineer.

A copy of all Contractor QC test data shall be provided to the Engineer daily, along with printed reports, in an approved format, on a weekly basis. After completion of the project, and prior to final payment, the Contractor shall submit a final report to the Engineer showing all test data reports, plus an analysis of all results showing ranges, averages, and corrective action taken on all failing tests.

The Contractor shall employ a QC testing organization, approved by the Engineer, to perform all Contractor required QC tests in accordance with Item 100 titled CONTRACTOR QUALITY CONTROL PROGRAM (CQCP).

In addition to all handwritten copies and printed reports, all QC test data from the Contractor and QA testing organizations may be furnished in electronic format meeting the requirements as required by the Engineer.

**60-03 Certification of compliance/analysis (COC/COA).** The Engineer may permit the use, prior to sampling and testing, of certain materials or assemblies when accompanied by manufacturer's COC stating that such materials or assemblies fully comply with the requirements of the contract. The certificate shall be signed by the manufacturer. Each lot of such materials or assemblies delivered to the work must be accompanied by a certificate of compliance in which the lot is clearly identified. The COA is the manufacturer's COC and includes all applicable test results.

Materials or assemblies used on the basis of certificates of compliance may be sampled and tested at any time and if found not to be in conformity with contract requirements will be subject to rejection whether in place or not.

The form and distribution of certificates of compliance shall be as approved by the Engineer.

When a material or assembly is specified by "brand name or equal", the Project Engineer will provide at least two (2) vendors/suppliers who can meet the requirements. When the Contractor elects to furnish the specified "or equal," the Contractor shall be required to furnish the manufacturer's certificate of compliance for each lot of such material or assembly delivered to the work. Such certificate of compliance shall clearly identify each lot delivered and shall certify as to:

- a. Conformance to the specified performance, testing, quality or dimensional requirements; and,
- b. Suitability of the material or assembly for the use intended in the contract work.

The Engineer shall be the sole judge as to whether the proposed "or equal" is suitable for use in the work.

The Engineer reserves the right to refuse permission for use of materials or assemblies on the basis of certificates of compliance.

As a guide to the certification process and requirements, the Contractor shall use the Illinois Department of Transportation, Bureau of Airport Engineering *Manual for Documentation of Airport Materials* including any addendums. Copies of this manual are available from the Department's Bureau of Airport Engineering. The *Manual for Documentation of Airport Materials* defines the Resident Engineer's/Contractor's responsibilities. The Contractor shall have the sole responsibility to provide the Engineer with appropriate documentation to satisfy the contract certification requirements prior to the delivery of materials.

If, upon delivery and incorporation of any materials, the Contractor has failed to provide the necessary submittals as specified in the contract documents, the pay item shall not be included on the construction progress payment report until such submittal have been furnished.

The cost of providing the required material documentation and certifications shall not be paid for separately, but shall be considered incidental to the associated item.

**60-04 Plant inspection.** The Engineer or their authorized representative may inspect, at its source, any specified material or assembly to be used in the work. Manufacturing plants may be inspected from time to time for the purpose of determining compliance with specified manufacturing methods or materials to be used in the work and to obtain samples required for acceptance of the material or assembly.

Should the Engineer conduct plant inspections, the following conditions shall exist:

- a. The Engineer shall have the cooperation and assistance of the Contractor and the producer with whom the Contractor has contracted for materials.
- b. The Engineer shall have full entry, with the allowable site-specific safety regulations, at all reasonable times to such parts of the plant that concern the manufacture or production of the materials being furnished.

- c. If required by the Engineer, the Contractor shall arrange for adequate office or working space that may be reasonably needed for conducting plant inspections. Place office or working space should be in a convenient location with respect to the plant.

It is understood and agreed that the Engineer shall have the right to retest any material that has been tested and approved at the source of supply after it has been delivered to the site. The Engineer shall have the right to reject only material which, when retested, does not meet the requirements of the contract, plans, or specifications.

**60-05 Resident engineer (RE) field office.** When and as specified, the Contractor shall provide dedicated space for the exclusive use of the Resident Engineer and inspectors, as a field office and field testing laboratory for the duration of the project in accordance with Item 150 titled RESIDENT ENGINEER FIELD OFFICE.

**60-06 Storage of materials.** Materials shall be stored to assure the preservation of their quality and fitness for the work. Stored materials, even though approved before storage, may again be inspected prior to their use in the work. Stored materials shall be located to facilitate their prompt inspection. The Contractor shall coordinate the storage of all materials with the Engineer. Materials to be stored on airport property shall not create an obstruction to air navigation nor shall they interfere with the free and unobstructed movement of aircraft. Unless otherwise shown on the plans and/or CSPP, the storage of materials and the location of the Contractor's plant and parked equipment or vehicles shall be as directed by the Engineer. Private property shall not be used for storage purposes without written permission of the Owner or lessee of such property. The Contractor shall make all arrangements and bear all expenses for the storage of materials on private property. Upon request, the Contractor shall furnish the Engineer a copy of the property Owner's permission.

All storage sites on private or airport property shall be restored to their original condition by the Contractor at their expense, except as otherwise agreed to (in writing) by the Owner or lessee of the property.

Topsoil shall be stockpiled at the locations designated by the Resident Engineer and in accordance with the approved Construction Safety and Phasing Plan.

When required by FAA aeronautical study or by Airport Management, prominently mark and light stockpiled material at the construction site in accordance with current Federal Aviation Administration Advisory Circular 150/5370-2, *Operational Safety on Airports During Construction* and in a manner acceptable to the Airport Management.

Stockpiled material should be constrained in a manner to prevent movement resulting from aircraft blast or wind conditions in excess of ten (10) knots.

**60-07 Unacceptable materials.** Any material or assembly that does not conform to the requirements of the contract, plans, or specifications, at the time they are used, shall be considered unacceptable and shall be rejected. The Contractor shall remove any rejected material or assembly from the site of the work, unless otherwise instructed by the Engineer, and at no additional cost to the Department.

Rejected material or assembly, the defects of which have been corrected by the Contractor, shall not be returned to the site of the work until such time as the Engineer has approved its use in the work.

**60-08 Owner furnished materials.** The Contractor shall furnish all materials required to complete the work, except those specified, if any, to be furnished by the Owner. Owner-furnished materials shall be made available to the Contractor at the location specified.

All costs of handling, transportation from the specified location to the site of work, storage, and installing Owner-furnished materials shall be included in the unit price bid for the contract item in which such Owner-furnished material is used.

After any Owner-furnished material has been delivered to the location specified, the Contractor shall be responsible for any demurrage, damage, loss, or other deficiencies that may occur during the Contractor's handling, storage, or use of such Owner-furnished material. The Department will deduct from any monies due or to become due the Contractor any cost incurred in making good such loss due to the Contractor's handling, storage, or use of Owner-furnished materials.

**60-09 Source of materials.** The Contractor, as soon as possible following the contract award, shall inform the Department of the sources of all materials contained in the contract.

If the Contractor decides to investigate new sources of supply, the Contractor shall furnish without charge such preliminary samples and reports rendered, but it is understood that such tests are for informational purposes only and that they shall not be construed as a guarantee of acceptance of any material which may be delivered later for incorporation in the work. Only materials actually delivered for use will be considered, and their acceptance will be based solely upon the results of the tests made on these materials.

If the Contractor installs equipment or apparatus to produce materials from new sources of supply, it will be at their own risk, and the Contractor shall assume full responsibility for the production of uniform and satisfactory materials. In case of failure of a source of supply to produce materials satisfactory to the Department, the Contractor shall indemnify and save harmless the Department from any and all claims for loss or damage of whatever nature which the Contractor may have suffered by reason of the installation of equipment and the operation of such sources of supply.

**60-10 Handling materials.** All materials shall be handled in such manner as to preserve their quality and fitness for the work. Aggregates shall be transported from the storage sites to the work in tight vehicles so constructed as to prevent loss or segregation of materials after loading and measuring in order that there may be no inconsistencies in the quantities of materials intended for incorporation in the work as loaded, and the quantities as actually received at the place of operations.

**END OF SECTION 60**



## Section 70 Legal Regulations and Responsibility to Public

- 70-01**     **Laws to be observed.** The Contractor shall keep fully informed of all federal and state laws, all local laws, ordinances, and regulations and all orders and decrees of bodies or tribunals having any jurisdiction or authority, which in any manner affect those engaged or employed on the work, or which in any way affect the conduct of the work. The Contractor shall at all times observe and comply with all such laws, ordinances, regulations, orders, and decrees; and shall protect and indemnify the Owner and all their officers, agents, or servants against any claim or liability arising from or based on the violation of any such law, ordinance, regulation, order, or decree, whether by the Contractor or the Contractor's employees.
- 70-02**     **Worker's compensation insurance.** Prior to the approval of the contract by the Department, the Contractor shall furnish to the Department certificates of insurance covering Worker's Compensation, or such satisfactory evidence that this liability is otherwise taken care of according to Section 4(a) of the *Worker's Compensation Act* of the State of Illinois as amended.
- Such insurance, or other means of protection as herein provided, shall be kept in force until all work to be performed under the terms of the contract has been completed and accepted in according to the Specifications, and it is hereby understood and agreed that the maintenance of such insurance or other protection, until acceptance of the work by the Department, is a part of the contract. Failure to maintain such insurance, cancellation by the Industrial Commission of its approval of such other means of protection as might have been elected, or any other act which results in lack of protection under the said *Worker's Compensation Act* may be considered as a breach of the contract.
- 70-03**     **Permits, licenses, and taxes.** The Contractor shall procure all permits and licenses, pay all charges, fees, and taxes, and give all notices necessary and incidental to the due and lawful execution of the work.
- 70-04**     **Patented devices, materials, and processes.** If the Contractor is required or desires to use any design, device, material, or process covered by letters of patent or copyright, the Contractor shall provide for such use by suitable legal agreement with the Patentee or Owner, guaranteeing the Department indemnity from and against all claims for infringement, and shall include the cost of such agreement in the price bid for the work. It shall be the duty of the Contractor, if so demanded by the Department, to furnish said Department with a copy of the legal agreement with the patentee or owner, and if such copy is not furnished when demanded, then the Department may, if it so elects, withhold any and all payments to said Contractor until said legal agreement is furnished. If a suitable legal agreement with the patentee or owner is not made as required herein. The Contractor and the surety shall indemnify and hold harmless the Department, any third party, or political subdivision from any and all claims for infringement by reason of the use of any such patented design, device, material or process, or any trademark or copyright, and shall indemnify the Department for any costs, expenses, and damages which it may be obliged to pay by reason of an infringement, at any time during the execution or after the completion of the work.
- 70-05**     **Restoration of surfaces disturbed by others.** The Owner reserves the right to authorize the construction, reconstruction, or maintenance of any public or private utility service, FAA or National Oceanic and Atmospheric Administration (NOAA) facility, or a utility service of another government agency at any time during the progress of the work. To the extent that such construction, reconstruction, or maintenance has been coordinated with the Engineer, such authorized work (by others) must be shown on the plans.

Except as listed above, the Contractor shall not permit any individual, firm, or corporation to excavate or otherwise disturb such utility services or facilities located within the limits of the work without the written permission of the Engineer.

Should the Owner of public or private utility service, FAA, or NOAA facility, or a utility service of another government agency be authorized to construct, reconstruct, or maintain such utility service or facility during the progress of the work, the Contractor shall cooperate with such Owners by arranging and performing the work in this contract to facilitate such construction, reconstruction or maintenance by others whether or not such work by others is listed above. When ordered as extra work by the Engineer, the Contractor shall make all necessary repairs to the work which are due to such authorized work by others, unless otherwise provided for in the contract, plans, or specifications. It is understood and agreed that the Contractor shall not be entitled to make any claim for damages due to such authorized work by others or for any delay to the work resulting from such authorized work.

**70-06 Federal participation.** The United States Government has agreed to reimburse the Owner for some portion of the contract costs. The contract work is subject to the inspection and approval of duly authorized representatives of the FAA Administrator. No requirement of this contract shall be construed as making the United States a party to the contract nor will any such requirement interfere, in any way, with the rights of either party to the contract.

**70-07 Sanitary, health, and safety provisions.** The Contractor's worksite and facilities shall comply with applicable federal, state, and local requirements for health, safety and sanitary provisions.

**70-08 Public convenience and safety.** The Contractor shall control their operations and those of their subcontractors and all suppliers, to assure the least inconvenience to the traveling public. Under all circumstances, safety shall be the most important consideration.

The Contractor shall maintain the free and unobstructed movement of aircraft and vehicular traffic with respect to their own operations and those of their own subcontractors and all suppliers in accordance with Section 40, paragraph 40-05 titled MAINTENANCE OF TRAFFIC, and shall limit such operations for the convenience and safety of the traveling public as specified in Section 80, paragraph 80-04 titled LIMITATION OF OPERATIONS.

The Contractor shall remove or control debris and rubbish resulting from its work operations at frequent intervals, and upon the order of the Resident Engineer. If the Resident Engineer determines the existence of Contractor debris in the work site represents a hazard to airport operations and the Contractor is unable to respond in a prompt and reasonable manner, the Resident Engineer reserves the right to assign the task of debris removal to a third party and recover the resulting costs as a liquidated damage against the Contractor.

**70-09 Construction safety and phasing plan (CSPP).** The Contractor shall complete the work in accordance with the approved construction safety and phasing plan (CSPP) developed in accordance with the current Federal Aviation Administration Advisory Circular (AC) 150/5370-2, *Operational Safety on Airports During Construction*.

**70-10 Use of explosives.** When the use of explosives is necessary for the prosecution of the work, the Contractor shall exercise the utmost care not to endanger life or property, including new work. The Contractor shall be responsible for all damage resulting from the use of explosives.

All explosives shall be stored in a secure manner in compliance with all laws and ordinances, and all such storage places shall be clearly marked. Where no local laws or ordinances apply, storage shall be provided satisfactory to the Engineer and, in general, not closer than 1,000 feet from the work or from any building, road, or other place of human occupancy.

The Contractor shall notify each property Owner and public utility company having structures or facilities in proximity to the site of the work of their intention to use explosives. Such notice shall be given sufficiently in advance to enable them to take such steps as they may deem necessary to protect their property from injury.

The use of electrical blasting caps shall not be permitted on or within 1,000 feet of the airport property.

- 70-11 Protection and restoration of property and landscape.** The Contractor shall be responsible for the preservation of all public and private property, and shall protect carefully from disturbance or damage all land monuments and property markers until the Resident Engineer has witnessed or otherwise referenced their location and shall not move them until directed.

The Contractor shall be responsible for all damage or injury to property of any character, during the prosecution of the work, resulting from any act, omission, neglect, or misconduct in manner or method of prosecuting the work, or at any time due to defective work or materials, and said responsibility shall not be released until the project has been completed and accepted.

When or where any direct or indirect damage or injury is done to public or private property by or on account of any act, omission, neglect, or misconduct in the prosecution of the work, or in consequence of the non-prosecution thereof by the Contractor, the Contractor shall restore, at their expense, such property to a condition similar or equal to that existing before such damage or injury was done, by repairing, or otherwise restoring as may be directed, or the Contractor shall make good such damage or injury in an acceptable manner.

The Contractor shall take special precautions during construction to protect existing pavement, graded ground, landscaping, areas with turf or sod, buildings, lights, guidance signs, navigational aids, and other existing features of the airport and surrounding area from damage or disturbance. Any such areas disturbed, damaged, or destroyed by the Contractor, except those areas within the limits of construction, shall be returned to their pre-construction condition to the satisfaction of the Engineer. The cost of work necessary to accomplish these requirements shall be considered incidental to the contract and no additional compensation will be allowed.

The Contractor shall take every precaution against fire.

- 70-12 Responsibility for damage claims.** The Contractor shall indemnify and hold harmless the Engineer, the Department, and the engineering firm and their officers, agents, and employees from all suits, actions, or claims, of any character, brought because of any injuries or damage received or sustained by any person, persons, or property on account of the operations of the Contractor; or on account of or in consequence of any neglect in safeguarding the work; or through use of unacceptable materials in constructing the work; or because of any act or omission, neglect, or misconduct of said Contractor; or because of any claims or amounts recovered from any infringements of patent, trademark, or copyright; or from any claims or amounts arising or recovered under the "Workmen's Compensation Act," or any other law, ordinance, order, or decree. Money due the Contractor under and by virtue of their own contract considered necessary by the Department for such purpose may be retained for the use of the Department or, in case no money is due, their own surety may be held until such suits, actions, or claims for injuries or damages shall have been settled and suitable evidence to that effect furnished to the Department, except that money due the Contractor will not be withheld when the Contractor produces satisfactory evidence that he or she is adequately protected by public liability and property damage insurance.

The Contractor, prior to execution of the contract, shall file with the Department copies of completed certificates of insurance, satisfactory to the Department, to afford protection against all claims for damages to public or private property, and injuries to persons, arising out of and during the progress of the work to its completion, as defined by Section 80, paragraph 80-12 titled TERMINATION OF THE CONTRACTOR'S RESPONSIBILITY. The policy of insurance shall include the Owner and the participating agencies as an additional insured or provide separate coverage with an Owner's Protective policy. The minimum amounts of insurance shall be as follows, except no restrictions or occurrence limits will be permitted.

<b>Bodily Injury</b>	<b>Property Damage Liability</b>	
Each Occurrence	Each Occurrence	Aggregate
\$2,000,000	\$1,000,000	\$2,000,000

All such insurance must include an endorsement whereby the insurer agrees to notify the Department at least 30 days prior to nonrenewal, reduction or cancellation. The Contractor shall cease operations on the project if the insurance is cancelled or reduced below the required minimum amount of coverage. All costs for insurance as specified herein will not be paid for separately, but shall be considered as incidental to the contract.

**70-13 Third party beneficiary clause.** It is specifically agreed between the parties executing the contract that it is not intended by any of the provisions of any part of the contract to create for the public or any member thereof, a third-party beneficiary or to authorize anyone not a party to the contract to maintain a suit for personal injuries or property damage pursuant to the terms or provisions of the contract.

**70-14 Opening sections of the work to traffic.** If it is necessary for the Contractor to complete portions of the contract work for the beneficial occupancy of the Owner prior to completion of the entire contract, such "phasing" of the work must be specified below and indicated on the approved construction safety and phasing plan (CSPP) and the project plans. When so specified, the Contractor shall complete such portions of the work on or before the date specified or as otherwise specified.

Upon completion of any portion of work listed above, such portion shall be accepted by the Department in accordance with Section 50, paragraph 50-13 titled PARTIAL ACCEPTANCE.

No portion of the work may be opened by the Contractor for public use until approved by the Engineer. Should it become necessary to open a portion of the work to traffic on a temporary or intermittent basis, such openings shall be made when, in the opinion of the Resident Engineer, such portion of the work is in an acceptable condition to support the intended traffic. Temporary or intermittent openings are considered to be inherent in the work and shall not constitute either acceptance of the portion of the work so opened or a waiver of any provision of the contract. Any damage to the portion of the work so opened that is not attributable to traffic which is permitted by the Engineer shall be repaired by the Contractor at their expense.

The Contractor shall make their own estimate of the inherent difficulties involved in completing the work under the conditions herein described and shall not claim any added compensation by reason of delay or increased cost due to opening a portion of the contract work.

It is necessary for the Contractor to complete the contract work in such a way as to maintain airfield access for all aircraft. The Contractor shall submit a progress schedule to the Project Engineer in conformance with Section 80, paragraph 80-03 titled PROSECUTION AND PROGRESS, showing the estimated beginning and completion dates of each sequence of work. It is vitally important to plan and conduct the work in such a manner that the length and amount of interruption to air traffic at the airport is minimized. If necessary to complete the work within the time limitations for the contract and the schedule approved by the Department, the Contractor shall work longer than regular hours or use multiple crews and equipment, or a combination of such techniques. Any premium costs of overtime or multiple crew and equipment operations shall be at the Contractor's expense.

The Contractor must conform to safety standards contained the current Federal Aviation Administration Advisory Circular (AC) 150/5370-2, *Operational Safety on Airports During Construction* and the approved CSPP.

Contractor shall refer to the plans, specifications, and the approved CSPP to identify barricade requirements, temporary and/or permanent markings, airfield lighting, guidance signs and other safety requirements prior to opening up sections of work to traffic.

**70-15 Contractor's responsibility for work.** Until the Engineer's final written acceptance of the entire completed work, excepting only those portions of the work accepted in accordance with Section 50, paragraph 50-13 titled PARTIAL ACCEPTANCE, the Contractor shall have the charge and care thereof and shall take every precaution against injury or damage to any part due to the action of the elements or from any other cause, whether arising from the prosecution or from the non-prosecution of the work. The Contractor shall rebuild, repair, restore, and make good all injuries or damages to any portion of the work occasioned by any of the above causes before final acceptance and shall bear the expense thereof except damage to the work due to unforeseeable causes beyond the control of and without the fault or negligence of the Contractor, including but not restricted to cataclysmic events such as earthquake, tidal wave, tornado, hurricane or other cataclysmic phenomenon of nature, or acts of the public enemy or of government authorities.

When materials are furnished to the Contractor by the Department or Owner, for inclusion in the work, the Contractor's responsibility for all such materials shall be the same as for materials furnished by said Contractor.

If the work is suspended for any cause whatever, the Contractor shall be responsible for the work and shall take such precautions necessary to prevent damage to the work. The Contractor shall provide for normal drainage and shall erect necessary temporary structures, signs, or other facilities at their own expense. During such period of suspension of work, the Contractor shall properly and continuously maintain in an acceptable growing condition all living material in newly established planting, seeding, and sodding furnished under the contract, and shall take adequate precautions to protect new tree growth and other important vegetative growth against injury.

**70-16 Contractor's responsibility for utility service and facilities of others.** As provided in paragraph 70-05 titled RESTORATION OF SURFACES DISTURBED BY OTHERS, the Contractor shall cooperate with the owner of any public or private utility service, FAA or NOAA, or a utility service of another government agency that may be authorized by the Owner to construct, reconstruct or maintain such utility services or facilities during the progress of the work. In addition, the Contractor shall control their operations to prevent the unscheduled interruption of such utility services and facilities.

To the extent that such public or private utility services, FAA, or NOAA facilities, or utility services of another governmental agency are known to exist within the limits of the contract work, the approximate locations have been indicated on the plans and/or in the contract documents.

The plans shall show the approximate location of the utilities or facilities known to exist within the limits of the contract work, however, it is the Contractor's responsibility to determine the actual location of all such facilities. The proposed contract documents shall be coordinated with the various Owners at the earliest possible time to avoid overlooking utility conflicts in the design and to obtain the best possible information needed to protect such utility services or facilities from damage resulting from the Contractor's operations. Where conflicts are indicated during the coordination, they shall be resolved by the airport Owner and the utility owner, in accordance with existing legal agreements, by providing for work in the proposed contract or by the utility owner. In such cases of conflict, regardless of how the conflict is resolved, the airport Owner and utility owner should also be advised of the need to furnish the best information possible as to location of the utility service or facility to ensure protection during the proposed contract work.

It is understood and agreed that the Owner does not guarantee the accuracy or the completeness of the location information relating to existing utility services, facilities, or structures that may be shown on the plans or encountered in the work. The location of the underground utilities as indicated on the plans has been obtained from existing records. Neither the Owner, Department, nor the Project Engineers assume any responsibility whatsoever in respect to the accuracy, completeness or sufficiency of the information. There is no guarantee, either expressed or implied, that the locations, size and type of material of existing underground utilities indicated are representative of those to be encountered in the construction. Any

inaccuracy or omission in such information shall not relieve the Contractor of the responsibility to protect such existing features from damage or unscheduled interruption of service.

It is further understood and agreed that the Contractor shall, upon execution of the contract, notify the Owners of all utility services or other facilities of their plan of operations. Such notification shall be in writing addressed to "The Person to Contact" as provided in this paragraph and paragraph 70-05 titled RESTORATION OF SURFACES DISTURBED BY OTHERS. A copy of each notification shall be given to the Engineer.

Within the State of Illinois, a State-Wide One Call Notice System has been established for notifying utilities. Outside the city limits of the City of Chicago, the system is known as the Joint Utility Locating Information for Excavators (JULIE) System. Within the city limits of the City of Chicago the system is known as DIGGER. All utility companies and municipalities which have buried utility facilities in the State of Illinois are a part of this system.

The Contractor shall call JULIE (800-892-0123) or DIGGER (312-744-7000), a minimum of 48 hours in advance of work being done in the area, and they will notify all member utility companies involved that their respective utility should be located. The political name of the township where the work is located, as shown on the location map, along with other location information such as land section and quarter section will have to be given.

For utilities which are not members of JULIE or DIGGER, the Contractor shall contact the owners directly. The general plan notes will indicate which utilities are not members of JULIE or DIGGER.

The type of utility and color used for marking are shown in the following table:

<b>Utility Service</b>	<b>Color</b>
Electric Power, Distribution and Transmission	Safety Red
Municipal Electrical Systems	Safety Red
Gas Distribution and Transmission	High Visibility Safety Yellow
Oil Distribution and Transmission	High Visibility Safety Yellow
Telephone and Telegraph System	Safety Alert Orange
Community Antenna and Television Systems	Safety Alert Orange
Water Systems	Safety Precaution Blue
Sewer Systems	Safety Green
Non-Potable Water and Slurry Lines	Safety Purple
Temporary Survey	Safety Pink
Proposed Excavation	Safety White (Black when snow is on the ground)

In addition to the general written notification provided, it shall be the responsibility of the Contractor to keep such individual Owners advised of changes in their plan of operations that would affect such Owners. The Contractor shall cooperate with the owners of any underground or overhead utility lines in their removal and rearrangement operations in order that these operations may progress in a reasonable manner, that duplication of rearrangement work may be reduced to a minimum, and that services rendered by those parties will not be unnecessarily interrupted.

Prior to beginning the work in the general vicinity of an existing utility service or facility, the Contractor shall again notify each such Owner of their plan of operation. If, in the Contractor's opinion, the Owner's assistance is needed to locate the utility service or facility or the presence of a representative of the Owner is desirable to observe the work, such advice should be included in the notification. Such notification shall be given by the most expeditious means to reach the utility owner's "Person to Contact" no later than two (2) normal business days prior to the Contractor's commencement of operations in such general vicinity. The Contractor shall furnish a written summary of the notification to the Engineer.

The Contractor's failure to give the two (2) days notice shall be cause for the Department to suspend the Contractor's operations in the general vicinity of a utility service or facility.

Where the outside limits of an underground utility service have been located and staked on the ground, the Contractor shall be required to use hand excavation methods within three (3) feet of such outside limits at such points as may be required to ensure protection from damage due to the Contractor's operations.

Should the Contractor damage or interrupt the operation of a utility service or facility by accident or otherwise, the Contractor shall immediately notify the proper authority and the Engineer shall take all reasonable measures to prevent further damage or interruption of service. The Contractor, in such events, shall cooperate with the utility service or facility owner and the Engineer continuously until such damage has been repaired and service restored to the satisfaction of the utility or facility owner.

The Contractor shall bear all costs of damage and restoration of service to any utility service or facility due to their operations whether due to negligence or accident. The Department reserves the right to deduct such costs from any monies due or which may become due the Contractor, or their own surety.

**70-17 FAA facilities and cable runs.** If the contract documents indicate, the Contractor is hereby advised that the construction limits of the project include existing facilities and buried cable runs that are owned, operated and maintained by the FAA. The Contractor, during the prosecution of the project work, shall comply with the following:

- a. The Contractor shall permit FAA maintenance personnel the right of access to the project work site for purposes of inspecting and maintaining all existing FAA owned facilities.
- b. The Contractor shall provide notice to the FAA Air Traffic Organization (ATO)/Technical Operations/System Support Center (SSC) Point-of-Contact through the airport manager a minimum of seven (7) calendar days prior to commencement of construction activities in order to permit sufficient time to locate and mark existing buried cables and to schedule any required facility outages.
- c. If execution of the project work requires a facility outage, the Contractor shall contact the FAA Point-of-Contact a minimum of 72 hours prior to the time of the required outage. If such outage will cause a significant impact to the National Airspace System (NAS), a minimum of 45 days may be required as stated in the contract documents.
- d. Any damage to FAA cables, access roads, or FAA facilities during construction caused by the Contractor's equipment or personnel whether by negligence or accident will require the Contractor to repair or replace the damaged cables, access road, or FAA facilities to FAA requirements. The Contractor shall not bear the cost to repair damage to underground facilities or utilities improperly located by the FAA.
- e. Any displaced or relocated FAA facility or cables due to construction will require a signed and executed reimbursable agreement between the Owner and the FAA Tech Ops Division.
- f. If the project work requires the cutting or splicing of FAA owned cables, the FAA Point-of-Contact shall be contacted a minimum of 72 hours prior to the time the cable work commences. The FAA reserves the right to have a FAA representative on site to observe the splicing of the cables as a condition of acceptance. All cable splices are to be accomplished in accordance with FAA specifications and require approval by the FAA Point-of-Contact as a condition of acceptance by the Owner. The Contractor is hereby advised that the FAA restricts the location of where splices may be installed, and the splicing of cables is not an acceptable form of repair for certain projects. If a cable splice is required in a location that is not permitted by the FAA, the Contractor shall furnish and install a sufficient length of new cable that eliminates the need for any splice. If any FAA cables are damaged, the Contractor shall replace the cables in their entirety.

- 70-18** **Furnishing rights-of-way.** The Owner will be responsible for furnishing all rights-of-way upon which the work is to be constructed in advance of the Contractor's operations.
- 70-19** **Personal liability of public officials.** In carrying out any of the contract provisions or in exercising any power or authority granted by this contract, there shall be no liability upon the Engineer, Resident Engineer, their authorized representatives, or any officials of the Department, either personally or as an official of the Department. It is understood that in such matters they act solely as agents and representatives of the Department.
- 70-20** **No waiver of legal rights.** Upon completion of the work, the Department will expeditiously make final inspection and notify the Contractor of final acceptance. Such final acceptance, however, shall not preclude or stop the Department from correcting any measurement, estimate, or certificate made before or after completion of the work, nor shall the Department be precluded or stopped from recovering from the Contractor or their surety, or both, such overpayment as may be sustained, or by failure on the part of the Contractor to fulfill their obligations under the contract. A waiver on the part of the Department of any breach of any part of the contract shall not be held to be a waiver of any other or subsequent breach.
- The Contractor, without prejudice to the terms of the contract, shall be liable to the Department for latent defects, fraud, or such gross mistakes as may amount to fraud, or as regards the Department's rights under any warranty or guaranty.
- 70-21** **Environmental protection.** The Contractor shall comply with all federal, state, and local laws and regulations controlling pollution of the environment. The Contractor shall take necessary precautions to prevent pollution of streams, lakes, ponds, and reservoirs with fuels, oils, asphalts, chemicals, or other harmful materials and to prevent pollution of the atmosphere from particulate and gaseous matter. The Contractor shall conduct and schedule operations so as to avoid or minimize siltation of streams, lakes, ponds and reservoirs. Where, in the opinion of the Engineer, the land has a high potential for erosion, the areas that can be exposed by construction operations at any one (1) time will be subject to approval by the Engineer and the duration of the exposure of the uncompleted construction to the elements shall be as short as practicable. Erosion control features shall be constructed concurrently with other work as directed by the Engineer.
- 70-22** **Archaeological and historical findings.** Unless otherwise specified in the contract documents, the Contractor is advised that the site of the work is not within any property, district, or site, and does not contain any building, structure, or object listed in the current National Register of Historic Places published by the United States Department of Interior.
- Should the Contractor encounter, during their operations, any building, part of a building, structure, or object that is incongruous with its surroundings, the Contractor shall immediately cease operations in that location and notify the Engineer. The Engineer will immediately investigate the Contractor's finding and the Department will direct the Contractor to either resume operations or to suspend operations as directed.
- Should the Department order suspension of the Contractor's operations in order to protect an archaeological or historical finding, or order the Contractor to perform extra work, such shall be covered by an appropriate contract change order or supplemental agreement as provided in Section 40, paragraph 40-04 titled EXTRA WORK, and Section 90, paragraph 90-06 titled PAYMENT FOR EXTRA WORK AND FORCE ACCOUNT. If appropriate, the contract change order or supplemental agreement shall include an extension of contract time in accordance with Section 80, paragraph 80-08 titled DETERMINATION AND EXTENSION OF CONTRACT TIME.
- 70-23** **Contractor's public liability and property damage liability Insurance.** The Contractor, with respect to the work that they perform, will be required to carry regular Contractor's Public Liability Insurance, including automobile coverage, in limits of not less than \$500,000 for all damages arising out of bodily injuries to or death of one (1) person and subject to that limit for each person, a total amount of \$1,000,000 for all damages arising out of bodily injuries to or death of two (2) or more persons in any one (1) accident, and regular Contractors' Property Damage Liability



Insurance, including automobile coverage, in limits of not less than \$500,000 for all damages arising out of injury to or destruction of property in any one (1) accident and, subject to that limit per accident, a total (or aggregate) limit of \$1,000,000 for all damages arising out of injury to or destruction of property during the policy period.

The Contractor shall furnish a certified copy of the policy to the Department. The policy shall provide that in the event the insurance should be changed or cancelled, such change or cancellation shall not be effective until 30 days after the Department has received notice of such change or cancellation from the insurance company.

**70-24 Contractor's protective public liability and property damage insurance.** At the time of filing their contract and bonds, the Contractor shall notify the Department, in writing, as to whether or not they propose to sublet any of the work under the terms of their contract. The Contractor, with respect to the operations performed for them by subcontractors, will be required to carry Contractors' Protective Public Liability and Property Damage Liability Insurance, including automobile coverage, in the same limits as prescribed in the paragraph 70-23 titled CONTRACTOR'S PUBLIC LIABILITY AND PROPERTY DAMAGE LIABILITY INSURANCE of this section, and shall furnish copies of policies of such insurance and certificates as above required. If no part of the work is to be sublet, this article will not apply.

Insurance coverage as required above shall be kept in force until all work to be performed under the terms of the contract has been accepted by the Department and it is clearly understood that the upkeep of these insurance policies until acceptance of the work by the Department is a part of the contract. The Contractor shall include the cost of all such insurance in their unit bid prices and no extra compensation will be granted to them, nor will any deduction be made by the Department due to extra work and/or decreased quantities of work and/or elimination of items.

Such insurance or other means of protection as herein provided shall be kept in force until all work to be performed under the terms of the contract has been completed and accepted in accordance with the specifications and it is hereby understood and agreed that the maintenance of such insurance or other protection, until acceptance of the work by the Department, is a part of the contract. Failure to maintain such insurance, cancellation by the Industrial Commission of its approval of such other means of protection as might have been elected, or any other act which results in lack of protection under the said "Workers' Compensation Act" may be considered as a breach of the contract.

**70-25 Contractor's responsibility for safety during construction.** As a minimum, the Contractor shall be responsible for safety during construction as follows:

- a. Possess a copy of the approved Construction Safety and Phasing Plan distributed at the preconstruction meeting.
- b. Comply with the approved Safety Plan and construction activity plans associated with the construction project and ensure that construction personnel are familiar with safety procedures and regulations on the Airport.
- c. Provide a point of contact that will coordinate an immediate response to correct any construction- related activity that may adversely affect the operational safety of the Airport.
- d. Possess a copy of current Federal Aviation Administration Advisory Circular (AC) 150/5370-2, *Operational Safety on Airports during Construction*.

## END OF SECTION 70

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## Section 80 Prosecution and Progress

**80-01 Subletting of contract.** The Engineer will not recognize any subcontractor on the work. The Contractor shall, at all times when work is in progress, be represented either in person, by a qualified superintendent, or by other designated, qualified representative who is duly authorized to receive and execute orders of the Engineer. The Contractor shall not subcontract, sell, transfer, assign, or otherwise dispose of the contract or contracts or any portion thereof, or of their right, title, or interest therein, without written consent of the Engineer.

Notwithstanding consent to subcontract approved by the Engineer, the Contractor shall perform, with their organization, an amount of work equal to at least 51% of the total contract cost, and with materials purchased or produced by the Contractor. Items designated in the contract as "specialty items" may be performed by subcontract and the cost of any such specialty items so performed by subcontract may be deducted from the total cost before computing the amount of work required to be performed by the Contractor with their own organization. "Specialty Items" will be those items so designated on the summary of quantities included in the plans.

No subcontracts, or assignments of payments due or to become due, shall in any case release the Contractor or surety of liability under the contract and bonds. All transactions of the Engineer shall be with the Contractor. The Contractor shall have a representative on the job at all times when either contract or subcontract work is being performed.

All requests to subcontract shall contain a certification that the subcontract agreement exists in writing, that the subcontract incorporates by reference the terms and conditions of the contract, and that the subcontract incorporates fully therein the required Federal and State Equal Employment Opportunity provisions and labor Compliance provisions, including the contract wage requirements. The Contractor shall permit Department or Federal representative to examine the subcontract agreements upon notice.

The Engineer may order the Contractor to remove a subcontractor who does not perform satisfactory work or does not possess the integrity, experience, ability, and equipment the work requires in accordance with the terms and conditions of the contract. The Contractor shall comply at once and shall not employ the subcontractor for any further work under the contract.

All subcontractors shall be registered with the Department as a condition for approval to perform work on the contract. Should the Contractor elect to assign their contract, said assignment shall be concurred in by the surety, shall be presented for the consideration and approval of the Engineer, and shall be consummated only on the written approval of the Engineer.

Prior to the issuance of the NTP, the Contractor shall submit to the Engineer all subcontract information on form AER 260, "Request for Approval of Subcontractor".

**80-02 Notice to proceed (NTP).** The Engineer's notice to proceed will state the date on which contract time commences. The Contractor is expected to commence project operations within ten (10) days of the NTP date. The Contractor shall notify the Engineer at least 24 hours in advance of the time contract operations begins. The Contractor shall not commence any actual operations prior to the date on which the notice to proceed is issued by the Engineer. The Contract Time will begin on the date the Contractor actually begins construction or ten (10) days from the date of the notice to proceed, whichever is earlier.

**80-03 Prosecution and progress.** Unless otherwise specified, the Contractor shall submit their coordinated construction schedule showing all work activities within the number of calendar days specified in the contract for the Engineer's review prior to the issuance of the NTP. The Contractor's progress schedule, once accepted by the Engineer, will represent the Contractor's baseline plan to accomplish the project in accordance with the terms and conditions of the

Contract. The Engineer will compare actual Contractor progress against the baseline schedule to determine that status of the Contractor's performance. The Contractor shall provide sufficient materials, equipment, and labor to guarantee the completion of the project in accordance with the contract documents within the time set forth in the proposal.

If the Contractor falls significantly behind the submitted schedule, the Contractor shall, upon the Engineer's request, submit a revised schedule for completion of the work within the contract time and modify their operations to provide such additional materials, equipment, and labor necessary to meet the revised schedule. Should the prosecution of the work be discontinued for any reason, the Contractor shall notify the Engineer through the Resident Engineer at least 24 hours in advance of resuming operations.

For Federal Aid Contracts, the Contractor shall not commence any actual construction prior to the date on which the NTP is issued by the Engineer. Payment for work accomplished prior to the NTP will be disallowed.

The project schedule shall be prepared as a network diagram in Critical Path Method (CPM), Program Evaluation and Review Technique (PERT), or other format, or as otherwise specified. It shall include information on the sequence of work activities, milestone dates, and activity duration. The schedule shall show all work items identified in the project proposal for each work area and shall include the project start date and end date.

The Contractor shall maintain the work schedule and provide an update and analysis of the progress schedule on a twice monthly basis, or as otherwise specified in the contract. Submission of the work schedule shall not relieve the Contractor of overall responsibility for scheduling, sequencing, and coordinating all work to comply with the requirements of the contract.

The Contractor shall notify the Resident Engineer in writing of any possible delays in delivery or availability of materials or equipment associated with the project.

**80-04**     **Limitation of operations.** The Contractor shall control their operations and the operations of their subcontractors and all suppliers to provide for the free and unobstructed movement of aircraft in the air operations areas (AOA) of the airport.

When the work requires the Contractor to conduct their operations within an AOA of the airport, the work shall be coordinated with airport operations (through the Resident Engineer) at least 48 hours prior to commencement of such work. The Contractor shall not close an AOA until so authorized by the Resident Engineer and until the necessary temporary marking, signage and associated lighting is in place as provided in Section 70, paragraph 70-09 titled CONSTRUCTION SAFETY AND PHASING PLAN (CSPP).

When the contract work requires the Contractor to work within an AOA of the airport on an intermittent basis (intermittent opening and closing of the AOA), the Contractor shall maintain constant communications as specified; immediately obey all instructions to vacate the AOA; and immediately obey all instructions to resume work in such AOA. Failure to maintain the specified communications or to obey instructions shall be cause for suspension of the Contractor's operations in the AOA until satisfactory conditions are provided. The areas of the AOA identified in the construction safety and phasing plan (CSPP), cannot be closed to operating aircraft to permit the Contractor's operations on a continuous basis and will therefore be closed to aircraft operations intermittently.

The Contractor shall be required to conform to safety standards contained in the current Federal Aviation Administration Advisory Circular (AC) 150/5370-2, *Operational Safety on Airports During Construction* and the approved CSPP.

**80-05**     **Operational safety on airport during construction.** All Contractors' operations shall be conducted in accordance with the approved project construction safety and phasing plan (CSPP) and the safety plan compliance document (SPCD) and the provisions set forth within the current Federal Aviation Administration Advisory Circular (AC) 150/5370-2, *Operational*

*Safety on Airports During Construction.* The CSPP included within the contract documents conveys minimum requirements for operational safety on the airport during construction activities. Prior to the issuance of the NTP, the Contractor shall prepare and submit to the Engineer a SPCD that details how it proposes to comply with the requirements presented within the CSPP.

The Contractor shall implement all necessary safety plan measures prior to commencement of any work activity. The Contractor shall conduct routine checks to assure compliance with the safety plan measures.

The Contractor is responsible to the Engineer for the conduct of all subcontractors it employs on the project. The Contractor shall assure that all subcontractors are made aware of the requirements of the CSPP and SPCD and that they implement and maintain all necessary measures.

No deviation or modifications may be made to the approved CSPP and SPCD unless approved in writing by the Engineer. The necessary coordination actions to review Contractor proposed modifications to an approved CSPP or approved SPCD can require a significant amount of time.

**80-06 Character of workers, methods, and equipment.** The Contractor shall, at all times employ sufficient labor and equipment for prosecuting the work to full completion in the manner and time required by the contract, plans, and specifications.

All workers shall have sufficient skill and experience to perform properly the work assigned to them. Workers engaged in special work or skilled work shall have sufficient experience in such work and in the operation of the equipment required to perform the work properly and satisfactorily.

Any person employed by the Contractor or by any subcontractor who violates any operational regulations or operational safety requirements and, in the opinion of the Resident Engineer, does not perform work in a proper and skillful manner or is intemperate or disorderly shall, at the written request of the Resident Engineer, be removed immediately by the Contractor or subcontractor employing such person, and shall not be employed again in any portion of the work without approval of the Resident Engineer.

Should the Contractor fail to remove such person or persons, or fail to furnish suitable and sufficient personnel for the proper prosecution of the work, the Resident Engineer may suspend the work by written notice until compliance with such orders.

All equipment that is proposed to be used on the work shall be of sufficient size and in such mechanical condition as to meet requirements of the work and to produce a satisfactory quality of work. Equipment used on any portion of the work shall not cause injury to previously completed work, adjacent property, or existing airport facilities due to its use.

When the methods and equipment to be used by the Contractor in accomplishing the work are not prescribed in the contract, the Contractor is free to use any methods or equipment that can be demonstrated to the Resident Engineer as satisfactory to accomplish the work in conformity with the requirements of the contract, plans, and specifications.

When the contract specifies the use of certain methods and equipment, such methods and equipment shall be used unless otherwise authorized by the Engineer. If the Contractor desires to use a method or type of equipment other than specified in the contract, the Contractor may request authority from the Engineer to do so. The request shall be in writing and shall include a full description of the methods and equipment proposed and of the reasons for desiring to make the change. If approval is given, it will be on the condition that the Contractor will be fully responsible for producing work in conformity with contract requirements. If, after trial use of the substituted methods or equipment, the Engineer determines that the work produced does not meet contract requirements, the Contractor shall discontinue the use of the substitute method or equipment and shall complete the remaining work with the specified methods and equipment. The Contractor shall remove any deficient work and replace it with work of specified quality, or

take such other corrective action as the Engineer may direct. No change will be made in basis of payment for the contract items involved nor in contract time as a result of authorizing a change in methods or equipment under this paragraph.

**80-07 Temporary suspension of the work.** The Engineer shall have the authority to suspend the work wholly, or in part, for such period or periods the Engineer may deem necessary, due to unsuitable weather, or other conditions considered unfavorable for the execution of the work, or for such time necessary due to the failure on the part of the Contractor to carry out orders given or perform any or all provisions of the contract.

In the event that the Contractor is ordered by the Engineer, in writing, to suspend work for some unforeseen cause not otherwise provided for in the contract and over which the Contractor has no control, the Contractor may be reimbursed for actual money expended on the work during the period of shutdown. No allowance will be made for anticipated profits. The period of shutdown shall be computed from the effective date of the written order to suspend work to the effective date of the written order to resume the work. Claims for such compensation shall be filed with the Resident Engineer within the time period stated in the Engineer's order to resume work. The Contractor shall submit with their own claim information substantiating the amount shown on the claim. The Resident Engineer will forward the Contractor's claim to the Department for consideration in accordance with local laws or ordinances. No provision of this article shall be construed as entitling the Contractor to compensation for delays due to inclement weather, for suspension made at the request of the Engineer, or for any other delay provided for in the contract, plans, or specifications.

If it becomes necessary to suspend work for an indefinite period, the Contractor shall store all materials in such manner that they will not become an obstruction nor become damaged in any way. The Contractor shall take every precaution to prevent damage or deterioration of the work performed and provide for normal drainage of the work. The Contractor shall erect temporary structures where necessary to provide for traffic on, to, or from the airport.

**80-08 Determination and extension of contract time.** The number of calendar days shall be stated in the proposal and contract and shall be known as the Contract Time.

If the contract time requires extension for reasons beyond the Contractor's control, it shall be adjusted as follows:

Contract Time based on calendar days shall consist of the number of calendar days stated in the contract counting from the effective date of the Notice to Proceed and including all Saturdays, Sundays, holidays, and non-work days. All calendar days elapsing between the effective dates of the Engineer's orders to suspend and resume all work, due to causes not the fault of the Contractor, shall be excluded.

The Engineer shall base the bi-weekly statement of contract time charged on the following considerations:

- a. Conditions beyond the Contractor's control such as strikes, lockouts, unusual delays in transportation, temporary suspension of the principal item of work under construction or temporary suspension of the entire work which have been ordered by the Engineer for reasons not the fault of the Contractor, shall not be charged against the contract time.
- b. The Engineer will not make charges against the contract time prior to the effective date of the notice to proceed.
- c. The Engineer will begin charges against the contract time on the date the Contractor actually begins construction or ten (10) days from the date of the Notice to Proceed, whichever is earlier, as stated in this Section, paragraph 80-02 titled NOTICE TO PROCEED.
- d. The Engineer will make charges against contract time after the Final Acceptance as provided for in Section 50, paragraph 50-14 titled FINAL ACCEPTANCE.

- e. The Contractor will be allowed one (1) week in which to file a written protest setting forth their objections to the Engineer's bi-weekly statement. If no objection is filed within such specified time, the bi-weekly statement shall be considered as acceptable to the Contractor.

The contract time is based on the originally estimated quantities as described in the paragraph titled SCHEDULE OF PRICES of the proposal. At the time of final payment, the contract time shall be increased in the same proportion as the cost of the actually completed quantities bears to the cost of the originally estimated quantities in the proposal. Such increase in the contract time shall not consider either cost of work or the extension of contract time that has been covered by a change order or supplemental agreement. Charges against the contract time will cease as of the date of final acceptance.

If the Contractor finds it impossible for reasons beyond their own control to complete the work within the contract time as specified, or as extended in accordance with the provisions of this paragraph, the Contractor may, at any time prior to the expiration of the contract time as extended, make a written request to the Engineer for an extension of time setting forth the reasons which the Contractor believes will justify the granting of their own request. Requests for extension of time, on calendar day project, caused by inclement weather, shall be supported with National Weather Bureau data showing the actual amount of inclement weather exceeded what could normally be expected during the contract period. The Contractor's plea that insufficient time was specified is not a valid reason for extension of time. If the supporting documentation justify the work was delayed because of conditions beyond the control and without the fault of the Contractor, the Engineer may extend the time for completion by a change order that adjusts the contract time or completion date. The extended time for completion shall then be in full force and effect, the same as though it were the original time for completion.

As part of the request for contract time extension review, consideration may be given to how timely the Contractor prosecuted the work up to the point of the delays and the efforts by the Contractor to get back on schedule including the addition of labor or equipment and the extension of work hours and work days.

- 80-09 Failure to complete on time.** For each calendar day, as specified in the contract, that any work remains uncompleted after the contract time (including all extensions and adjustments as provided in paragraph 80-08 titled DETERMINATION AND EXTENSION OF CONTRACT TIME the sum specified in the contract and proposal as liquidated damages (LD) will be deducted from any money due or to become due the Contractor or their own surety. Such deducted sums shall not be deducted as a penalty but shall be considered as liquidation of a reasonable portion of damages including but not limited to additional engineering services that will be incurred by the Department should the Contractor fail to complete the work in the time provided in their contract. Should the Contractor fail to complete the work within the final contract time, the Contractor shall be liable to the Department in the amount shown in the current schedule of deductions as provided in the contract documents, not as a penalty but as liquidated damages, for each day of overrun in the final contract time.

Permitting the Contractor to continue and finish the work or any part of it after the time fixed for its completion, or after the date to which the time for completion may have been extended, will in no way operate as a waiver on the part of the Owner of any of its rights under the contract.

- 80-10 Default and termination of contract.** The Contractor shall be considered in default of their contract and such default will be considered as cause for the Department to terminate the contract for any of the following reasons, if the Contractor:

- a. Fails to begin the work under the contract within the time specified in the Notice to Proceed, or
- b. Fails to perform the work or fails to provide sufficient workers, equipment and/or materials to assure completion of work in accordance with the terms of the contract, or
- c. Performs the work unsuitably or neglects or refuses to remove materials or to perform anew such work as may be rejected as unacceptable and unsuitable, or

- d. Discontinues the prosecution of the work, or
- e. Fails to resume work which has been discontinued within a reasonable time after notice to do so, or
- f. Becomes insolvent or is declared bankrupt, or commits any act of bankruptcy or insolvency, or
- g. Allows any final judgment to stand against the Contractor unsatisfied for a period of ten (10) days, or
- h. Makes an assignment for the benefit of creditors, or
- i. For any other cause whatsoever, fails to carry on the work in an acceptable manner.

Should the Engineer consider the Contractor in default of the contract for any reason above, the Engineer shall immediately give written notice to the Contractor and the Contractor's surety as to the reasons for considering the Contractor in default and the Department's intentions to terminate the contract.

If the Contractor or surety, within a period of ten (10) days after such notice, does not proceed in accordance therewith, then the Department will, upon written notification from the Engineer of the facts of such delay, neglect, or default and the Contractor's failure to comply with such notice, have full power and authority without violating the contract, to take the execution of the work out of the hands of the Contractor. The Department may appropriate or use any or all materials and equipment that have been mobilized for use in the work and are acceptable and may enter into an agreement for the completion of said contract according to the terms and provisions thereof, or use such other methods as in the opinion of the Engineer will be required for the completion of said contract in an acceptable manner.

All costs and charges incurred by the Department, together with the cost of completing the work under contract, will be deducted from any monies due or which may become due the Contractor. If such expense is less than the sum which would have been payable under the contract, then the Contractor shall be entitled to receive the difference subject to any claims or liens thereon which may be filed with the Department or any prior assignment filed with it. If such expense exceeds the sum which would have been payable under the contract, then the Contractor and the surety shall be liable and shall pay to the Department the amount of such excess.

**80-11 Termination for national emergencies.** The Department shall terminate the contract or portion thereof by written notice when the Contractor is prevented from proceeding with the construction contract as a direct result of an Executive Order of the President with respect to the execution of war or in the interest of national defense.

When the contract, or any portion thereof, is terminated before completion of all items of work in the contract, payment will be made for the actual number of units or items of work completed at the contract price or as mutually agreed for items of work partially completed or not started. No claims or loss of anticipated profits shall be considered.

Reimbursement for organization of the work, and other overhead expenses, (when not otherwise included in the contract) and moving equipment and materials to and from the job will be considered, the intent being that an equitable settlement will be made with the Contractor.

Acceptable materials, obtained or ordered by the Contractor for the work and that are not incorporated in the work shall, at the option of the Contractor, be purchased from the Contractor at actual cost as shown by receipted bills and actual cost records at such points of delivery as may be designated by the Engineer .

Termination of the contract or a portion thereof shall neither relieve the Contractor of their responsibilities for the completed work nor shall it relieve their surety of its obligation for and concerning any just claim arising out of the work performed.

**80-12 Termination of the contractor's responsibility.** Whenever the improvement called for by the contract shall have been completely performed on the part of the Contractor and all parts of the work have been approved by the Engineer and accepted by the participating agencies according to the contract, and the final estimate paid, the Contractor's obligations shall then be considered fulfilled, except as set forth in their bond and in Section 70, paragraphs 70-12 and 70-20 titled RESPONSIBILITY FOR DAMAGE CLAIMS and NO WAIVER OF LEGAL RIGHTS respectively.

Termination of the contract or a portion thereof shall neither relieve the Contractor of their responsibilities for the completed work nor shall it relieve their surety of its obligation for and concerning any just claim arising out of the work performed.

**80-13 Work area, storage area and sequence of operations.** The Contractor shall obtain approval from the Engineer prior to beginning any work in all areas of the airport. No operating runway, taxiway, or air operations area (AOA) shall be crossed, entered, or obstructed while it is operational. The Contractor shall plan and coordinate work in accordance with the current Federal Aviation Administration Advisory Circular (AC) 150/5370-2, *Operational Safety on Airports During Construction* and the approved CSPP and SPCD.

Work performed by the Contractor outside of daylight hours shall be done under sufficient artificial area lighting to allow for proper construction methods and inspection. Lights shall consist of vehicle or moveable pole mounted floodlights and/or spotlights of sufficient number to illuminate the work area. Vehicle headlights will be allowed only in addition to other lights mentioned above. Lighting shall not interfere with air operations. Any work being performed under insufficient artificial lighting, in the Resident Engineer's judgment, shall be stopped until additional lighting is provided. All work performed during that time will not be acceptable until proper inspection and testing can be made.

**END OF SECTION 80**



## Section 90 Measurement and Payment

**90-01 Measurement of quantities.** All work completed under the contract will be measured by the Resident Engineer, or their authorized representatives, using United States Customary Units of Measurement.

The units of measure shall be English and shall correspond to the units in the contract. Metric units are generally “hard” converted and the table below lists factors for the exact English equivalents.

### English to Metric Conversions

Unit	English	Conversion Factor	Metric
Length	in	25.4	mm
	ft	0.3048	m
	mile	1.6093	km
Area	in <sup>2</sup>	645.2	sq mm <sup>2</sup>
	ft <sup>2</sup>	0.0929	sq m <sup>2</sup>
	yd <sup>2</sup>	0.8361	sq m <sup>2</sup>
	acre	0.4047	ha
Volume	in <sup>3</sup>	16387.1	cu mm
	yd <sup>3</sup>	0.764555	cu m
	gallon	3.7854	L
Mass	ounces	28.3495	g
	pounds	0.45359	kg
	Kip (10,00 lb)	0.45359	metric ton
	ton	0.9072	metric ton
Mass/Area	ounces/yd <sup>2</sup> .	0.0339057	kg/m <sup>2</sup>
	lb/ft <sup>2</sup>	4.8824	kg/m <sup>2</sup>
	lb/yd <sup>2</sup> .	0.5425	kg/m <sup>2</sup>
	lb/acre	1.1208	kg/ha
	ton/acre	2.2417	metric ton/ha
Density	lb/cu ft.	16.01894	kg/m <sup>3</sup>
	lb/yd <sup>3</sup>	0.5933	kg/m <sup>3</sup>
Force	pounds	4.44822	N
	kip	4.44822	kN
Pressure/Stress	lb/ft <sup>2</sup>	47.8803	Pa
	kip/ ft <sup>2</sup>	47.8803	kPa
	lb/in <sup>2</sup>	6894.76	Pa
	ksi	6894.76	kPa
Energy, Work	foot pound	1.35582	J
Torque	foot pound	1.35582	N m

Unit	English	Conversion Factor	Metric
Power	hp	745.7	W
Speed	miles/hour	1.6093	km/hour
Temperature	$(^{\circ}\text{F} - 32)/1.8 = ^{\circ}\text{C}$		

The method of measurement and computations to be used in determination of quantities of material furnished and of work performed under the contract will be those methods generally recognized as conforming to good engineering practice.

Unless otherwise specified, longitudinal measurements for area computations will be made horizontally, and no deductions will be made for individual fixtures (or leave-outs) having an area of nine (9) square feet or less. Unless otherwise specified, transverse measurements for area computations will be the neat dimensions shown on the plans or ordered in writing by the Engineer.

Structures will be measured according to neat lines shown on the plans or as altered to fit field conditions.

Unless otherwise specified, all contract items which are measured by the linear foot such as electrical ducts, conduits, pipe culverts, underdrains, and similar items shall be measured parallel to the base or foundation upon which such items are placed.

The term "lump sum" when used as an item of payment will mean complete payment for the work described in the contract. When a complete structure or structural unit (in effect, "lump sum" work) is specified as the unit of measurement, the unit will be construed to include all necessary fittings and accessories.

When requested by the Contractor and approved by the Engineer in writing, material specified to be measured by the cubic yard may be weighed, and such weights will be converted to cubic yards for payment purposes. Factors for conversion from weight measurement to volume measurement will be determined by the Resident Engineer and shall be agreed to by the Contractor before such method of measurement of pay quantities is used.

### Measurement and Payment Terms

Term	Description
Excavation and Embankment Volume	In computing volumes of excavation, the average end area method will be used unless otherwise specified.
Measurement and Proportion by Weight	The term "ton" will mean the short ton consisting of 2,000 pounds avoirdupois. All materials that are measured or proportioned by weights shall be weighed on accurate, independently certified scales by competent, qualified personnel at locations designated by the Resident Engineer. If material is shipped by rail, the car weight may be accepted provided that only the actual weight of material is paid for. However, car weights will not be acceptable for material to be passed through mixing plants. Trucks used to haul material being paid for by weight shall be weighed empty daily at such times as the Resident Engineer directs, and each truck shall bear a plainly legible identification mark.
Measurement by Volume	Materials to be measured by volume in the hauling vehicle shall be hauled in vehicles approved by the Engineer and measured therein at the point of delivery. Vehicles for this purpose may be of any size or type acceptable for the materials hauled, provided that the body is of such shape that the actual contents may be readily and accurately determined. All vehicles shall be loaded to at least their water level capacity, and all loads shall be leveled when the vehicles arrive at the point of delivery.

Term	Description
Asphalt Material	Asphalt materials will be measured by the gallon or ton. When measured by volume, such volumes will be measured at 60°F or will be corrected to the volume at 60°F using ASTM D1250 for asphalts. Net certified scale weights or weights based on certified volumes in the case of rail shipments will be used as a basis of measurement, subject to correction when asphalt material has been lost from the car or the distributor, wasted, or otherwise not incorporated in the work. When asphalt materials are shipped by truck or transport, net certified weights by volume, subject to correction for loss or foaming, will be used for computing quantities.
Cement	Cement will be measured by the ton or hundredweight.
Structure	Structures will be measured according to neat lines shown on the plans or as altered to fit field conditions.
Timber	Timber will be measured by the thousand feet board measure (MFBM) actually incorporated in the structure. Measurement will be based on nominal widths and thicknesses and the extreme length of each piece.
Plates and Sheets	The thickness of plates and galvanized sheet used in the manufacture of corrugated metal pipe, metal plate pipe culverts and arches, and metal cribbing will be specified and measured in decimal fraction of inch.
Miscellaneous Items	When standard manufactured items are specified such as fence, wire, plates, rolled shapes, pipe conduit, etc., and these items are identified by gauge, unit weight, section dimensions, etc., such identification will be considered to be nominal weights or dimensions. Unless more stringently controlled by tolerances in cited specifications, manufacturing tolerances established by the industries involved will be accepted.
Scales	<p>Scales must be tested for accuracy and serviced before use. Scales for weighing materials which are required to be proportioned or measured and paid for by weight shall be furnished, erected, and maintained by the Contractor, or be certified permanently installed commercial scales. Platform scales shall be installed and maintained with the platform level and rigid bulkheads at each end. Scales shall be accurate within 0.5% of the correct weight throughout the range of use. The Contractor shall have the scales checked under the observation of the Resident Engineer before beginning work and at such other times as requested. The intervals shall be uniform in spacing throughout the graduated or marked length of the beam or dial and shall not exceed 0.1% of the nominal rated capacity of the scale, but not less than one (1) pound. The use of spring balances will not be permitted.</p> <p>In the event inspection reveals the scales have been "overweighing" (indicating more than correct weight) they will be immediately adjusted. All materials received subsequent to the last previous correct weighting-accuracy test will be reduced by the percentage of error in excess of 0.5%.</p> <p>In the event inspection reveals the scales have been under-weighing (indicating less than correct weight), they shall be immediately adjusted. No additional payment to the Contractor will be allowed for materials previously weighed and recorded.</p> <p>Beams, dials, platforms, and other scale equipment shall be so arranged that the operator and the Resident Engineer can safely and conveniently view them.</p> <p>Scale installations shall have available ten (10) standard 50-pound weights for testing the weighing equipment or suitable weights and devices for other approved equipment.</p> <p>All costs in connection with furnishing, installing, certifying, testing, and maintaining scales; for furnishing check weights and scale house; and for all other items specified in the contract documents, for the weighing of materials for</p>

Term	Description
	proportioning or payment, shall be included in the unit contract prices for the various items of the project.
Rental Equipment	Rental of equipment will be measured by time in hours of actual working time and necessary traveling time of the equipment within the limits of the work. Special equipment ordered in connection with extra work will be measured as agreed in the change order or supplemental agreement authorizing such work as provided in paragraph 90-06 titled PAYMENT FOR EXTRA WORK AND FORCE ACCOUNT.
Pay Quantities	When the estimated quantities for a specific portion of the work are designated as the pay quantities in the contract, they shall be the final quantities for which payment for such specific portion of the work will be made, unless the dimensions of said portions of the work shown on the plans are revised by the Resident Engineer. When the project is constructed essentially to the lines, grades, or dimensions shown on the Plans, the Contractor and Engineer may agree in writing by use of form AER 981, <i>Agreement on Accuracy of Plan Quantities</i> that the plan quantities for specific pay items are accurate and shall be used as the final pay quantities. If so agreed, no further measurement will be required and payment will be made for the quantities shown in the contract for the various items involved unless errors are discovered after the work has begun, the Engineer revises the dimensions shown on the plans or there is any dispute regarding the accuracy of the plan quantities. If revised dimensions result in an increase or decrease in the quantities of such work, the final quantities for payment will be revised in the amount represented by the authorized (approved by change order) changes in the dimensions. If disagreement exists between the Contractor and the Resident Engineer as to the accuracy of the plan quantities, either party shall, before any work is started which would affect the measurement, have the right to request in writing and thereby cause the quantities to be measured as herein specified.

**90-02 Scope of payment.** The Contractor shall receive and accept compensation provided for in the contract as full payment for furnishing all materials, labor, tools, and equipment for performing all work contemplated and embraced under the contract in a complete and acceptable manner, and for all risk of every description connected with the execution of the work, loss, damage, or expense of whatever character incurred by or in consequence of suspension or discontinuance of such execution arising out of the nature of the work and from the action of the elements; for any unforeseen difficulties or obstructions which may arise or be encountered during the execution of the work until its final acceptance by the Department, subject to the provisions of Section 70, paragraph 70-20 titled NO WAIVER OF LEGAL RIGHTS.

When the "basis of payment" paragraph of a technical specification requires that the contract price (price bid) include compensation for certain work or material essential to the item, this same work or material will not also be measured for payment under any other contract item which may appear elsewhere in the contract, plans, or specifications.

The payment of any current estimate prior to final acceptance of the work by the Department shall in no way constitute an acknowledgement of the acceptance of the work, nor in any way prejudice or affect the obligation of the Contractor, at their expense, to repair, correct, renew, or replace any defects or imperfections in the construction of the work under contract and its appurtenances, nor any damage due or attributable to such defects, which defects, imperfections, or damage shall have been discovered on or before the final inspection and acceptance of the work. The Engineer shall be the sole judge of such defects, imperfections, or damage, and the Contractor shall be liable to the Department or Owner (Sponsor) for failure to correct the same as provided herein.

- 90-03 Compensation for altered quantities.** When the accepted quantities of work vary from the quantities in the proposal, the Contractor shall accept as payment in full, so far as contract items are concerned, payment at the original contract price for the accepted quantities of work actually completed and accepted. No allowance, except as provided for in Section 40, paragraph 40-02 titled ALTERATION OF WORK AND QUANTITIES, will be made for any increased expense, loss of expected reimbursement, or loss of anticipated profits suffered or claimed by the Contractor which results directly from such alterations or indirectly from their own unbalanced allocation of overhead and profit among the contract items, or from any other cause.
- 90-04 Increased quantities.** Payment will not be made for quantities in excess of the maximum payment percentages found in the current Illinois Department of Transportation, Bureau of Airport Engineering *Airport Construction Documentation Manual*.
- 90-05 Payment for deleted items.** As specified in Section 40, paragraph 40-03 titled DELETED ITEMS, the Engineer shall have the right to delete from the work (order nonperformance) any contract item, except major contract items, in the best interest of the Owner.
- Should the Engineer delete or order nonperformance of a contract item or portion of such item from the work, the Contractor shall accept payment in full at the contract prices for any work actually completed and acceptable prior to the Engineer's order to delete or non-perform such contract item.
- Acceptable materials ordered by the Contractor or delivered on the work prior to the date of the Engineer's order will be paid for at the actual cost to the Contractor and shall thereupon become the property of the Owner.
- In addition to the reimbursement hereinbefore provided, the Contractor shall be reimbursed for all actual costs incurred for the purpose of performing the deleted contract item prior to the date of the Engineer's order. Such additional costs incurred by the Contractor must be directly related to the deleted contract item and shall be supported by certified statements by the Contractor as to the nature the amount of such costs.
- 90-06 Payment for extra work and force account.** Extra work, performed in accordance with Section 40, paragraph 40-04 titled EXTRA WORK, will be paid for at the contract prices or agreed prices specified in the change order or supplemental agreement authorizing the extra work.
- Extra work will be paid for at either the contract price, a lump sum price or agreed unit prices, or on a force account basis.
- a. Lump sum price or agreed unit price.** When extra work is to be paid for at either a lump sum price or agreed unit prices, the lump sum or unit prices shall be agreed upon by the Contractor and Engineer.
- b. Force account basis.** When extra work is to be paid for by force account, the basis for the force account shall be as follows:
- (1) Labor.** For all labor and foremen in direct charge of the specific operations, the Contractor shall receive the actual normal rate of wage paid for each and every hour that said labor and foremen are actually engaged in such work.
- The Contractor shall receive the actual costs paid to, or in behalf of, workers by reason of subsistence and travel allowances, health and welfare benefits, pension fund benefits or other benefits, when such amounts are required by collective bargaining agreement or other employment contract generally applicable to the classes of labor employed on the work.
- An amount equal to 35% of the sum of the above items will also be paid the Contractor.
- (2) Bond, insurance and tax.** For property damage, liability and workmen's compensation insurance premiums, unemployment insurance contributions and social security taxes on the force account work the Contractor shall receive the actual cost, to which 10% will

be added. The Contractor shall furnish satisfactory evidence of the rate or rates paid for such bond, insurance and tax.

**(3) Materials.** For materials accepted by the Engineer and used, the Contractor shall receive the actual cost of such materials delivered on the work, including transportation charges paid by the Contractor (exclusive of machinery rentals as hereinafter set forth), to which cost, 15% will be added.

**(4) Equipment.** Equipment used for extra work shall be authorized by the Engineer. The equipment shall be specifically described, be of suitable size and capacity for the work to be performed and be in good operating condition. For such equipment, the Contractor will be paid as follows:

**(a) Contractor Owned Equipment.** Contractor owned equipment will be paid for by the hour using the applicable FHWA hourly rate from the "Equipment Watch Rental Rate Blue Book" (Blue Book) in effect when the force account work begins. The FHWA hourly rate is calculated as follows.

$$\text{FHWA hourly rate} = (\text{monthly rate}/176) \times (\text{model year adj.}) \times (\text{Illinois adj.}) + \text{EOC}$$

Where: EOC = Estimated Operating Costs per hour (from the Blue Book)

The time allowed will be the actual time the equipment is operating on the extra work. For the time required to move the equipment to and from the site of the extra work and any authorized idle (standby) time, payment will be made at the following hourly rate:

$$0.5 \times (\text{FHWA hourly rate} - \text{EOC})$$

All time allowed shall fall within the working hours authorized for the extra work.

The rates above include the cost of fuel, oil, lubrication, supplies, small tools, necessary attachments, repairs, overhaul and maintenance of any kind, depreciation, storage, overhead, profits, insurance, and all incidentals. The rates do not include labor.

The Contractor shall submit to the Engineer sufficient information for each piece of equipment and its attachments to enable the Engineer to determine the proper equipment category. If a rate is not established in the Blue Book for a particular piece of equipment, the Engineer will establish a rate for that piece of equipment that is consistent with its cost and use in the industry.

**(b) Rented Equipment.** Whenever it is necessary for the Contractor to rent equipment to perform extra work, the rental and transportation costs of the equipment plus 5% for overhead will be paid. In no case shall the rental rates exceed those of established distributors or equipment rental agencies.

All prices shall be agreed to in writing before the equipment is used.

**(5) Miscellaneous.** No additional allowance will be made for general superintendence, the use of small tools, or other costs for which no specific allowance is herein provided.

**(6) Statements.** No payment will be made for work performed on a force account basis until the Contractor has furnished the Engineer with itemized statements of the cost of such force account work. Statements shall be accompanied and supported by invoices for all materials used and transportation charges. However, if materials used on the force account work are not specifically purchased for such work but are taken from the Contractor's stock, then in lieu of the invoices, the Contractor shall furnish an affidavit certifying that such materials were taken from their stock, that the quantity claimed was actually used, and that the price and transportation claimed represent the actual cost to the Contractor.

- (a) Name, classification, date, daily hours, total hours, rate, and extension for each laborer and foreman. Payrolls shall be submitted to substantiate actual wages paid if so requested by the Engineer.
  - (b) Designation, dates, daily hours, total hours, rental rate, and extension for each unit of machinery and equipment.
  - (c) Quantities of materials, prices and extensions.
  - (d) Transportation of materials.
  - (e) Cost of property damage, liability and workmen's compensation insurance premiums, unemployment insurance contributions, and social security tax.
- (7) **Work Performed by an Approved Subcontractor.** When extra work is performed by an approved subcontractor, the Contractor shall receive, as administrative costs, an amount equal to 5% of the total approved costs of such work with the minimum payment being 100 dollars.
- (8) All statements of the cost of force account work shall be furnished to the Engineer not later than 60 days after receipt of form AER 635, *Extra Work Daily Report*. If the statement is not received within the specified time frame, all demands for payment for the extra work are waived and the Department is released from any and all such demands. It is the responsibility of the Contractor to ensure that all statements are received within the specified time regardless of the manner or method of delivery.

**90-07 Partial payments.** Partial payments will be made to the Contractor at least twice each month as the work progresses and/or when construction progress warrants. The Department shall prepare a construction progress payment (CPP). Said payments will be based upon weekly construction reports, prepared by the Resident Engineer, of the value of the work performed and materials complete and in place, in accordance with the contract, plans, and specifications. This CPP will be computed for the amount of the value of the work completed since the previous CPP. Such partial payments may also include the delivered actual cost of those materials stockpiled and stored in accordance with paragraph 90-08 titled PAYMENT FOR MATERIALS ON HAND. No partial payment will be made when the amount due to the Contractor since the last estimate amounts to less than 500 dollars.

Retainage for each CPP to the Contractor shall be calculated as follows:

- a. For the first 50% of the total contract value, an amount of 10% of the value of the completed work shall be retained from the Contractor until after completion of the entire final contract and to the satisfaction of the Department.
- b. After more than 50% of the total contract value is completed, the Department may, at its discretion, certify the remaining partial payments be made to the Contractor without further retainage, provided that satisfactory progress is being made, and provided that the total retained amount is not less than 5% of the total adjusted contract value.
- c. At the discretion of the Department and with the consent of the surety, a semi-final CPP may be made when the principal contract payment items have been satisfactorily completed. In no event shall the amount retained from the Contractor after making the semi-final payment be less than 1% of the adjusted contract value, nor less than 500 dollars.
- d. Should the Contractor exercise their option, as provided in the paragraph 90-09 titled TRUST AGREEMENT OPTION of this section, no such percent retainage shall be deducted.

Regardless of retainage withheld, the Contractor is required to pay all subcontractors in full for satisfactory performance of their contracts no later than 30 days after the Contractor has received a partial payment. The Department must ensure prompt and full payment of retainage from the prime Contractor to the subcontractor within 30 days after the subcontractor's work is satisfactorily completed. A subcontractor's work is satisfactorily completed when all the tasks

called for in the subcontract have been accomplished and documented as required by the Department. When the Department has made an incremental acceptance of a portion of a prime contract, the work of a subcontractor covered by that acceptance is deemed to be satisfactorily completed.

If, upon delivery of any of the materials, the Contractor fails to supply documentation meeting the requirements of the current Illinois Department of Transportation, Bureau of Airport Engineering Manual for Documentation of Airport Materials, the Department shall not include payment for that material on a Contractor Progress Payment report until such statements have been furnished. Copies of the latest revision of the Bureau of Airport Engineering Manual for Documentation of Airport Materials may be obtained by contacting the Department. Copies are also available on the internet at the Illinois Department of Transportation's website.

It is understood and agreed that the Contractor shall not be entitled to demand or receive partial payment based on quantities of work in excess of those provided in the proposal or covered by approved change orders or supplemental agreements, except when such excess quantities have been determined by the Engineer to be a part of the final quantity for the item of work in question.

No partial payment shall bind the Department to the acceptance of any materials or work in place as to quality or quantity. All partial payments are subject to correction at the time of final payment as provided in paragraph 90-10 titled ACCEPTANCE AND FINAL PAYMENT.

The Contractor shall deliver to the Department a complete release of all claims for labor and material arising out of this contract before the final payment is made. If any subcontractor or supplier fails to furnish such a release in full, the Contractor may furnish a bond or other collateral satisfactory to the Department to indemnify the Department against any potential lien or other such claim. The bond or collateral shall include all costs, expenses, and attorney fees the Department may be compelled to pay in discharging any such lien or claim.

**90-08 Payment for materials on hand.** A payment may, at the discretion of the Department and upon presentation of receipted bills and freight bills, be made for the value of acceptable reinforcing steel, structural steel, stone, gravel, sand, or other nonperishable materials delivered on the work or in acceptable storage places and not used at the time of such payment, provided that such materials meet the requirements of the contract, plans, and specifications and are delivered to acceptable sites on the airport property or at other sites in the vicinity that are acceptable to the Department. Such materials, when so paid for by the Department, shall become the property of the Department, and in the event of default on the part of the Contractor, the Department may use or cause to be used such materials in the construction of the work provided for in the contract. The value of stored or stockpiled items shall be reduced on progress payments as the stockpiled items are used in the work.

Such delivered costs of stored or stockpiled materials may be included in a separate progress payment or be included in the next partial payment after the following conditions are met:

- a. The material has been stored or stockpiled in a manner acceptable to the Engineer at or on an approved site.
- b. The Contractor has furnished the Engineer with acceptable evidence of the quantity and quality of such stored or stockpiled materials.
- c. The Contractor has furnished the Engineer with satisfactory evidence that the material and transportation costs have been paid.
- d. The Contractor has furnished the Engineer legal title (free of liens or encumbrances of any kind) to the material stored or stockpiled.
- e. The Contractor has furnished the Engineer evidence that the material stored or stockpiled is insured against loss by damage to or disappearance of such materials at any time prior to use in the work.



It is understood and agreed that the Contractor is solely responsible for all materials stored or stockpiled.

It is understood and agreed that the transfer of title and the Department's payment for such stored or stockpiled materials shall in no way relieve the Contractor of their responsibility for furnishing and placing such materials in accordance with the requirements of the contract, plans, and specifications.

In no case will the amount of partial payments for materials on hand exceed the contract price for such materials or the contract price for the contract item in which the material is intended to be used.

No partial payment will be made for stored or stockpiled living or perishable plant materials.

The Contractor shall bear all costs associated with the partial payment of stored or stockpiled materials in accordance with the provisions of this paragraph.

**90-09 Trust agreement option.** When the awarding authority is the State of Illinois and at the request of a Contractor the amounts to be paid to the Contractor, including the amounts to be retained from the Contractor as set forth in paragraph 90-07 titled PARTIAL PAYMENTS of this section, may be deposited under the Department's Trust Agreement with an Illinois financial institution of the Contractor's choice. The Contractor shall receive any interest thereon. The Trust Agreement contains, as a minimum, the following provisions:

- a. The terms and conditions for depositing the retainage, holding the retainage in trust and the final disbursement of the retainage;
- b. The return or repayment of retainage upon demand made by the Department;
- c. The types of investments the financial institution may make with the retainage;
- d. The terms and conditions of the return or repayment of retainage in case of default of the Contractor;
- e. The Department's right to withhold progress payments on account of lien claims, liquidated damages, or as otherwise provided by the contract.
- f. The Contractor's responsibilities for obtaining the written consent of the financial institution, and any costs or service fees for administering the Trust Agreement shall be borne by the Contractor;
- g. The termination of the Trust Agreement upon completion of the contract.

**90-10 Acceptance and final payment.** When the contract work has been accepted in accordance with the requirements of Section 50, paragraph 50-14 titled FINAL ACCEPTANCE, and all parts of the work have been approved by the Department, a final construction payment showing the value of the work, will be prepared by the Department as soon as the necessary measurements and computations can be made, all prior CPP's upon which payments have been made being approximate only and subject to correction in the final payment. The amount of the final payment will be the final adjusted contract value, less all previous payments and less any sums that have been deducted or retained by virtue of liquidated damages or otherwise under the provisions of the contract. The final payment will be paid to the Contractor as soon as practicable after the final approval of work, provided the Contractor has furnished to the Department satisfactory evidence that all sums of money due for any labor, materials, apparatus, fixtures, or machinery furnished for the purpose of the contract have been paid or that the person or persons to whom the same may be due have consented to such final payment.

The Contractor and the Engineer shall resolve all disputes (if any) in the measurement and computation of final quantities to be paid within 30 calendar days of the Contractor's receipt of the Engineer's final estimate. If, after such 30 day period, a dispute still exists, the Contractor may approve the Engineer's estimate under protest of the quantities in dispute, and such

disputed quantities shall be considered by the Department as a claim in accordance with Section 50, paragraph 50-15, CLAIMS FOR ADJUSTMENT AND DISPUTES.

After the Contractor has approved, or approved under protest, the Engineer's final estimate, and after the Engineer's receipt of the project closeout documentation required in paragraph 90-12 titled CONTRACTOR FINAL PROJECT DOCUMENTATION, final payment will be processed based on the entire sum, or the undisputed sum in case of approval under protest, determined to be due the Contractor less all previous payments and all amounts to be deducted under the provisions of the contract. All prior partial estimates and payments shall be subject to correction in the final estimate and payment.

If the Contractor has filed a claim for additional compensation under the provisions of Section 50, paragraph 50-15 titled CLAIMS FOR ADJUSTMENTS AND DISPUTES, or under the provisions of this paragraph, such claims will be considered by the Department in accordance with local laws or ordinances. Upon final adjudication of such claims, any additional payment determined to be due the Contractor will be paid pursuant to a supplemental final estimate.

**90-11 Construction warranty.**

- a. In addition to any other warranties in this contract, the Contractor warrants that work performed under this contract conforms to the contract requirements and is free of any defect in equipment, material, workmanship, or design furnished, or performed by the Contractor or any subcontractor or supplier at any tier.
- b. This warranty shall continue for a period of one (1) year from the date of final acceptance of the work, except as noted. If the Department takes possession of any part of the work before final acceptance, this warranty shall continue for a period of one (1) year from the date the Department takes possession. However, this will not relieve the Contractor from corrective items required by the final acceptance of the project work. Light Emitting Diode emitting diode (LED) light fixtures with the exception of obstruction lighting, must be warranted by the manufacturer for a minimum of four (4) years after date of installation inclusive of all electronics.
- c. The Contractor shall remedy at the Contractor's expense any failure to conform, or any defect. In addition, the Contractor shall remedy at the Contractor's expense any damage to Owner real or personal property, when that damage is the result of the Contractor's failure to conform to contract requirements; or any defect of equipment, material, workmanship, or design furnished by the Contractor.
- d. The Contractor shall restore any work damaged in fulfilling the terms and conditions of this clause. The Contractor's warranty with respect to work repaired or replaced will run for one (1) year from the date of repair or replacement.
- e. The Department will notify the Contractor, in writing, within seven (7) days after the discovery of any failure, defect, or damage.
- f. If the Contractor fails to remedy any failure, defect, or damage within 14 days after receipt of notice, the Department shall have the right to replace, repair, or otherwise remedy the failure, defect, or damage at the Contractor's expense.
- g. With respect to all warranties, express or implied, from subcontractors, manufacturers, or suppliers for work performed and materials furnished under this contract, the Contractor shall: (1) Obtain all warranties that would be given in normal commercial practice; (2) Require all warranties to be executed, in writing, for the benefit of the Department, as directed by the Department, and (3) Enforce all warranties for the benefit of the Department.
- h. This warranty shall not limit the Department's rights with respect to latent defects, gross mistakes, or fraud.

- 90-12 Contractor final project documentation.** Approval of final payment to the Contractor is contingent upon completion and submittal of the items required by the Department. The final payment will not be approved until the Engineer approves the Contractor's final submittal.

**END OF SECTION 90**

## Part 2 – General Construction Items

### Item 100 Contractor Quality Control Program (CQCP)

**100-01 General.** Quality is more than test results. Quality is the combination of proper materials, testing, workmanship, equipment, inspection, and documentation of the project. Establishing and maintaining a culture of quality is key to achieving a quality project. The Contractor shall establish, provide, and maintain an effective Contractor Quality Control Program (CQCP) that details the methods and procedures that will be taken to assure that all materials and completed construction required by this contract conform to contract plans, technical specifications and other requirements, whether manufactured by the Contractor, or procured from subcontractors or vendors. Although guidelines are established and certain minimum requirements are specified here and elsewhere in the contract technical specifications, the Contractor shall assume full responsibility for accomplishing the stated purpose.

The Contractor shall establish a CQCP that will:

- a. Provide qualified personnel to develop and implement the CQCP.
- b. Provide for the production of acceptable quality materials.
- c. Provide sufficient information to assure that the specification requirements can be met.
- d. Document the CQCP process.

The Contractor shall not begin any construction or production of materials to be incorporated into the completed work until the CQCP has been reviewed and approved by the Engineer. No partial payment will be made for materials subject to specific quality control (QC) requirements until the CQCP has been reviewed and approved.

The QC requirements contained in this section and elsewhere in the contract technical specifications are in addition to and separate from the quality assurance (QA) testing requirements. QA testing requirements are the responsibility of the Engineer or Contractor as specified in the specifications.

A Quality Control (QC)/Quality Assurance (QA) workshop with the Engineer, Resident Engineer, Contractor, subcontractors, and testing laboratories, must be held prior to start of construction. The workshop shall address QC and QA requirements of the project specifications. The QC/QA workshop will be facilitated by the Contractor. The Contractor shall coordinate with the Department and the Resident Engineer on time and location of the QC/QA workshop. Items to be addressed, at a minimum, will include:

- a. Review of the CQCP including submittals, QC Testing, Action & Suspension Limits for Production, Corrective Action Plans, Distribution of QC reports, and Control Charts.
- b. Discussion of the QA program.
- c. Discussion of the QC and QA Organization and authority including coordination and information exchange between QC and QA.
- d. Establish regular meetings to discuss control of materials, methods and testing.
- e. Establishment of the overall QC culture.

**100-02 Description of program.**

- a. General description.** The Contractor shall establish a CQCP to perform QC inspection and testing of all items of work required by the technical specifications, including those performed by subcontractors. The CQCP shall ensure conformance to applicable specifications and plans with respect to materials, off-site fabrication, workmanship, construction, finish, and functional performance. The CQCP shall be effective for control of all construction work performed under this Contract and shall specifically include surveillance and tests required by the technical specifications, in addition to other requirements of this section and any other activities deemed necessary by the Contractor to establish an effective level of QC.
- b. Contractor quality control program (CQCP).** The Contractor shall describe the CQCP in a written document that shall be reviewed and approved by the Engineer prior to the start of any production, construction, or off-site fabrication. The written CQCP shall be submitted to the Engineer for review and approval at least ten (10) calendar days before the CQCP Workshop. The Contractor's CQCP and QC testing laboratory must be approved in writing by the Engineer prior to the Notice to Proceed (NTP).

The CQCP shall be organized to address, as a minimum, the following:

- (1) QC organization and resumes of key staff
- (2) Project progress schedule
- (3) Submittals schedule
- (4) Inspection requirements
- (5) QC testing plan
- (6) Documentation of QC activities and distribution of QC reports
- (7) Requirements for corrective action when QC and/or QA acceptance criteria are not met
- (8) Material quality and construction means and methods. Address all elements applicable to the project that affect the quality of the pavement structure including subgrade, subbase, base, and surface course. Some elements that must be addressed include, but is not limited to mix design, aggregate grading, quality of materials, stockpile management, proportioning, mixing and transporting, placing and finishing, joints, dowel and tie-bar placement and alignment, compaction and/or consolidation, quality control testing and inspection, smoothness, flexural or compressive strength, finishing and curing, laydown plan, equipment, and temperature management plan.

The Contractor must add any additional elements to the CQCP that is necessary to adequately control all production and/or construction processes required by this contract.

**100-03 CQCP organization.** The CQCP shall be implemented by the establishment of a QC organization. An organizational chart shall be developed to show all QC personnel, their authority, and how these personnel integrate with other management/production and construction functions and personnel.

The organizational chart shall identify all QC staff by name and function, and shall indicate the total staff required to implement all elements of the CQCP, including inspection and testing for each item of work. If necessary, different technicians can be used for specific inspection and testing functions for different items of work. If an outside organization or independent testing laboratory is used for implementation of all or part of the CQCP, the personnel assigned shall be subject to the qualification requirements specified in the contract documents. The organizational chart shall indicate which personnel are Contractor employees and which are provided by an outside organization.

The QC organization shall, as a minimum, consist of the following personnel:

- a. Program administrator.** The Contractor Quality Control Program Administrator (CQCPA) must be a full-time employee of the Contractor, or a consultant engaged by the Contractor. The CQCPA must have a minimum of five (5) years of experience in airport and/or highway QC pavement construction with prior QC experience on a project of comparable size and scope as the contract.

Included in the five (5) years of paving/QC experience, the CQCPA must have successfully completed the Level III Department Quality Management Training Program classes.

The CQCPA must have full authority to institute any and all actions necessary for the successful implementation of the CQCP to ensure compliance with the contract plans and technical specifications. The CQCPA authority must include the ability to immediately stop production until materials and/or processes are in compliance with contract specifications. The CQCPA must report directly to a principal officer of the construction firm. The CQCPA may supervise the Quality Control Program on more than one (1) project provided that person can be at the job site within two (2) hours after being notified of a problem.

- b. QC technicians.** A sufficient number of QC technicians necessary to adequately implement the CQCP must be provided. These personnel must be either Engineers, engineering technicians, or experienced craftsman with demonstrated and documented capability to perform the applicable inspection and testing. The minimum requirement for aggregate, hot-mix asphalt or Portland cement concrete testing is successful completion of the prescribed Department Quality Management Training Program classes and of minimum of two (2) years of experience in their area of expertise.

The QC technicians must report directly to the CQCPA and shall perform the following functions:

- (1) Inspection of all materials, construction, plant, and equipment for conformance to the technical specifications, and as required by paragraph 100-06 titled INSPECTION REQUIREMENTS.
- (2) Performance of all QC tests as required by the technical specifications and paragraph 100-08 titled QC TESTING PLAN.
- (3) Performance of tests for the Engineer when required by the technical specifications.

- c. Staffing levels.** The Contractor shall provide sufficient qualified QC personnel to monitor each work activity at all times. Where material is being produced in a plant for incorporation into the work, separate plant and field technicians shall be provided at each plant and field placement location. The scheduling and coordinating of all inspection and testing must match the type and pace of work activity. The CQCP shall state where different technicians will be required for different work elements.

**100-04 Project progress schedule.** Critical QC activities must be shown on the project schedule as required by Section 80, paragraph 80-03 titled PROSECUTION AND PROGRESS.

**100-05 Submittals schedule.** The Contractor shall submit a detailed listing of all submittals (for example, mix designs, material certifications) and shop drawings required by the technical specifications and any other material related submittals required by the Engineer. The listing can be developed in a spreadsheet format and shall include as a minimum:

- a. Specification item number
- b. Item description
- c. Description of submittal
- d. Specification paragraph requiring submittal
- e. Scheduled date of submittal

**100-06 Inspection requirements.** QC inspection functions shall be organized to provide inspections for all definable features of work, as detailed below. All inspections shall be documented by the Contractor as specified by paragraph 100-09 titled DOCUMENTATION.

Inspections shall be performed as needed to ensure continuing compliance with contract requirements until completion of the particular feature of work. Inspections shall include the following minimum requirements:

- a. During plant operation for material production, QC test results and periodic inspections shall be used to ensure the quality of aggregates and other mix components, and to adjust and control mix proportioning to meet the approved mix design and other requirements of the technical specifications. All equipment used in proportioning and mixing shall be inspected to ensure its proper operating condition. The CQCP shall detail how these and other QC functions will be accomplished and used.
- b. During field operations, QC test results and periodic inspections shall be used to ensure the quality of all materials and workmanship. All equipment used in placing, finishing, and compacting shall be inspected to ensure its proper operating condition and to ensure that all such operations are in conformance to the technical specifications and are within the plan dimensions, lines, grades, and tolerances specified. The CQCP shall document how these and other QC functions will be accomplished and used.

**100-07 Contractor QC testing facility.**

- a. For projects that include Item 401 titled ASPHALT MIX PAVEMENT SURFACE COURSE, Item 402 titled POROUS FRICTION COURSE, Item 403 titled ASPHALT MIX PAVEMENT BASE COURSE, and Item 404 titled FUEL-RESISTANT ASPHALT MIX PAVEMENT SURFACE COURSE, the Contractor shall ensure facilities, including all necessary equipment, materials, and current reference standards, are provided that meet requirements in the following paragraphs of the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 6-08, *Minimum Private Laboratory Requirements for Construction Materials Testing or Mix Design*.
- b. For projects that include Item 501 titled CEMENT CONCRETE PAVEMENT, the Contractor shall ensure facilities, including all necessary equipment, materials, and current reference standards, are provided that meet requirements of American Association of State Highway and Transportation Officials (AASHTO) Materials Reference Laboratory (AMRL)

**100-08 QC testing plan.** As a part of the overall CQCP, the Contractor shall implement a QC testing plan, as required by the technical specifications. The testing plan shall include the minimum tests and test frequencies required by each technical specification Item, as well as any additional QC tests that the Contractor deems necessary to adequately control production and/or construction processes.

The QC testing plan can be developed in a spreadsheet fashion and shall, as a minimum, include the following:

- a. Specification item number (e.g., Item 401)
- b. Item description (e.g., Mix Asphalt Pavements)
- c. Test type (e.g., gradation, grade, asphalt content)
- d. Test standard (e.g., ASTM or American Association of State Highway and Transportation Officials (AASHTO) test number, as applicable)
- e. Test frequency (e.g., as required by technical specifications or minimum frequency when requirements are not stated)
- f. Responsibility (e.g., plant technician)
- g. Control requirements (e.g., target, permissible deviations)

All QC test results shall be documented by the Contractor as required by paragraph 100-09 titled DOCUMENTATION.

**100-09 Documentation.** The Contractor shall maintain current QC records of all inspections and tests performed. These records shall include factual evidence that the required QC inspections or tests have been performed, including type and number of inspections or tests involved; results of inspections or tests; nature of defects, deviations, causes for rejection, etc.; proposed remedial action; and corrective actions taken.

These records must cover both conforming and defective or deficient features, and must include a statement that all supplies and materials incorporated in the work are in full compliance with the terms of the contract. Legible copies of these records shall be furnished to the Resident Engineer daily. The records shall cover all work placed subsequent to the previously furnished records and shall be verified and signed by the CQCPA.

Contractor QC records required for the contract shall include, but are not necessarily limited to, the following records:

**a. Daily inspection reports.** Each Contractor QC technician shall maintain a daily log of all inspections performed for both Contractor and subcontractor operations. These technician's daily reports shall provide factual evidence that continuous QC inspections have been performed and shall, as a minimum, include the following:

- (1) Technical specification item number and description
- (2) Compliance with approved submittals
- (3) Proper storage of materials and equipment
- (4) Proper operation of all equipment
- (5) Adherence to plans and technical specifications
- (6) Summary of any necessary corrective actions
- (7) Safety inspection.
- (8) Photographs and/or video

The daily inspection reports shall identify all QC inspections and QC tests conducted, results of inspections, location and nature of defects found, causes for rejection, and remedial or corrective actions taken or proposed.

The daily inspection reports shall be signed by the responsible QC technician and the CQCPA. The Engineer shall be provided at least one (1) copy of each daily inspection report on the work day following the day of record. When QC inspection and test results are recorded and transmitted electronically, the results must be archived.

**b. Daily test reports.** The Contractor shall be responsible for establishing a system that will record all QC test results. Daily test reports shall document the following information:

- (1) Technical specification item number and description
- (2) Test designation
- (3) Location
- (4) Date of test
- (5) Control requirements
- (6) Test results
- (7) Causes for rejection
- (8) Recommended remedial actions



**(9) Retests**

Test results from each day's work period shall be submitted to the Engineer prior to the start of the next day's work period. When required by the technical specifications, the Contractor shall maintain statistical QC charts. When QC daily test results are recorded and transmitted electronically, the results must be archived.

- 100-10 Corrective action requirements.** The CQCP shall indicate the appropriate action to be taken when a process is deemed, or believed, to be out of control (out of tolerance) and detail what action will be taken to bring the process into control. The requirements for corrective action shall include both general requirements for operation of the CQCP as a whole, and for individual items of work contained in the technical specifications.

The CQCP shall detail how the results of QC inspections and tests will be used for determining the need for corrective action and shall contain clear rules to gauge when a process is out of control and the type of correction to be taken to regain process control.

When applicable or required by the technical specifications, the Contractor shall establish and use statistical QC charts for individual QC tests. The requirements for corrective action shall be linked to the control charts.

- 100-11 Observations by the Resident Engineer.** All items of material and equipment are subject to observation by the Resident Engineer at the point of production, manufacture or shipment to determine if the Contractor, producer, manufacturer or shipper maintains an adequate QC system in conformance with the requirements detailed here and the applicable technical specifications and plans. In addition, all items of materials, equipment and work in place shall be subject to observation by the Resident Engineer at the site for the same purpose.

Observations by the Resident Engineer does not relieve the Contractor of performing QC inspections of, either on-site or off-site, Contractor's or subcontractor's work.

**100-12 Noncompliance.**

- a. The Engineer will provide written notice to the Contractor of any noncompliance with their CQCP. After receipt of such notice, the Contractor must take corrective action.
- b. When QC activities do not comply with either the CQCP or the contract provisions or when the Contractor fails to properly operate and maintain an effective CQCP, and no effective corrective actions have been taken after notification of non-compliance, the Engineer will recommend the Department take the following actions:
- (1) Order the Contractor to replace ineffective or unqualified QC personnel or subcontractors and/or
  - (2) Order the Contractor to stop operations until appropriate corrective actions are taken.

**REFERENCES**

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

**American Association of State Highway and Transportation Officials (AASHTO)**

AMRL	AASHTO Materials Reference Laboratory
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**Illinois Department of Transportation, Bureau of Materials Policy Memoranda (PM)**

PM 6-08	Minimum Private Laboratory Requirement for Construction Materials Testing or Mix Design
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**Illinois Department of Transportation, Quality Management Training Program**

CET 020	Mixture Aggregate Technician
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CET 021	Aggregate Technician
CET 023	Hot Mix Asphalt Level II
CET 024	Portland Cement Concrete Level II Technician
CET 026	Nuclear Density
CET 027	Mixture Aggregate Technician Upgrade
CET 029	Hot Mix Asphalt Level I
CET 030	Portland Cement Concrete Level I
CET 031	Hot Mix Asphalt Level III
CET 039	Portland Cement Concrete Level III

**END OF ITEM 100**

## Item 102 Temporary Air and Water Pollution, Soil Erosion, and Siltation Control

### DESCRIPTION

- 102-1.1** This item shall consist of temporary control measures as specified in the contract documents or as ordered by the Resident Engineer during the life of a contract to control pollution of air and water, soil erosion, and siltation through the use of silt fences, berms, dikes, dams, sediment basins, fiber mats, gravel, mulches, grasses, slope drains, and other erosion control devices or methods.

Temporary erosion control shall be in accordance with the approved erosion control plan; the approved construction safety and phasing plan (CSPP) and the current Federal Aviation Administration Advisory Circular (AC) 150/5370-2, Operational Safety on Airports During Construction. The temporary erosion control measures contained herein shall be coordinated with the permanent erosion control measures specified as part of this contract to the extent practical to assure economical, effective, and continuous erosion control throughout the construction period.

Temporary control may include work outside the construction limits such as borrow pit operations, equipment and material storage sites, waste areas, and temporary plant sites.

Temporary control measures shall be designed, installed and maintained to minimize the creation of wildlife attractants that have the potential to attract hazardous wildlife on or near public-use airports.

As part of this item, the Contractor shall be required to comply with the requirements of the National Pollutant Discharge Elimination System (NPDES) Storm Water Permit for construction site activities.

Information on the above-referenced permits may be obtained from:

Illinois Environmental Protection Agency  
Division of Water Pollution Control  
1021 North Grand Avenue East  
Springfield, Illinois 62702

- 102-1.2** This item shall consist of furnishing, transporting, and placing a protective course of stone, minimum 12 inches depth, laid as riprap on separation fabric in the areas specified in the contract documents.
- 102-1.3** This item shall consist of placing a separation fabric on a prepared subgrade prior to the placement of riprap as specified in the contract documents.

### MATERIALS

- 102-2.1 Grass.** Grass that will not compete with the grasses sown later for permanent cover per Item 901 titled SEEDING shall be a quick-growing species (such as ryegrass, Italian ryegrass, or cereal grasses) suitable to the area providing a temporary cover. Selected grass species shall not create a wildlife attractant.
- 102-2.2 Mulches.** Mulches may be hay, straw, fiber mats, netting, bark, wood chips, or other suitable material reasonably clean and free of noxious weeds and deleterious materials per Item 908 titled MULCHING. Mulches shall not create a wildlife attractant.

- 102-2.3 Fertilizer.** Fertilizer shall be a standard commercial grade and shall conform to all federal and state regulations and to the standards of the Association of Official Agricultural Chemists.
- 102-2.4 Slope drains.** Slope drains may be constructed of pipe, fiber mats, rubble, concrete, asphalt, or other materials that will adequately control erosion.
- 102-2.5 Silt fence.** Silt fence shall consist of polymeric filaments which are formed into a stable network such that filaments retain their relative positions. Synthetic filter fabric shall contain ultraviolet ray inhibitors and stabilizers to provide a minimum of six (6) months of expected usable construction life. Silt fence shall meet the requirements of AASHTO M 288.
- 102-2.6 Bale stakes.** Shall be four (4) feet minimum length each and be either of sound wood 1" square (minimum) or #4 rebar.
- 102-2.7 Hay or straw bales.** Bales shall be either hay or straw, approved by the Resident Engineer, compacted and adequately bound by wire to the approximate size of 12 inches by 18 inches by 36 inches. The Contractor is responsible for following current Environmental Protection Agency standards to obtain acceptance for a National Pollutant Discharge Elimination System (NPDES) permit. The Contractor is responsible for any changes to the materials in order to approve the permit.
- 102-2.8 Temporary ditch checks.** Temporary ditch checks shall be constructed with products from the Department's approved list, rolled excelsior or with aggregate placed on filter fabric when specified.
- 102-2.9 Inlet and pipe protection.** The protection shall be constructed with hay or straw bales, silt filter fence or inlet filters.
- 102-2.10 Riprap.** The material shall be stone, quarried from undisturbed, consolidated deposits (ledges) of rock reasonably free of shale and shaly stone. The ledges shall be sufficiently thick to produce the desired dimensions. The stone shall be reasonably free of laminations, seams, cracks, and other structural defects or imperfections tending to destroy its resistance to weather. Field stone or boulders will not be accepted.
- a. Quality.** The material shall be quarried from ledges meeting the quality designations listed in the following table.

#### Coarse Aggregate Quality

Quality Test	Quality A <sup>1,2,3</sup>	Quality B <sup>1</sup>
Na <sub>2</sub> SO <sub>4</sub> Soundness 5 Cycle, Illinois Modified AASHTO T 104 <sup>1</sup> , % Loss max.	15	25

1. Elongated pieces (length is greater than five (5) times the average thickness) shall not exceed 10% by weight.
  2. The stone, when checked in a full gradation product, shall have a specific gravity (dry) greater than 2.450, as determined by the Department.
  3. The stone shall be reasonably free of chert.
- b. Gradation requirements.** The material shall meet the gradation limits listed in the following table. All gradations produced shall be well graded.

### Erosion Protection and Sediment Control Gradations

Percentage passing (lb)	Gradation				
	RR 3	RR 4	RR 5	RR 6	RR 7
1000 <sup>1</sup>					100
600 <sup>1</sup>				100	
400 <sup>1</sup>			100		
300					50±20
170				50±20	
150 <sup>1</sup>		100			
90			50±20		
50 <sup>1</sup>	100				
40		50±20			
12					8±8
10	50±20				
6				8±8	
3			8±8		
1	8±8	8±8			

1. A maximum of 15% of the total test sample by weight may be oversize material. Each oversize piece shall not exceed the maximum size of the gradation by more than 20%.

**102-2.11 Filter fabric.** The filter fabric shall consist of woven yarns or nonwoven filaments formed from a plastic yarn of polyolefins or polyesters. Woven fabrics shall be Class 3 for riprap gradations RR 4 and RR 5, and Class 2 for RR 6 and RR 7 according to AASHTO M 288. Woven slit film geotextiles (i.e. geotextiles made from yarns of a flat, tape-like character) shall not be permitted. Nonwoven fabrics shall be Class 2 for riprap gradations RR 4 and RR 5, and Class 1 for RR 6 and RR7 according to AASHTO M 288. After forming, the fabric shall be processed so that the yarns or filaments retain their relative positions with respect to each other. The fabric shall be free of defects or flaws which significantly affect its physical and/or filtering properties.

The filter fabric shall be formed in widths of not less than six (6) feet. Sheets of fabric may be sewn together with thread of a material meeting the chemical requirements given for the yarns or filaments to form fabric widths as required. The sheets of filter fabric shall be sewn together at the point of manufacture or another approved location.

The filter fabric shall be according to the following.

PHYSICAL PROPERTIES <sup>1</sup>				
	Gradation Nos. RR4 & RR5		Gradation Nos. RR 6 & RR 7	
	Woven	Nonwoven	Woven	Nonwoven
Grab Strength, lb ASTM D 4632 <sup>2</sup>	180 min.	157 min.	247 min.	202 min.
Elongation/Grab Strain, % ASTM D 4632 <sup>2</sup>	49 max.	50 min.	49 max.	50 min.
Trapezoidal Tear Strength, lb ASTM D 4533 <sup>2</sup>	67 min.	56 min.	90 min.	79 min.

PHYSICAL PROPERTIES <sup>1</sup>				
	Gradation Nos. RR4 & RR5		Gradation Nos. RR 6 & RR 7	
	Woven	Nonwoven	Woven	Nonwoven
Puncture Strength, lb ASTM D 6241 <sup>2</sup>	370 min.	309 min.	494 min.	43 min.
Ultraviolet Stability, % retained strength after 500 hours of exposure ASTM D 4355	50 min.			

1. NTPEP results (manufacturer's QC test values) to meet test requirements. Manufacturer shall have public release status and current reports on laboratory results in Test Data of NTPEP's DataMine.
2. Values represent the minimum average roll value (MARV) in the weaker principle direction [machine direction (MD) or cross-machine directions (XD)].

As determined by the Engineer, the filter fabric shall meet the requirements noted in the following after an onsite investigation of the soil to be protected.

Soil by Weight (Mass) Passing the No. 200 Sieve, %	Apparent Opening Size, Sieve No., ASTM D 4751 <sup>1</sup>	Permittivity, sec <sup>-1</sup> ASTM D 4491
49 max.	60 max.	0.2 min.
50 min.	70 max.	0.1 min.

1. Values represent the maximum average roll value.

**102-2.12 Other.** All other materials shall meet commercial grade standards and shall be approved by the Engineer before being incorporated into the project.

### CONSTRUCTION REQUIREMENTS

**102-3.1 General.** In the event of conflict between these requirements and pollution control laws, rules, or regulations of other federal, state, or local agencies, the more restrictive laws, rules, or regulations shall apply.

The Resident Engineer shall be responsible for assuring compliance to the extent that construction practices, construction operations, and construction work are involved.

The Contractor shall conduct their construction operations in accordance with the latest revision of the Illinois Environmental Protection Agency publication, *Standards and Specifications for Soil Erosion and Sediment Control*.

Erosion control must be considered by the Contractor prior to exposing any erodible material. Erosion protection for Contractor-furnished borrow pits, equipment storage sites, plant sites and haul roads shall be provided by the Contractor.

The Contractor has the responsibility to limit the surface area of erodible earth material exposed by clearing and grubbing, excavation, borrow and embankment operations and to provide immediate permanent or temporary pollution control measures. Cut slopes shall be permanently

seeded and mulched as the excavation proceeds to the extent considered desirable and practical.

Slopes that erode easily shall be temporarily seeded as the work progresses with a cereal grain of wheat, rye or oats obtained from a local supplier or seed store. The cereal grains may be planted by a hand seeder or other acceptable method and covered by a drag or harrow to provide a quick cover crop. Inspection of the cereal grain seed will not be required. The intent of using cereal grains as temporary erosion control is to permit the Contractor to quickly seed potential areas as the need arises with on-site personnel and equipment.

**102-3.2 Schedule.** Prior to the start of construction, the Contractor shall submit schedules in accordance with the approved construction safety and phasing plan (CSPP) and the plans for accomplishment of temporary and permanent erosion control work for clearing and grubbing; grading; construction; paving; and structures at watercourses. The Contractor shall also submit a proposed method of erosion and dust control on haul roads and borrow pits and a plan for disposal of waste materials. Work shall not be started until the erosion control schedules and methods of operation for the applicable construction have been accepted by the Resident Engineer.

**102-3.3 Construction details.** The Contractor will be required to incorporate all permanent erosion control features into the project at the earliest practicable time as outlined in the plans and approved CSPP. Except where future construction operations will damage slopes, the Contractor shall perform the permanent seeding and mulching and other specified slope protection work in stages, as soon as substantial areas of exposed slopes can be made available. Temporary erosion and pollution control measures will be used to correct conditions that develop during construction that were not foreseen during the design stage; that are needed prior to installation of permanent control features; or that are needed temporarily to control erosion that develops during normal construction practices, but are not associated with permanent control features on the project.

Where erosion may be a problem, schedule and perform clearing and grubbing operations so that grading operations and permanent erosion control features can follow immediately if project conditions permit. Temporary erosion control measures are required if permanent measures cannot immediately follow grading operations. The Resident Engineer shall limit the area of clearing and grubbing, excavation, borrow, and embankment operations in progress, commensurate with the Contractor's capability and progress in keeping the finish grading, mulching, seeding, and other such permanent control measures current with the accepted schedule. If seasonal limitations make such coordination unrealistic, temporary erosion control measures shall be taken immediately to the extent feasible and justified as directed by the Resident Engineer.

The Contractor shall provide immediate permanent or temporary pollution control measures to minimize contamination of adjacent streams or other watercourses, lakes, ponds, or other areas of water impoundment as directed by the Resident Engineer. If temporary erosion and pollution control measures are required due to the Contractor's negligence, carelessness, or failure to install permanent controls as a part of the work as scheduled or directed by the Resident Engineer, the work shall be performed by the Contractor and the cost shall be incidental to this item.

The Resident Engineer may increase or decrease the area of erodible earth material that can be exposed at any time based on an analysis of project conditions.

The erosion control features installed by the Contractor shall be maintained by the Contractor during the construction period.

Provide temporary structures whenever construction equipment must cross watercourses at frequent intervals. Pollutants such as fuels, lubricants, bitumen, raw sewage, wash water from concrete mixing operations, and other harmful materials shall not be discharged into any waterways, impoundments or into natural or manmade channels.

**102-3.4 Installation, maintenance and removal of silt fence.** The installation and maintenance of silt fence shall be as specified in the contract documents, or as directed by the Resident Engineer. Silt fences shall extend a minimum of 16 inches and a maximum of 34 inches above the ground surface. Posts shall be set no more than ten (10) feet on center. Filter fabric shall be cut from a continuous roll to the length required minimizing joints where possible. When joints are necessary, the fabric shall be spliced at a support post with a minimum 12 inch overlap and securely sealed. A trench shall be excavated approximately four (4) inches deep by four (4) inches wide on the upslope side of the silt fence. The trench shall be backfilled, and the soil compacted over the silt fence fabric. The Contractor shall remove and dispose of silt that accumulates during construction and prior to establishment of permanent erosion control. The fence shall be maintained in good working condition until permanent erosion control is established. Silt fence shall be removed upon approval of the Resident Engineer.

**102-3.5 Riprap.** Prior to placement of the riprap material, the Contractor will undercut the designated area 12 inches below finish grade. The undercut material will be used as embankment fill material. The riprap course will be 12 inches total depth.

The riprap shall be placed in such a manner as to produce a reasonably well graded mass of rock with the minimum practicable percentage of voids. Placing of materials shall begin at the lower elevations and progress up the slope. The larger pieces shall be well distributed and the entire mass in its final position shall be roughly graded and shall present an even, close surface true to line and grade. Desired distribution of various sizes shall be obtained by selective loading or by controlled dumping methods, which will produce the specified results.

**102-3.6 Filter fabric.** The separation fabric shall be stored above the ground, inside and away from sunlight at temperatures less than 140° and protected from damage. The exposure of the separation fabric to the elements between laydown and cover shall be a maximum of 14 days.

The depth and area of excavation shall not exceed the dimensions necessary to properly place the filter fabric. Prior to the installation of the fabric, the surface shall be cleared of debris, sharp objects, and trees. Tree stumps shall be cut to the level of the prepared ground surface. If stumps cannot be cut to the ground level, they shall be completely removed. All wheel tracks, ruts, or surface irregularities in excess of two (2) inches in depth shall be graded smooth or otherwise filled with soil to provide a reasonably smooth surface. The filter fabric shall not be placed until the preparation has been approved by the Engineer.

At the time of placement, the fabric shall be free of defects, deterioration and damage.

The fabric shall be unrolled directly over the surface either by hand or by mechanical methods, provided the surface is not rutted. The long dimension of the fabric shall be parallel to the centerline. Overlaps in the fabric shall be placed so that any upstream strip of fabric will overlap the downstream strip, and the upslope roll shall overlap the downslope roll.

The fabric shall be laid loosely, free of folds and creases. The fabric shall be turned down and buried two (2) feet at all exterior limits, except where a stone filled key trench is provided below natural ground. As the riprap proceeds up the grade, the top edge of the fabric shall be buried as a part of the last operation,

Fabric of insufficient width or length to fully cover the specified area shall be lapped or sewn. The minimum laps for lap only areas are 12 inches and for sewn areas are four (4) inches.

When sewn, the fabric shall be stitched at a minimum rate of four (4) stitches per one (1) inch. The seam strength shall be equal to or more than the minimum grab tensile strength of the fabric when tested wet according to ASTM D4632.

Securing pins for anchoring filter fabric shall be nominally 3/16-inch diameter steel bars, pointed at one (1) end and fabricated with a head to retain a steel washer having an outside diameter of not less than 1-1/2 inch. The length of the pin shall not be less than 12 inches. Securing pins shall be inserted through both strips of overlapped cloth at not greater than the following intervals along a line through the midpoint of the overlap.



Each securing pin shall be pushed through the fabric until the washer bears against the fabric and secures it firmly to the surface. Additional pins, regardless of location, shall be installed as necessary to prevent any slippage of the filter fabric. When the Resident Engineer determines that the proper lap is not being maintained by the use of pins, the fabric shall be sewn.

The fabric shall be protected during construction from contamination by surface runoff, and any fabric so contaminated shall be removed and replaced.

Fabric damaged during its installation or during placement of aggregate base shall be replaced or repaired. Repairs shall be made by removing the material around the damage and covering it with a patch of fabric using an overlap of four (4) feet in each direction. The patch shall be held in position with securing pins.

**102-3.7 Temporary erosion control.** The installation and maintenance temporary erosion control systems shall be as specified in the contract documents, or as directed by the Resident Engineer, and where appropriate, according to the manufacturer's specifications. Specific requirements for the various systems shall be as follows.

**a. Temporary ditch checks.** Manufactured ditch checks shall be installed according to manufacturer's specifications. Spacing of ditch checks shall be such that the low point in the center of one (1) ditch check is at the same elevation as the base the ditch check immediately upstream. Temporary ditch checks shall be sufficiently long enough that the top of the device in the middle of the ditch is six (6) inches lower than the bottom of the terminating ends of the ditch side slopes.

(1) When rolled excelsior is used, each ditch check shall be installed and maintained such that the device is no less than ten (10) inches high at the point of overflow. Units installed at a spacing requiring a height greater than ten (10) inches shall be maintained at the height for the spacing at which they were originally installed.

**b. Inlet and pipe protection.** When inlet filters are specified, they shall be installed either directly on the drainage structure or under the grate of the drainage structure resting on the lip of the frame. The fabric bag shall hang down into the drainage structure. Prior to ordering materials, the Contractor shall determine the size and shape of the various drainage structures being protected.

**c. Temporary erosion control seeding.** Seed bed preparation will not be required if the soil is in a loose condition. Light disking shall be done if the soil is hard packed or caked. Fertilizer nutrients will not be required.

The original seed bags shall be opened in the presence of the Resident Engineer. The seed shall be applied by hand broadcasting to achieve a reasonably uniform coverage at a rate of 100 pounds per acre. Seed shall be applied to all bare areas every seven (7) days, regardless of weather conditions or progress of work. The Resident Engineer may require that critical locations be seeded immediately, and the Contractor shall seed these areas within 48 hours of such a directive.

**d. Temporary mulch.** The temporary mulch cover shall be installed according to Item 908 titled MULCHING.

**e. Straw bale barrier.** The installation and control of straw bale barriers shall be at the locations as specified in the contract documents, or as directed by the Resident Engineer.

**102-3.8 Dust control.** The Contractor shall employ construction methods and means that will keep flying dust to the minimum as directed by the Resident Engineer. The Contractor shall provide for the laying of water on the project, and on roads, streets, aprons and other areas immediately adjacent to the project limits, wherever traffic, or buildings that are occupied or in use, are affected by such dust caused by hauling or other operations. The cost of carrying out the foregoing provisions shall be incidental to the contract.

- 102-3.9 Maintenance of temporary erosion control system.** The temporary erosion control systems installed by the Contractor shall be properly maintained as directed by the Resident Engineer to control siltation at all times during the life of the contract. Any additional material and work required by the Resident Engineer will be measured and paid as herein specified. If the Contractor fails to maintain the temporary erosion control systems as directed by the Resident Engineer, the Resident Engineer may at the expiration of a period of 48 hours, after having given the Contractor written notice, proceed to maintain the systems as deemed necessary, and the cost thereof shall be deducted from any compensation due, or which may become due the Contractor under this contract.
- 102-3.10 Removal of erosion control.** The Contractor shall remove temporary erosion control structures when ordered to do so by the Resident Engineer. The costs associated with the removals shall be incidental to this item. In the event that temporary erosion and pollution control measures are ordered by the Resident Engineer due to the Contractor's negligence or carelessness, the work shall be performed by the Contractor at his or her own expense.

#### METHOD OF MEASUREMENT

- 102-4.1** The quantity of temporary seeding and mulching shall be measured for payment by the number of square yards as specified, completed, and accepted by the Resident Engineer.
- 102-4.2** The quantity of temporary slope drains shall be measured for payment by the number of linear feet as specified, completed, and accepted by the Resident Engineer.
- 102-4.3** The quantity of temporary benches, dikes, dams, and sediment basins shall be measured for payment by the number of cubic yards of excavation performed, including necessary cleaning of sediment basins, and the cubic yard of embankment placed as directed by the Resident Engineer.
- 102-4.4** The quantity of fertilizer shall be measured for payment by the ton as specified, completed, and accepted by the Resident Engineer.
- 102-4.5** The quantity of silt fence installation and removal shall be measured for payment by the linear foot as specified, completed, and accepted by the Resident Engineer.
- 102-4.6** The quantity of hay or straw bales shall be measured for payment by the number of completed units placed as specified and accepted by the Resident Engineer.
- 102-4.7** The quantity of temporary ditch checks shall be measured for payment by the linear foot as specified, completed, and accepted by the Resident Engineer. It shall be measured along the long axis of the device in place.
- 102-4.8** The quantity of inlet and pipe protection shall be measured for payment by the number of completed units placed as specified, completed, and accepted by the Resident Engineer.
- 102-4.9** The quantity of riprap shall be measured for payment by the number of square yards as specified, completed, and accepted by the Resident Engineer.
- 102-4.10** The quantity of filter fabric shall be measured for payment by the number of square yards as specified, completed, and accepted by the Resident Engineer.
- 102-4.11** Control work performed for protection of construction areas outside the construction limits, such as borrow and waste areas, haul roads, equipment and material storage sites, and temporary plant sites, will not be measured and paid for directly but shall be considered incidental to the contract and as a subsidiary obligation of the Contractor.

### **BASIS OF PAYMENT**

**102-5.1** Payment for accepted quantities of work performed by the Contractor and measured by the Resident Engineer shall be at made the contract unit price as specified in paragraph 102-4.1 of this section.

Where other directed work falls within the specifications for a work item that has a contract price, the units of work shall be measured and paid for at the contract unit price bid for the various items.

Temporary control features not covered by contract items that are ordered by the Resident Engineer will be paid for in accordance with Section 90, paragraph 90-06 titled PAYMENT FOR EXTRA WORK AND FORCE ACCOUNT.

### **REFERENCES**

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

#### **ASTM International (ASTM)**

ASTM D 4355	Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture, and heat in a Xenon Arc-Type Apparatus
ASTM D 4533	Standard Test Method for Trapezoid Tearing Strength of Geotextiles
ASTM D 4632	Standard Test Method for Grab Breaking Load and Elongation of Geotextiles
ASTM D 6241	Standard Test Method for Static Puncture Strength of Geotextiles and Geotextile-Related Products Using a 50-mm Probe

#### **American Association of State Highway and Transportation Officials (AASHTO)**

AASHTO M 288	Standard Specification for Geosynthetic Specification for Highway Applications
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#### **Federal Aviation Administration Advisory Circulars (AC)**

AC 150/5370-2	Operational Safety on Airports During Construction
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#### **Illinois Department of Transportation, Bureau of Materials Illinois Laboratory Test Procedure (ITP)**

*Manual of Aggregate Quality Test Procedures*

AASHTO T 104	Illinois Modified, Standard Method of Test for Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate
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**END OF ITEM 102**

## Item 105 Mobilization

### DESCRIPTION

- 105-1.1** This item of work shall consist of mobilization required by the contract at the time of notice to proceed, but is not limited to, work and operations necessary for the movement of personnel, equipment, material and supplies to and from the project site for work on the project except as provided in the contract as separate pay items; establishment of offices, buildings, and other necessary general facilities for the contractor's operations at the site; premiums paid for performance and payment bonds including coinsurance and reinsurance agreements as applicable.

If additional mobilization activities and costs are required during the performance of the contract as a result of added items of work, such costs shall be included in the unit price for the item or items of work added. This does not apply to any approved "time and materials work."

This item also includes all efforts related to restoration of the project site, staging area and haul road as directed in the bidding documents at the conclusion of the job. This activity includes, but is not limited to, incidental grading, seeding and clean-up, as required to restore the project site to original condition.

- 105-1.2 Mobilization limit.** Mobilization shall be limited to 10% of the original contract amount. Mobilization charges in excess of 10% of the original contract amount will not be paid.

- 105-1.3 Posted notices.** Prior to commencement of construction activities, the Contractor must post the following documents in a prominent and accessible place where they may be easily viewed by all employees of the prime Contractor and by all employees of subcontractors engaged by the prime Contractor: Equal Employment Opportunity (EEO) Poster "Equal Employment Opportunity is the Law" in accordance with the Office of Federal Contract Compliance Programs Executive Order 11246, as amended; Davis Bacon Wage Poster (WH 1321) - DOL "Notice to All Employees" Poster; and Applicable Davis-Bacon Wage Rate Determination. These notices must remain posted until final acceptance of the work by the Department.

### METHOD OF MEASUREMENT

- 105-2.1** Based upon the contract lump sum price for "Mobilization" partial payments will be allowed as follows:
- a. With first pay request, 25%.
  - b. When 25% or more of the original contract is earned, an additional 25%.
  - c. When 50% or more of the original contract is earned, an additional 40%.
  - d. After final inspection, staging area clean-up and delivery of all project closeout materials as required by Section 90, paragraph 90-12 titled CONTRACTOR FINAL PROJECT DOCUMENTATION, the final 10%.

### BASIS OF PAYMENT

- 105-3.1** Payment for accepted quantities of work performed by the Contractor and measured by the Resident Engineer shall be made at the contract unit price as specified in paragraphs 105-2.1 of this section.

**REFERENCES**

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

**Office of Federal Contract Compliance Programs (OFCCP)**

Executive Order 11246, as amended

EEOC-P/E-1 – Equal Employment Opportunity is the Law Poster

**United States Department of Labor, Wage and Hour Division (WHD)**

WH 1321 – Employee Rights under the Davis-Bacon Act Poster

**END OF ITEM 105**

### Item 110 Method of Estimating Percentage of Material Within Specification Limits (PWL)

**110-01 General.** When the specifications provide for acceptance of material based on the method of estimating percentage of material within specification limits (PWL), the PWL will be determined in accordance with this section. All test results for a lot will be analyzed statistically to determine the total estimated percent of the lot that is within specification limits. The PWL is computed using the sample average ( $\bar{X}$ ) and sample standard deviation ( $S_n$ ) of the specified number ( $n$ ) of sublots for the lot and the specification tolerance limits,  $L$  for lower and  $U$  for upper, for the particular acceptance parameter. From these values, the respective Quality index,  $Q_L$  for Lower Quality Index and/or  $Q_U$  for Upper Quality Index, is computed and the PWL for the lot for the specified  $n$  is determined from the included table. All specification limits specified in the technical sections shall be absolute values. Test results used in the calculations shall be to the significant figure given in the test procedure.

There is some degree of uncertainty (risk) in the measurement for acceptance because only a small fraction of production material (the population) is sampled and tested. This uncertainty exists because all portions of the production material have the same probability to be randomly sampled. The Contractor's risk is the probability that material produced at the acceptable quality level is rejected or subjected to a pay adjustment. The Department's risk is the probability that material produced at the rejectable quality level is accepted.

It is the intent of this section to inform the Contractor that, in order to consistently offset the Contractor's risk for material evaluated, production quality (using population average and population standard deviation) must be maintained at the acceptable quality specified or higher. In all cases, it is the responsibility of the Contractor to produce at quality levels that will meet the specified acceptance criteria when sampled and tested at the frequencies specified.

**110-02 Method for computing PWL.** The computational sequence for computing PWL is as follows:

- a. Divide the lot into  $n$  sublots in accordance with the acceptance requirements of the specification.
- b. Locate the random sampling position within the subplot in accordance with the requirements of the specification.
- c. Make a measurement at each location or take a test portion and make the measurement on the test portion in accordance with the testing requirements of the specification.

- d. Find the sample average ( $\bar{X}$ ) for all subplot test values within the lot by using the following formula:

$$\bar{X} = (x_1 + x_2 + x_3 + \dots + x_n) / n$$

Where:  $\bar{X}$  = Sample average of all subplot test values within a lot

$x_1, x_2, \dots, x_n$  = Individual subplot test values

$n$  = Number of subplot test values

- e. Find the sample standard deviation ( $S_n$ ) by use of the following formula:

$$S_n = [(d_1^2 + d_2^2 + d_3^2 + \dots + d_n^2)/(n-1)]^{1/2}$$

Where:  $S_n$  = Sample standard deviation of the number of subplot test values in the set

$d_1, d_2, \dots, d_n$  = Deviations of the individual subplot test values  $x_1, x_2, \dots$  from the average value  $\bar{X}$

that is:  $d_1 = (x_1 - X)$ ,  $d_2 = (x_2 - X)$  ...  $d_n = (x_n - X)$

$n$  = Number of subplot test values

- f. For single sided specification limits (i.e., L only), compute the Lower Quality Index  $Q_L$  by use of the following formula:

$$Q_L = (X - L) / S_n$$

Where: L = specification lower tolerance limit

Estimate the percentage of material within limits (PWL) by entering the table with  $Q_L$ , using the column appropriate to the total number ( $n$ ) of measurements. If the value of  $Q_L$  falls between values shown on the table, use the next higher value of PWL.

- g. For double-sided specification limits (i.e., L and U), compute the Quality Indexes  $Q_L$  and  $Q_U$  by use of the following formulas:

$$Q_L = (X - L) / S_n$$

and

$$Q_U = (U - X) / S_n$$

Where: L and U = specification lower and upper tolerance limits

Estimate the percentage of material between the lower (L) and upper (U) tolerance limits (PWL) by entering the table separately with  $Q_L$  and  $Q_U$ , using the column appropriate to the total number ( $n$ ) of measurements, and determining the percent of material above  $P_L$  and percent of material below  $P_U$  for each tolerance limit. If the values of  $Q_L$  fall between values shown on the table, use the next higher value of  $P_L$  or  $P_U$ . Determine the PWL by use of the following formula:

$$PWL = (P_U + P_L) - 100$$

Where:  $P_L$  = percent within lower specification limit

$P_U$  = percent within upper specification limit

### EXAMPLE OF PWL CALCULATION

**Project:** Example Project

**Test Item:** Item 401, Lot A.

- a. PWL Determination for Mat Density.

- (1) Density of four (4) random cores taken from Lot A.

$$A-1 = 96.60$$

$$A-2 = 97.55$$

$$A-3 = 99.30$$

$$A-4 = 98.35$$

$$n = 4$$

- (2) Calculate average density for the lot.

$$X = (x_1 + x_2 + x_3 + \dots + x_n) / n$$

$$X = (96.60 + 97.55 + 99.30 + 98.35) / 4$$

$$X = 97.95\% \text{ density}$$

- (3) Calculate the standard deviation for the lot.

$$S_n = [((96.60 - 97.95)^2 + (97.55 - 97.95)^2 + (99.30 - 97.95)^2 + (98.35 - 97.95)^2) / (4 - 1)]^{1/2}$$

$$S_n = [(1.82 + 0.16 + 1.82 + 0.16) / 3]^{1/2}$$

$$S_n = 1.15$$

- (4)** Calculate the Lower Quality Index  $Q_L$  for the lot. ( $L=96.3$ )

$$Q_L = (X - L) / S_n$$

$$Q_L = (97.95 - 96.30) / 1.15$$

$$Q_L = 1.4348$$

- (5)** Determine PWL by entering the table with  $Q_L = 1.44$  and  $n = 4$ .

$$PWL = 98$$

**b.** PWL Determination for Air Voids.

- (1)** Air Voids of four (4) random samples taken from Lot A.

$$A-1 = 5.00$$

$$A-2 = 3.74$$

$$A-3 = 2.30$$

$$A-4 = 3.25$$

- (2)** Calculate the average air voids for the lot.

$$X = (x_1 + x_2 + x_3 + \dots + x_n) / n$$

$$X = (5.00 + 3.74 + 2.30 + 3.25) / 4$$

$$X = 3.57\%$$

- (3)** Calculate the standard deviation  $S_n$  for the lot.

$$S_n = [((3.57 - 5.00)^2 + (3.57 - 3.74)^2 + (3.57 - 2.30)^2 + (3.57 - 3.25)^2) / (4 - 1)]^{1/2}$$

$$S_n = [(2.04 + 0.03 + 1.62 + 0.10) / 3]^{1/2}$$

$$S_n = 1.12$$

- (4)** Calculate the Lower Quality Index  $Q_L$  for the lot. ( $L = 2.0$ )

$$Q_L = (X - L) / S_n$$

$$Q_L = (3.57 - 2.00) / 1.12$$

$$Q_L = 1.3992$$

- (5)** Determine  $P_L$  by entering the table with  $Q_L = 1.41$  and  $n = 4$ .

$$P_L = 97$$

- (6)** Calculate the Upper Quality Index  $Q_U$  for the lot. ( $U = 5.0$ )

$$Q_U = (U - X) / S_n$$

$$Q_U = (5.00 - 3.57) / 1.12$$

$$Q_U = 1.2702$$

- (7)** Determine  $P_U$  by entering the table with  $Q_U = 1.29$  and  $n = 4$ .

$$P_U = 93$$

- (8)** Calculate Air Voids PWL

$$PWL = (P_L + P_U) - 100$$

$$PWL = (97 + 93) - 100 = 90$$



**EXAMPLE OF OUTLIER CALCULATION (REFERENCE ASTM E178)****Project:** Example Project**Test Item:** Item 401, Lot A.**a. Outlier Determination for Mat Density.****(1)** Density of four (4) random cores taken from Lot A arranged in descending order.

A-3 = 99.30

A-4 = 98.35

A-2 = 97.55

A-1 = 96.60

**(2)** From ASTM E178, Table 1, for n=4 an upper 5% significance level, the critical value for test criterion = 1.463.**(3)** Use average density, standard deviation, and test criterion value to evaluate density measurements.**(a)** For measurements greater than the average:

If (measurement - average) / (standard deviation) is less than test criterion, then the measurement is not considered an outlier.

For A-3, check if  $(99.30 - 97.95) / 1.15$  is greater than 1.463.

Since 1.174 is less than 1.463, the value is not an outlier.

**(b)** For measurements less than the average:

If (average - measurement) / (standard deviation) is less than test criterion, then the measurement is not considered an outlier.

For A-1, check if  $(97.95 - 96.60) / 1.15$  is greater than 1.463.

Since 1.135 is less than 1.463, the value is not an outlier.

**Note:** In this example, a measurement would be considered an outlier if the density were:Greater than  $(97.95 + 1.463 \times 1.15) = 99.63\%$ 

OR

less than  $(97.95 - 1.463 \times 1.15) = 96.27\%$ .

**Table for Estimating Percent of Lot Within Limits (PWL)**

Percent Within Limits (P <sub>L</sub> and P <sub>U</sub> )	Positive Values of Q (Q <sub>L</sub> and Q <sub>U</sub> )							
	n=3	n=4	n=5	n=6	n=7	n=8	n=9	n=10
99	1.1541	1.4700	1.6714	1.8008	1.8888	1.9520	1.9994	2.0362
98	1.1524	1.4400	1.6016	1.6982	1.7612	1.8053	1.8379	1.8630
97	1.1496	1.4100	1.5427	1.6181	1.6661	1.6993	1.7235	1.7420
96	1.1456	1.3800	1.4897	1.5497	1.5871	1.6127	1.6313	1.6454
95	1.1405	1.3500	1.4407	1.4887	1.5181	1.5381	1.5525	1.5635
94	1.1342	1.3200	1.3946	1.4329	1.4561	1.4717	1.4829	1.4914
93	1.1269	1.2900	1.3508	1.3810	1.3991	1.4112	1.4199	1.4265
92	1.1184	1.2600	1.3088	1.3323	1.3461	1.3554	1.3620	1.3670
91	1.1089	1.2300	1.2683	1.2860	1.2964	1.3032	1.3081	1.3118
90	1.0982	1.2000	1.2290	1.2419	1.2492	1.2541	1.2576	1.2602
89	1.0864	1.1700	1.1909	1.1995	1.2043	1.2075	1.2098	1.2115
88	1.0736	1.1400	1.1537	1.1587	1.1613	1.1630	1.1643	1.1653
87	1.0597	1.1100	1.1173	1.1192	1.1199	1.1204	1.1208	1.1212
86	1.0448	1.0800	1.0817	1.0808	1.0800	1.0794	1.0791	1.0789
85	1.0288	1.0500	1.0467	1.0435	1.0413	1.0399	1.0389	1.0382
84	1.0119	1.0200	1.0124	1.0071	1.0037	1.0015	1.0000	0.9990
83	0.9939	0.9900	0.9785	0.9715	0.9671	0.9643	0.9624	0.9610
82	0.9749	0.9600	0.9452	0.9367	0.9315	0.9281	0.9258	0.9241
81	0.9550	0.9300	0.9123	0.9025	0.8966	0.8928	0.8901	0.8882
80	0.9342	0.9000	0.8799	0.8690	0.8625	0.8583	0.8554	0.8533
79	0.9124	0.8700	0.8478	0.8360	0.8291	0.8245	0.8214	0.8192
78	0.8897	0.8400	0.8160	0.8036	0.7962	0.7915	0.7882	0.7858
77	0.8662	0.8100	0.7846	0.7716	0.7640	0.7590	0.7556	0.7531
76	0.8417	0.7800	0.7535	0.7401	0.7322	0.7271	0.7236	0.7211
75	0.8165	0.7500	0.7226	0.7089	0.7009	0.6958	0.6922	0.6896
74	0.7904	0.7200	0.6921	0.6781	0.6701	0.6649	0.6613	0.6587
73	0.7636	0.6900	0.6617	0.6477	0.6396	0.6344	0.6308	0.6282
72	0.7360	0.6600	0.6316	0.6176	0.6095	0.6044	0.6008	0.5982
71	0.7077	0.6300	0.6016	0.5878	0.5798	0.5747	0.5712	0.5686
70	0.6787	0.6000	0.5719	0.5582	0.5504	0.5454	0.5419	0.5394
69	0.6490	0.5700	0.5423	0.5290	0.5213	0.5164	0.5130	0.5105
68	0.6187	0.5400	0.5129	0.4999	0.4924	0.4877	0.4844	0.4820
67	0.5878	0.5100	0.4836	0.4710	0.4638	0.4592	0.4560	0.4537
66	0.5563	0.4800	0.4545	0.4424	0.4355	0.4310	0.4280	0.4257
65	0.5242	0.4500	0.4255	0.4139	0.4073	0.4030	0.4001	0.3980
64	0.4916	0.4200	0.3967	0.3856	0.3793	0.3753	0.3725	0.3705
63	0.4586	0.3900	0.3679	0.3575	0.3515	0.3477	0.3451	0.3432
62	0.4251	0.3600	0.3392	0.3295	0.3239	0.3203	0.3179	0.3161
61	0.3911	0.3300	0.3107	0.3016	0.2964	0.2931	0.2908	0.2892

Percent Within Limits (P <sub>L</sub> and P <sub>U</sub> )	Positive Values of Q (Q <sub>L</sub> and Q <sub>U</sub> )							
	n=3	n=4	n=5	n=6	n=7	n=8	n=9	n=10
60	0.3568	0.3000	0.2822	0.2738	0.2691	0.2660	0.2639	0.2624
59	0.3222	0.2700	0.2537	0.2461	0.2418	0.2391	0.2372	0.2358
58	0.2872	0.2400	0.2254	0.2186	0.2147	0.2122	0.2105	0.2093
57	0.2519	0.2100	0.1971	0.1911	0.1877	0.1855	0.1840	0.1829
56	0.2164	0.1800	0.1688	0.1636	0.1607	0.1588	0.1575	0.1566
55	0.1806	0.1500	0.1406	0.1363	0.1338	0.1322	0.1312	0.1304
54	0.1447	0.1200	0.1125	0.1090	0.1070	0.1057	0.1049	0.1042
53	0.1087	0.0900	0.0843	0.0817	0.0802	0.0793	0.0786	0.0781
52	0.0725	0.0600	0.0562	0.0544	0.0534	0.0528	0.0524	0.0521
51	0.0363	0.0300	0.0281	0.0272	0.0267	0.0264	0.0262	0.0260
50	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Percent Within Limits (P <sub>L</sub> and P <sub>U</sub> )	Negative Values of Q (Q <sub>L</sub> and Q <sub>U</sub> )							
	n=3	n=4	n=5	n=6	n=7	n=8	n=9	n=10
49	-0.0363	-0.0300	-0.0281	-0.0272	-0.0267	-0.0264	-0.0262	-0.0260
48	-0.0725	-0.0600	-0.0562	-0.0544	-0.0534	-0.0528	-0.0524	-0.0521
47	-0.1087	-0.0900	-0.0843	-0.0817	-0.0802	-0.0793	-0.0786	-0.0781
46	-0.1447	-0.1200	-0.1125	-0.1090	-0.1070	-0.1057	-0.1049	-0.1042
45	-0.1806	-0.1500	-0.1406	-0.1363	-0.1338	-0.1322	-0.1312	-0.1304
44	-0.2164	-0.1800	-0.1688	-0.1636	-0.1607	-0.1588	-0.1575	-0.1566
43	-0.2519	-0.2100	-0.1971	-0.1911	-0.1877	-0.1855	-0.1840	-0.1829
42	-0.2872	-0.2400	-0.2254	-0.2186	-0.2147	-0.2122	-0.2105	-0.2093
41	-0.3222	-0.2700	-0.2537	-0.2461	-0.2418	-0.2391	-0.2372	-0.2358
40	-0.3568	-0.3000	-0.2822	-0.2738	-0.2691	-0.2660	-0.2639	-0.2624
39	-0.3911	-0.3300	-0.3107	-0.3016	-0.2964	-0.2931	-0.2908	-0.2892
38	-0.4251	-0.3600	-0.3392	-0.3295	-0.3239	-0.3203	-0.3179	-0.3161
37	-0.4586	-0.3900	-0.3679	-0.3575	-0.3515	-0.3477	-0.3451	-0.3432
36	-0.4916	-0.4200	-0.3967	-0.3856	-0.3793	-0.3753	-0.3725	-0.3705
35	-0.5242	-0.4500	-0.4255	-0.4139	-0.4073	-0.4030	-0.4001	-0.3980
34	-0.5563	-0.4800	-0.4545	-0.4424	-0.4355	-0.4310	-0.4280	-0.4257
33	-0.5878	-0.5100	-0.4836	-0.4710	-0.4638	-0.4592	-0.4560	-0.4537
32	-0.6187	-0.5400	-0.5129	-0.4999	-0.4924	-0.4877	-0.4844	-0.4820
31	-0.6490	-0.5700	-0.5423	-0.5290	-0.5213	-0.5164	-0.5130	-0.5105
30	-0.6787	-0.6000	-0.5719	-0.5582	-0.5504	-0.5454	-0.5419	-0.5394
29	-0.7077	-0.6300	-0.6016	-0.5878	-0.5798	-0.5747	-0.5712	-0.5686
28	-0.7360	-0.6600	-0.6316	-0.6176	-0.6095	-0.6044	-0.6008	-0.5982
27	-0.7636	-0.6900	-0.6617	-0.6477	-0.6396	-0.6344	-0.6308	-0.6282

Percent Within Limits (P <sub>L</sub> and P <sub>U</sub> )	Negative Values of Q (Q <sub>L</sub> and Q <sub>U</sub> )							
	n=3	n=4	n=5	n=6	n=7	n=8	n=9	n=10
26	-0.7904	-0.7200	-0.6921	-0.6781	-0.6701	-0.6649	-0.6613	-0.6587
25	-0.8165	-0.7500	-0.7226	-0.7089	-0.7009	-0.6958	-0.6922	-0.6896
24	-0.8417	-0.7800	-0.7535	-0.7401	-0.7322	-0.7271	-0.7236	-0.7211
23	-0.8662	-0.8100	-0.7846	-0.7716	-0.7640	-0.7590	-0.7556	-0.7531
22	-0.8897	-0.8400	-0.8160	-0.8036	-0.7962	-0.7915	-0.7882	-0.7858
21	-0.9124	-0.8700	-0.8478	-0.8360	-0.8291	-0.8245	-0.8214	-0.8192
20	-0.9342	-0.9000	-0.8799	-0.8690	-0.8625	-0.8583	-0.8554	-0.8533
19	-0.9550	-0.9300	-0.9123	-0.9025	-0.8966	-0.8928	-0.8901	-0.8882
18	-0.9749	-0.9600	-0.9452	-0.9367	-0.9315	-0.9281	-0.9258	-0.9241
17	-0.9939	-0.9900	-0.9785	-0.9715	-0.9671	-0.9643	-0.9624	-0.9610
16	-1.0119	-1.0200	-1.0124	-1.0071	-1.0037	-1.0015	-1.0000	-0.9990
15	-1.0288	-1.0500	-1.0467	-1.0435	-1.0413	-1.0399	-1.0389	-1.0382
14	-1.0448	-1.0800	-1.0817	-1.0808	-1.0800	-1.0794	-1.0791	-1.0789
13	-1.0597	-1.1100	-1.1173	-1.1192	-1.1199	-1.1204	-1.1208	-1.1212
12	-1.0736	-1.1400	-1.1537	-1.1587	-1.1613	-1.1630	-1.1643	-1.1653
11	-1.0864	-1.1700	-1.1909	-1.1995	-1.2043	-1.2075	-1.2098	-1.2115
10	-1.0982	-1.2000	-1.2290	-1.2419	-1.2492	-1.2541	-1.2576	-1.2602
9	-1.1089	-1.2300	-1.2683	-1.2860	-1.2964	-1.3032	-1.3081	-1.3118
8	-1.1184	-1.2600	-1.3088	-1.3323	-1.3461	-1.3554	-1.3620	-1.3670
7	-1.1269	-1.2900	-1.3508	-1.3810	-1.3991	-1.4112	-1.4199	-1.4265
6	-1.1342	-1.3200	-1.3946	-1.4329	-1.4561	-1.4717	-1.4829	-1.4914
5	-1.1405	-1.3500	-1.4407	-1.4887	-1.5181	-1.5381	-1.5525	-1.5635
4	-1.1456	-1.3800	-1.4897	-1.5497	-1.5871	-1.6127	-1.6313	-1.6454
3	-1.1496	-1.4100	-1.5427	-1.6181	-1.6661	-1.6993	-1.7235	-1.7420
2	-1.1524	-1.4400	-1.6016	-1.6982	-1.7612	-1.8053	-1.8379	-1.8630
1	-1.1541	-1.4700	-1.6714	-1.8008	-1.8888	-1.9520	-1.9994	-2.0362

### REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

#### ASTM International (ASTM)

ASTM E 178

Standard Practice for Dealing with Outlying Observations

**END OF ITEM 110**

**Item 150 Resident Engineer Field Office****DESCRIPTION**

- 150-1.1** If a field office is required for the project, the Contractor shall provide dedicated space for the use of the Resident Engineer and inspectors, as a field office for the duration of the project. This facility shall be an approved weatherproof building or buildings hereinafter described at locations approved by the Resident Engineer. Unless otherwise provided, the building shall be independent of any building used by the Contractor and all keys to the buildings shall be turned over to the Resident Engineer. The Resident Engineer will designate the location of the building and it shall remain on the work site until released by the Resident Engineer. Mobile units may be substituted with the approval of the Engineer.

**CONSTRUCTION METHODS**

- 150-2.1** Field offices shall have a minimum ceiling height of seven (7) feet and a minimum floor space of 450 square feet. The office shall be provided with sufficient heat, natural and artificial light, and air conditioning. Doors and windows shall be equipped with locks approved by the Resident Engineer.

Windows shall be equipped with exterior screens to allow adequate ventilation. All windows shall be equipped with interior shades, curtains or blinds.

Suitable on-site sanitary facilities separate from those for the Contractor's personnel, meeting Federal, State, and local health department requirements shall be provided, maintained clean and in good working condition, and shall be stocked with lavatory and sanitary supplies at all times.

In addition, the following equipment and furniture meeting the approval of the Resident Engineer shall be furnished:

- a. Two (2) desks and two (2) non-folding chairs with upholstered seats and backs.
- b. Two (2) free standing four (4) drawer legal size file cabinets with lock and an Underwriters Laboratories insulated file device 350 degrees one (1) hour rating.
- c. Four (4) folding chairs
- d. One (1) equipment cabinet of minimum inside dimension of 44 inches high by 24 inches wide by 30 inches deep with lock. The walls shall be of steel with a 3/32" minimum thickness with concealed hinges and enclosed lock constructed in such a manner as to prevent entry by force. The cabinet assembly shall be permanently attached to a structural element of the field office in a manner to prevent theft of the entire cabinet.
- e. One (1) carbon dioxide fire extinguisher (ten (10) pound rated capacity)
- f. One (1) electric water cooler dispenser with water supply as needed, or bottled water
- g. One (1) telephone, with touch tone, where available, and a digital telephone answering machine or a cellular telephone with voicemail, for exclusive use by the Resident Engineer. One (1) additional dedicated telephone line for a computer shall also be provided or a functional internet Wi-Fi device such as a mobile hot spot providing hi-speed broadband internet access to the field office for the exclusive use of the Resident Engineer.

- h. One (1) dry process copy machine (including maintenance and operating supplies) capable of both collating and reproducing prints up to a legal size (8.5 inches by 14 inches) and capable of copying field books
- i. For projects requiring PCC flexural strength testing, the Contractor shall provide beam tanks and a beam tank shed as part of this item. This shed shall be large enough to hold all the necessary beam tanks. The Contractor shall make provisions in this shed to heat/cool as necessary to keep beam tank water temperature between 70°F to 76°F. The Contractor shall be required to provide water to the beam shed as required to protect the beams. If the beam tank is not located at the Resident Engineer's Field Office, the shed shall be large enough to store the beam breaker. The shed shall be locked, and the Resident Engineer given all keys.
- j. One (1) refrigerator with a minimum size of eight (8) cubic feet with a freezer unit.
- k. One (1) electric desk tape calculator and adding machine with tape or one (1) tape printing calculator.
- l. One (1) lockable cabinet or closet that is large enough in which a nuclear density machine may be stored.
- m. High-speed internet access shall be provided to the field office by the Contractor via modem if phone or cable connections are available. If not, the Contractor shall provide a wireless air card, or a similar internet access method, which shall be approved by the Resident Engineer. Dial up, or equivalent, internet service will not be acceptable.

#### **METHOD OF MEASUREMENT**

- 150-3.1** Payment for providing the field office fully equipped as specified shall be made at the contract lump sum price.

The building will include all utility costs and shall be released to the Contractor in good condition at the end of the project.

The cellular telephone and associated charges will be included in the contract unit price per lump sum for engineer's field office. This price shall include all utility costs and shall reflect the salvage value of the building or buildings, equipment, and furniture which remain the property of the contractor after release by the engineer, except the project engineer's firm will pay that portion of the monthly long distance, monthly local telephone, and online data usage that, when combined, exceed 250 dollars.

#### **BASIS OF PAYMENT**

- 150-4.1** Payment for accepted quantities of work performed by the Contractor shall be made at the contract unit price as specified in paragraphs 150-3.1 of this section.

#### **END OF ITEM 150**

## Part 3 – Sitework

### Item 101 Preparation/Removal of Existing Pavements

#### DESCRIPTION

- 101-1.1** This item shall consist of preparation of existing pavement surfaces for overlay, surface treatments, removal of existing pavement, and other miscellaneous items. The work shall be accomplished in accordance with the contract documents.

#### EQUIPMENT AND MATERIALS

- 101-2.1** All equipment and materials shall be specified here and in the following paragraphs or approved by the Engineer. The equipment shall not cause damage to the pavement to remain in place.

#### CONSTRUCTION

**101-3.1 Removal of existing pavement.**

The Contractor's removal operation shall be controlled to not damage adjacent pavement structure, and base material, cables, utility ducts, pipelines, or drainage structures which are to remain under the pavement.

- a. Concrete pavement removal.** Full depth saw cuts shall be made perpendicular to the slab surface. The Contractor shall saw through the full depth of the slab including any dowels at the joint, removing the pavement and installing new dowels as specified in the contract documents. Where the perimeter of the removal limits is not located on the joint and there are no dowels present, the perimeter shall be saw cut the full depth of the pavement. After completion of the saw cutting, the Contractor shall remove the pavement structure using methods which will allow a vertical surface along all sides of the removal area. The pavement inside the saw cut shall be removed by methods which will not cause distress in the pavement which is to remain in place. If the material is to be wasted on the airport site, it shall be reduced to a maximum size as specified in the contract documents.

Material obtained from removal operations shall be hauled to a disposal site off of airport property by the Contractor. No additional compensation will be made for hauling and disposal of the removed material. Existing aggregate base shall be compacted in accordance with Item 209 titled CRUSHED AGGREGATE BASE COURSE. Existing subgrade shall be compacted in accordance with Item 152 EXCAVATION, SUBGRADE, AND EMBANKMENT. Concrete slabs that are damaged by under breaking shall be repaired or removed and replaced as directed by the Resident Engineer.

The edge of existing concrete pavement against which new pavement abuts shall be protected from damage at all times. Spall and underbreak repair shall be as specified in the contract documents. Any underlying material that is to remain in place, shall be recompacted and/or replaced as specified in the contract documents. Adjacent areas damaged during repair shall be repaired or replaced at the Contractor's expense.

- b. Asphalt pavement removal.** Asphalt pavement to be removed shall be cut to the full depth of the asphalt pavement around the perimeter of the area to be removed, as specified in the contract documents at locations determined by the Resident Engineer. After completion of saw cutting, the Contractor shall remove the pavement structure using methods which will

allow a vertical surface along all sides of the removal area. Material obtained from removal operations shall be hauled to a disposal site off of airport property by the Contractor. No additional compensation will be made for hauling and disposal of the removed material. Existing aggregate base shall be compacted in accordance with Item 209 titled CRUSHED AGGREGATE BASE COURSE. Existing subgrade shall be compacted in accordance with Item 152 titled EXCAVATION, SUBGRADE, AND EMBANKMENT. If the material is to be wasted on the airport site or incorporated into embankment, it shall be broken to a maximum size designated by the Resident Engineer.

- c. **Repair or removal of base, subbase, and/or subgrade.** All failed material including surface, base course, subbase course, and subgrade shall be removed and repaired as specified in the contract documents or as directed by the Resident Engineer. Materials and methods of construction shall comply with the applicable sections of these specifications. Any damage caused by Contractor's removal process shall be repaired at the Contractor's expense.

**101-3.2 Preparation of joints and cracks prior to overlay/surface treatment.** Remove all vegetation and debris from cracks to a minimum depth of one (1) inch. If extensive vegetation exists, treat the specific area with a concentrated solution of a water-based herbicide approved by the Resident Engineer. No crack sealer material shall be placed until the cracks have been cleaned of all loose dirt and material. Following the initial routing and cleaning operation, all cracks will be blown out with compressed air. The cracks shall be inspected and approved prior to placing the sealer material. Any and all loose materials shall be disposed of by the Contractor off site. Fill all cracks greater than one-quarter (1/4) inch wide with a crack sealant per ASTM D6690. The crack sealant, preparation, and application shall be compatible with the surface treatment/overlay to be used. To minimize contamination of the asphalt with the crack sealant, underfill the crack sealant a minimum of one-eighth (1/8) inch, not to exceed one-quarter (1/4) inch. The crack sealant shall be applied uniformly solid from bottom to top and shall be filled without formation of entrapped air or voids. The heating kettle shall be an indirect heating type, constructed as a double boiler. A positive temperature control and mechanical agitation shall be provided. The sealant shall not be heated to more than 20°F above the safe heating temperature. The safe heating temperature can be obtained from the manufacturer's shipping container. A direct connecting pressure type extruding device with nozzles shaped for insertion into the joint shall be provided. Sealing material should be used sparingly. Only enough material shall be poured into the opening to fill the crevice to within one-quarter (1/4) inch of the pavement surface. Any excess joint or crack sealer shall be removed from the pavement surface. Overfilling will not be permitted.

Wider cracks over 1-1/2 inch wide, along with soft or sunken spots, indicate that the pavement or the pavement base should be repaired or replaced as stated below.

Cracks and joints may be filled with a mixture of emulsified asphalt and aggregate. The aggregate shall consist of limestone, volcanic ash, sand, or other material that will cure to form a hard substance. The combined gradation shall be as shown in the following table.

#### Gradation

Sieve Size	Percent Passing
No. 4	100
No. 8	90-100
No. 16	65-90
No. 30	40-60
No. 50	25-42
No. 100	15-30
No. 200	10-20



Up to 3% cement can be added to accelerate the set time. The mixture shall not contain more than 20% natural sand without approval in writing from the Engineer.

The proportions of asphalt emulsion and aggregate shall be determined in the field and may be varied to facilitate construction requirements. Normally, these proportions will be approximately one (1) part asphalt emulsion to five (5) parts aggregate by volume. The material shall be poured or placed into the joints or cracks and compacted to form a voidless mass. The joint or crack shall be filled to within +0 to -1/8 inches of the surface. Any material spilled outside the width of the joint shall be removed from the pavement surface prior to constructing the overlay. Where concrete overlays are to be constructed, only the excess joint material on the pavement surface and vegetation in the joints need to be removed.

**101-3.3 Removal of foreign substances/contaminates prior to overlay and seal-coat.** Removal of foreign substances/contaminates from existing pavement that will affect the bond of the new treatment shall consist of removal of rubber, fuel spills, oil, crack sealer, at least 90% of paint, and other foreign substances from the surface of the pavement. Areas that require removal are specified in the contract documents and as directed by the Resident Engineer in the field during construction.

The Contractor shall remove existing and temporary pavement markings as specified in the contract documents or as directed by the Engineer using sandblasting, water blasting, shot blasting, or other approved method. If chemicals are used, they shall comply with the state's environmental protection regulations. Removal methods used shall not cause major damage to the pavement, or to any structure or utility within or adjacent to the work area. Major damage is defined as changing the properties of the pavement, removal of asphalt causing the aggregate to ravel, or removing pavement over one-eighth (1/8) inch deep. If it is deemed by the Resident Engineer that damage to the existing pavement is caused by operational error, such as permitting the application method to dwell in one (1) location for too long, the Contractor shall repair the damaged area without compensation and as directed by the Resident Engineer.

Removal of foreign substances shall not proceed until approved by the Resident Engineer. Water used for high-pressure water equipment shall be provided by the Contractor at the Contractor's expense. No material shall be deposited on the pavement shoulders. All wastes shall be disposed of in areas specified in the contract documents.

**101-3.4 Concrete spall or failed asphaltic concrete pavement repair.**

**a. Repair of concrete spalls in areas to be overlaid with asphalt.** The Contractor shall repair all spalled concrete as specified in the contract documents or as directed by the Resident Engineer. The perimeter of the repair shall be saw cut a minimum of two (2) inches outside the affected area and two (2) inches deep. The deteriorated material shall be removed to a depth where the existing material is firm or cannot be easily removed with a geologist pick. The removed area shall be filled with asphalt mixture with aggregate sized appropriately for the depth of the patch. The material shall be compacted with equipment approved by the Resident Engineer until the material is dense and no movement or marks are visible. The material shall not be placed in lifts over four (4) inches in depth. This method of repair applies only to pavement to be overlaid.

Asphalt mix pavement repair of concrete pavement is not allowed for depths less than one-third (1/3) of the PCC pavement thickness.

**b. Asphalt pavement repair.** The Contractor shall repair all spalled concrete as specified in the contract documents or as directed by the Resident Engineer. The failed areas shall be removed as specified in paragraph 101-3.1 b. All failed material including surface, base course, subbase course, and subgrade shall be removed. Materials and methods of construction shall comply with the applicable sections of these specifications.

**101-3.5 Cold milling.** Milling shall be performed with a power-operated milling machine or grinder, capable of producing a uniform finished surface. The milling machine or grinder shall operate without tearing or gouging the underlying surface. The milling machine or grinder shall be

equipped with grade and slope controls, and a positive means of dust control. All millings shall be removed and disposed of off Airport property, unless otherwise specified. However, the Airport maintains the right of first refusal for all material currently on the project site. If the Contractor mills or grinds deeper or wider than the contract documents specify, the Contractor shall replace the material removed with new material at the Contractor's Expense.

- a. **Patching.** The milling machine shall be capable of cutting a vertical edge without chipping or spalling the edges of the remaining pavement and it shall have a positive method of controlling the depth of cut. The Resident Engineer shall layout the area to be milled with a straightedge in increments of one (1) foot widths. The area to be milled shall cover only the failed area. Any excessive area that is milled because the Contractor doesn't have the appropriate milling machine, or areas that are damaged because of his negligence, shall be repaired by the Contractor at the Contractor's Expense.
- b. **Profiling, grade correction, or surface correction.** The milling machine shall have a minimum width of seven (7) feet and it shall be equipped with electronic grade control devices that will cut the surface to the grade specified. The tolerances shall be maintained within +0 inch and -1/4 inch of the specified grade. The machine must cut vertical edges and have a positive method of dust control. The machine must have the ability to windrow the millings or cuttings or remove the millings or cuttings from the pavement and load them into a truck. All millings shall be removed and disposed of off Airport property, unless otherwise specified.
- c. **Clean-up.** The Contractor shall sweep the milled surface daily and immediately after the milling until all residual materials are removed from the pavement surface. Prior to paving, the Contractor shall wet down the milled pavement and thoroughly sweep and/or blow the surface to remove loose residual material. Waste materials shall be collected and removed from the pavement surface and adjacent areas by sweeping or vacuuming. Waste materials shall be removed and disposed of off Airport property, unless otherwise specified.

**101-3.6 Preparation of asphalt pavement surfaces prior to surface treatment.** Existing asphalt pavements to be treated with a surface treatment shall be prepared as follows:

- a. Patch asphalt pavement surfaces that have been softened by petroleum derivatives or have failed due to any other cause. Remove damaged pavement to the full depth of the damage and replace with new asphalt pavement similar to that of the existing pavement in accordance with paragraph 101-3.4 b titled ASPHALT PAVEMENT REPAIR.
- b. Repair joints and cracks in accordance with paragraph 101-3.2 titled PREPARATION OF JOINTS AND CRACKS PRIOR TO OVERLAY/SURFACE TREATMENT.
- c. Remove oil or grease that has not penetrated the asphalt pavement by scrubbing with a detergent and washing thoroughly with clean water. After cleaning, treat these areas with an oil spot primer.
- d. Clean pavement surface immediately prior to placing the surface treatment so that it is free of dust, dirt, grease, vegetation, oil or any type of objectionable surface film.

**101-3.7 Maintenance.** The Contractor shall perform all maintenance work necessary to keep the pavement in a satisfactory condition until the full section is complete and accepted by the Resident Engineer. The surface shall be kept clean and free from foreign material. The pavement shall be properly drained at all times. If cleaning is necessary or if the pavement becomes disturbed, any work repairs necessary shall be performed by the Contractor. The maintenance cost shall be considered incidental to the contract and as a subsidiary obligation of the Contractor.

**101-3.8 Preparation of joints in rigid pavement prior to resealing.** Prior to application of sealant material, clean and dry the joints of all scale, dirt, dust, old sealant, curing compound, moisture and other foreign matter. The Contractor shall demonstrate, in the presence of the Resident Engineer, that the method used cleans the joint and does not damage the joint.

- 101-3.9 Removal of existing joint sealant.** The existing joint material shall be removed to the depth as specified in the contract documents or as directed. All existing joint sealants will be removed by plowing or use of hand tools. Any remaining sealant and or debris will be removed by use of wire brushes or other tools as necessary. Re-saw joints removing no more than 1/16 inch from each joint face. Immediately after sawing, flush out joint with water and other tools as necessary to completely remove the slurry.
- 101-3.10 Cleaning prior to sealing.** Immediately before sealing, joints shall be thoroughly cleaned by removing any remaining laitance, curing, compound, protrusions of hardened concrete, dirt, dust, and other foreign material. Allow sufficient time to dry out joints prior to sealing. Joint surfaces will be surface-dry prior to installation of sealant.
- 101-3.11 Joint sealant.** Joint material and installation will be in accordance with Item 605 titled JOINT SEALANTS FOR PAVEMENTS.
- 101-3.12 Preparation of cracks in flexible pavement prior to sealing.** Prior to application of sealant material, clean and dry the joints of all scale, dirt, dust, old sealant, curing compound, moisture and other foreign matter. The Contractor shall demonstrate, in the presence of the Resident Engineer, that the method used cleans the cracks and does not damage the pavement.
- 101-3.13 Preparation of crack.** Widen crack with router by removing a minimum of 1/16 inch from each side of crack. Immediately before sealing, cracks will be blown out with a hot air lance combined with oil and water-free compressed air. The Contractor may use any combination of joint/crack rakes, plows, routers, wire wheels and air compressors to clean the crack/joint of all laitance, sealant debris and dust film.
- a. Crack sealing, five-eighths (5/8) inch to one (1) inch wide.** Cracks and joints in this width range shall be cleaned of all dirt, existing sealant and debris to a depth sufficient to allow for a backer rod and the new joint sealant at the thickness specified in Item 605 titled JOINT SEALANTS FOR PAVEMENTS.
  - b. Crack sealing, three-eighths (3/8) inch to five-eighths (5/8) inch wide.** These cracks and joints shall be cleaned of all dirt, debris, and old sealant. Routing shall be as necessary to shape the sealant reservoir and provide adequate depth for backer rod and sealant.
  - c. Crack sealing, less than three-eighths (3/8) inch wide.** These cracks and joints shall be routed to a minimum of three-eighths (3/8) inch wide and to a sufficient depth to provide the backer rod and joint sealant. The routed reservoir shall be cleaned and sealed.
- 101-3.14 Removal of existing crack sealant.** Existing sealants will be removed by routing or random crack saw. Following routing or sawing any remaining debris will be removed by use of a hot lance combined with oil and water-free compressed air.
- 101-3.15 Crack sealant.** Crack sealant material and installation will be in accordance with Item 605 titled JOINT SEALANTS FOR PAVEMENTS.
- 101-3.16 Removal of pipe and other buried structures.**
- a. Removal of existing pipe material.** Remove the types of pipe as specified in the contract documents. The pipe material shall be legally disposed of off-site in a timely manner following removal. Trenches shall be backfilled with material equal to or better in quality than adjacent embankment. Trenches under paved areas must be compacted to 95% of AASHTO T 99 for areas designated for aircraft with gross weights of 60,000 pounds or less and AASHTO T 180 for areas designated for aircraft with gross weights greater than 60,000 pounds.
  - b. Removal of inlets/manholes.** Where specified in the contract documents or as directed by the Resident Engineer, inlets and/or manholes shall be removed and legally disposed of off-site in a timely fashion after removal. Excavations after removal shall be backfilled with material equal or better in quality than adjacent embankment. When under paved areas must be compacted to 95% of AASHTO T 99 for areas designated for aircraft with gross

weights of 60,000 pounds or less and AASHTO T 180 for areas designated for aircraft with gross weights greater than 60,000 pounds, when outside of paved areas must be compacted to 95% of AASHTO T 99.

#### METHOD OF MEASUREMENT

- 101-4.1 Pavement removal.** The quantity of pavement removal shall be measured for payment by the number of square yards removed by the as specified, completed, and accepted by the Resident Engineer. Any pavement removed outside the limits of removal because the pavement was damaged by negligence on the part of the Contractor shall not be included in the measurement for payment.
- No direct measurement or payment shall be made for saw cutting. Saw cutting shall be incidental to pavement removal. Dowel bar installation shall be incidental to pavement removal.
- 101-4.2 Joint and crack repair.** The quantity of joint and crack repair shall be measured for payment by the number of the linear foot of joint repair as specified, completed, and accepted by the Resident Engineer.
- 101-4.3 Removal of foreign substances/contaminates.** The quantity of foreign substances/contaminates removal shall be measured for payment by the number of square foot of substance/contaminates removed by the Contractor as specified, completed, and accepted by the Resident Engineer.
- 101-4.4 Spalled and failed asphalt pavement repair.** The quantity of failed asphalt pavement repair shall be measured for payment by the number of square feet of pavement repair as specified, completed, and accepted by the Resident Engineer.
- 101-4.5 Concrete spall repair.** The quantity of concrete spall repair shall be measured for payment by the number of square feet of spall repair as specified, completed, and accepted by the Resident Engineer. The location and average depth of the patch shall be determined and agreed upon by the Resident Engineer and the Contractor.
- 101-4.6 Cold milling.** The quantity of cold milling shall be measured for payment by the number of square yards of pavement milled by the Contractor as specified, completed, and accepted by the Resident Engineer. The location and average depth of the cold milling shall be as specified in the contract documents. If the initial cut does not correct the condition, the Contractor shall re-mill the area and will be paid only once for the total depth of milling.
- 101-4.7 Removal of pipe and other buried structures.** The quantity of pipe removal shall be measured for payment by the number of linear foot of pipe removed by the Contractor as specified, completed, and accepted by the Resident Engineer. Other buried structures will be made at the contract unit price for each completed and accepted item. This price shall be full compensation for all labor, equipment, tools, and incidentals necessary to complete this item in accordance with paragraph 101-3.16 titled REMOVAL OF PIPE AND OTHER BURIED STRUCTURES.

#### BASIS OF PAYMENT

- 101-5.1** Payment for accepted quantities of work performed by the Contractor and measured by the Resident Engineer shall be made at the contract unit price as specified in paragraphs 101-4.1 through 101-4.7 of this section. Payment shall be full compensation for furnishing all materials and for all preparation, hauling, and placing of the material and for all labor, equipment, tools, and incidentals necessary to complete the work as specified.

**REFERENCES**

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

**ASTM International (ASTM)**

ASTM D 6690                      Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements

**Federal Aviation Administration Advisory Circulars (AC)**

AC 150/5380-6                      Guidelines and Procedures for Maintenance of Airport Pavements.

**END OF ITEM 101**

## Item 151 Clearing and Grubbing

### DESCRIPTION

**151-1.1** This item shall consist of clearing or clearing and grubbing, including the disposal of materials, for all areas within the limits specified in the contract documents or as required by the Resident Engineer.

- a. Clearing.** Clearing shall consist of the cutting and removal of all trees, stumps, brush, logs, hedges, the removal of fences and other loose or projecting material from the designated areas. The grubbing of stumps and roots will not be required.

Clearing, when so designated, shall consist of the cutting and removal of isolated single trees or isolated groups of trees. The cutting of all the trees of this classification shall be in accordance with the requirements for the particular area being cleared, or as specified in the contract documents, or as directed by the Resident Engineer. The trees shall be considered isolated when they are 40 feet or more apart, with the exception of a small clump of approximately five (5) trees or less.

- b. Clearing and grubbing.** Clearing and grubbing shall consist of clearing the surface of the ground of the designated areas of all trees, stumps, down timber, logs, snags, brush, undergrowth, hedges, heavy growth of grass or weeds, fences, structures, debris, and rubbish of any nature, natural obstructions or such material which in the opinion of the Resident Engineer is unsuitable for the foundation of strips, pavements, or other required structures, including the grubbing of stumps, roots, matted roots, foundations, and the disposal from the project of all spoil materials resulting from clearing and grubbing by burning or otherwise. Burning shall only be used with prior approval of the Airport for burning on-site.
- c. Tree removal.** Tree Removal shall consist of the cutting and removal of isolated single trees or isolated groups of trees, and the grubbing of stumps and roots. The removal of all the trees of this classification shall be in accordance with the requirements for the particular area being cleared.

### CONSTRUCTION METHODS

**151-2.1 General.** The areas denoted in the contract documents to be cleared or cleared and grubbed shall be staked on the ground by the Resident Engineer. The clearing and grubbing shall be done at a satisfactory distance in advance of the grading operations. Unless otherwise specified, no cutting or trimming of trees shall occur between April 1 and September 30, both days inclusive, due to potential impact to the Indiana Bat, which is protected by the Endangered species Act of 1973. If otherwise specified, the Contractor shall verify that the required permits have been obtained prior to the commencement of tree cutting or trimming operations.

The removal of existing structures and utilities required to permit orderly progress of work shall be accomplished by local agencies, unless otherwise specified in the contract documents. Whenever a telephone pole, pipeline, conduit, sewer, roadway, or other utility is encountered and must be removed or relocated, the Contractor shall advise the Resident Engineer who will notify the proper local authority or owner to secure prompt action.

**151-2.2 Disposal.** All materials removed by clearing or by clearing and grubbing shall be disposed of in the designated waste disposal area, outside the Airport's limits at the Contractor's responsibility, or by burning, except when otherwise directed by the Resident Engineer. When

burning of material is permitted with prior approval of the Airport, it shall be burned under the constant overseeing of a watchman to assure the surrounding vegetation and other adjacent property is not jeopardized. Burning shall be done in accordance with all applicable federal, state and local laws, ordinances, and regulations. The Contractor shall notify the agency having jurisdiction and obtain all approvals in writing before starting any burning operations. Permission to burn shall be coordinated with the Airport Management daily and when changes in weather conditions may affect the airport.

The Contractor shall procure an EPA Clean Air Permit for burning. The permit shall require an air curtain destructor at each burn pit.

Under no circumstances shall burning be allowed if it has been deemed that burning may cause interference to airport operations. In no case shall burning be allowed within 750 feet of the centerline of any runway.

The Contractor is responsible for clean-up of burn areas.

As far as practicable, waste concrete and masonry shall be placed on slopes of embankments or channels. When embankments are constructed of such material, this material shall be placed in accordance with requirements for formation of embankments. Any broken concrete or masonry that cannot be used in construction and all other materials not considered suitable for use elsewhere, shall be disposed of by the Contractor. In no case, shall any discarded materials be left in windrows or piles adjacent to or within the airport limits. The manner and location of disposal of materials shall be subject to the approval of the Resident Engineer and shall not create an unsightly or objectionable view. When the Contractor is required to locate a disposal area outside the airport property limits, the Contractor shall obtain and file with the Resident Engineer permission in writing from the property owner for the use of private property for this purpose. All waste materials which are not used or burned at the site shall be removed and disposed of legally off airport property.

**151-2.3 Blasting.** If blasting is allowed, it shall be performed in accordance with Section 70, paragraph 70-10 titled USE OF EXPLOSIVES and all federal, state, and local safety regulations. Submit notice 15 days prior to starting work. Submit a blasting plan, prepared and sealed by a registered professional Engineer, that includes calculations for overpressure and debris hazard. Obtain written approval prior to performing any blasting and notify the Resident Engineer 24 hours prior to blasting. Include provisions for storing, handling and transporting explosives as well as for the blasting operations in the plan. The Contractor is responsible for damage caused by blasting operations.

**151-2.4 Clearing.** The Contractor shall clear the staked or indicated area of all materials as specified in the contract documents. Trees unavoidably falling outside the specified clearing limits must be cut up, removed, and disposed of in a satisfactory manner. To minimize damage to trees that are to be left standing, trees shall be felled toward the center of the area being cleared. The Contractor shall preserve and protect from injury all trees not to be removed. The trees, stumps, and brush shall be cut flush with the original ground surface. The grubbing of stumps and roots will not be required.

When isolated trees are designated for clearing, the trees shall be classed in accordance with the butt diameter size as measured at a point of 4.5 feet above the ground level or at a designated height specified in the proposal.

Fences shall be removed and disposed of as directed by the Resident Engineer. Fence wire shall be neatly rolled, and the wire and posts stored on the airport if they are to be used again, or stored at a location designated by the Resident Engineer if the fence is to remain the property of a local owner or of the Department.

**151-2.5 Clearing and grubbing.** In areas specified in the contract documents or as designated by the Resident Engineer to be cleared and grubbed, all stumps, roots, buried logs, brush, grass, and other unsatisfactory materials as indicated in the contract documents, shall be removed, except where embankments exceeding 3-1/2 feet in depth will be constructed outside of paved areas.

For embankments constructed outside of paved areas, all unsatisfactory materials shall be removed, but sound trees, stumps, and brush can be cut off flush with the original ground and allowed to remain. Tap roots and other projections over 1-1/2 inches in diameter shall be grubbed out to a depth of at least 18 inches below the finished subgrade or slope elevation.

Any buildings and miscellaneous structures that are shown on the plans to be removed shall be demolished or removed, and all materials shall be disposed of by removal from the site. The cost of removal is incidental to this item. The remaining or existing foundations, wells, cesspools, and like structures shall be destroyed by breaking down the materials of which the foundations, wells, cesspools, etc., are built to a depth at least two (2) feet below the existing surrounding ground. Any broken concrete, blocks, or other objectionable material that cannot be used in backfill shall be removed and disposed of at the Contractor's expense. The holes or openings shall be backfilled with acceptable material and properly compacted.

All holes in embankment areas remaining after the grubbing operation shall have the sides of the holes flattened to facilitate filling with acceptable material and compacting as required in Item 152 EXCAVATION, SUBGRADE, AND EMBANKMENT. The same procedure shall be applied to all holes remaining after grubbing in areas where the depth of holes exceeds the depth of the proposed excavation.

### METHOD OF MEASUREMENT

- 151-3.1** The quantity of clearing as shown by the limits specified in the contract documents shall be measured by for payment by the number of acres or fractions thereof, of land specifically cleared and/or cleared and grubbed by the Contractor as specified, completed, and accepted by the Resident Engineer.

When isolated trees are designated for clearing, the quantities of trees, as determined in accordance with ranges of butt diameter size, measured at a point 4.5 feet above the ground level at the tree, shall be measured according to the schedule of sizes as follows:

The number of trees:

From 0 to 2-1/2 feet, butt diameter

From 2-1/2 to five (5) feet, butt diameter

From five (5) feet or more, butt diameter

When the project is constructed essentially to the lines, grades, or dimensions shown on the Plans, and the Contractor and the Resident Engineer have agreed in writing on form AER 981, *Agreement on Accuracy of Plan Quantities*, that the plan quantities are accurate, no further measurement will be required and payment will be made for the quantities shown in the contract for the various items involved. If an error in plan quantity is discovered after the work has been started, an appropriate adjustment will be made.

When the contract documents have been altered or when disagreement exists between the Contractor and the Engineer as to the accuracy of the plan quantities, either party shall, before any work is started which would affect the measurement, have the right to request in writing and thereby cause the quantities involved to be measured as herein specified.

### BASIS OF PAYMENT

- 151-4.1** Payment for accepted quantities of work performed by the Contractor and measured by the Resident Engineer shall be made at the contract unit price as provided in paragraph 151.3.1 of this section. Payment shall be full compensation for furnishing all materials and for all labor, equipment, tools, and incidentals necessary to complete the work as specified.



The removal of items within the clearing or clearing and grubbing limits will not be measured and paid for directly but shall be considered incidental to the contract and as a subsidiary obligation of the Contractor, unless shown or specified as otherwise.

**END OF ITEM 151**

## Item 152 Excavation, Subgrade, and Embankment

### DESCRIPTION

- 152-1.1 General.** This item covers excavation, disposal, placement, and compaction of all materials within the limits of the work required to construct safety areas, runways, taxiways, aprons, and intermediate areas as well as other areas for drainage, building construction, parking, or other purposes in accordance with these specifications and in conformity to the dimensions and typical sections as specified in the contract documents.

All suitable material taken from excavation shall be used in the formation of embankment, subgrade, and for backfilling as specified in the contract documents or as directed by the Resident Engineer.

This item shall consist of all topsoil stripping, excavation and undercutting, embankment, final shaping, topsoiling, pavement shoulder construction, grading and compacting necessary to construct the proposed embankments in conformance with the lines and grades as specified in the contract documents.

The Contractor is required to test the existing soils and provide the Resident Engineer with the maximum dry density and optimum moisture. All associated labor, equipment, materials and incidentals associated with obtaining the Proctor information shall be considered incidental to the contract and as a subsidiary obligation of the Contractor. If in the opinion of the Resident Engineer the Proctor information is determined to be non-representative of the material being placed, the Resident Engineer may require the Contractor to provide an additional Proctor that is representative of the materials used.

- 152-1.2 Digital terrain model (DTM).** Digital terrain model (DTM) files of the existing surfaces, finished surfaces and other various surfaces may be used to develop the design plans.

If volumetric quantities were calculated by comparing DTM files of the applicable design surfaces and generating Triangle Volume Reports, electronic copies of DTM files and a paper copy of the original topographic map will be issued to the successful bidder.

If volumetric quantities were calculated using design cross sections which were created for this project using the DTM files of the applicable design surfaces and generating End Area Volume Reports, paper copies of design cross sections and a paper copy of the original topographic map will be issued to the successful bidder.

- 152-1.3 Classification.** All material excavated shall be classified as defined below:

- a. **Unclassified excavation.** Unclassified excavation shall consist of the excavation and disposal of all material, regardless of its nature which is not otherwise classified and paid for under one (1) of the following items.
- b. **Rock excavation.** Rock excavation shall include all solid rock in ledges, in bedded deposits, in unstratified masses, and conglomerate deposits which are so firmly cemented they cannot be removed without blasting or using rippers. All boulders containing a volume of more than one-half (1/2) cubic yard will be classified as "rock excavation."
- c. **Muck excavation.** Muck excavation shall consist of the removal and disposal of deposits or mixtures of soils and organic matter not suitable for foundation material. Muck shall include materials that will decay or produce subsidence in the embankment. It may consist of decaying stumps, roots, logs, humus, or other material not satisfactory for incorporation in the embankment.

- d. Drainage excavation.** Drainage excavation shall consist of all excavation made for the primary purpose of drainage and includes drainage ditches, such as intercepting, inlet or outlet ditches; temporary levee construction; or any other type as specified in the contract documents.
- e. Borrow excavation.** Borrow excavation shall consist of approved material required for the construction of embankments or for other portions of the work in excess of the quantity of usable material available from required excavations. Borrow material shall be obtained from areas designated by the Engineer within the limits of the airport property but outside the normal limits of necessary grading, or from areas outside the airport boundaries.
- 152-1.4 Unsuitable excavation.** Unsuitable material shall be disposed in designated waste areas as specified in the contract documents. Materials containing vegetable or organic matter, such as muck, peat, organic silt, or sod shall be considered unsuitable for use in embankment construction. Material suitable for topsoil may be used on the embankment slope when approved by the Resident Engineer.
- 152-1.5 Geotextile fabric.** This work shall consist of furnishing and installing geotechnical fabric in subgrades or as embankment foundations.

### EQUIPMENT AND MATERIALS

- 152-2.1 Geotextile fabric.** Fabric for soil stabilization shall consist of woven yarns or nonwoven filaments of polyolefins or polyesters. Woven fabrics shall be Class 2 and nonwoven fabrics shall be Class 1 according to AASHTO M 288. The physical properties for soil stabilization fabrics shall be according to the following.

PHYSICAL PROPERTIES		
	Ground Stabilization Woven <sup>1</sup>	Ground Stabilization Nonwoven <sup>1</sup>
Grab Strength, lb ASTM D 4632 <sup>2</sup>	247 min. <sup>3</sup>	202 min. <sup>3</sup>
Elongation/Grab Strain, % ASTM D 4632 <sup>3</sup>	49 max.	50 min.
Trapezoidal Tear Strength, lb – ASTM D 4533 <sup>3</sup>	90 min.	79 min.
Puncture Strength, lb ASTM D 6241 <sup>3</sup>	494 min.	433 min.
Apparent Opening Size, Sieve No. ASTM D 4751 <sup>4</sup>	40 max.	40 max.
Permittivity, sec <sup>-1</sup> ASTM D 4491	0.05 min.	
Ultraviolet Stability, % retained strength after 500 hours of exposure ASTM D 4355	50 min.	50 min.

1. NTPEP results (manufacturer's QC test values) to meet test requirements. Manufacturer shall have public release status and current reports on laboratory results in Test Data of NTPEP's DataMine.
2. MD = Machine direction. XD = Cross-machine direction.
3. Values represent the minimum average roll value (MARV) in the weaker principle direction, MD or XD.
4. Values represent the maximum average roll value.

## CONSTRUCTION METHODS

### 152-3.1 **General.** Before beginning excavation, grading, and embankment operations in any area, the area shall be cleared or cleared and grubbed in accordance with Item 151 titled CLEARING AND GRUBBING.

The suitability of material to be placed in embankments shall be subject to approval by the Resident Engineer. All unsuitable material shall be disposed of in waste areas as specified in the contract documents. All waste areas shall be graded to allow positive drainage of the area and adjacent areas. The surface elevation of waste areas shall be as specified in the contract documents or approved by the Resident Engineer.

When the Contractor's excavating operations encounter artifacts of historical or archaeological significance, the operations shall be temporarily discontinued and the Resident Engineer notified per Section 70, paragraph 70-22 titled ARCHAEOLOGICAL AND HISTORICAL FINDINGS. At the direction of the Resident Engineer, the Contractor shall excavate the site in such a manner as to preserve the artifacts encountered and allow for their removal. Such excavation will be paid for as extra work.

Areas outside the limits of the pavement areas where the top layer of soil has become compacted by hauling or other Contractor activities shall be scarified and disked to a depth of four (4) inches, to loosen and pulverize the soil. Stones or rock fragments larger than four (4) inches in their greatest dimension will not be permitted in the top six (6) inches of the subgrade.

If it is necessary to interrupt existing surface drainage, sewers or under-drainage, conduits, utilities, or similar underground structures, the Contractor shall be responsible for and shall take all necessary precautions to preserve them or provide temporary services. When such facilities are encountered, the Contractor shall notify the Resident Engineer, who shall arrange for their removal if necessary. The Contractor, at their own expense, shall satisfactorily repair or pay the cost of all damage to such facilities or structures that may result from any of the Contractor's operations during the period of the contract.

#### a. **Blasting.** Blasting will be permitted as directed by the Resident Engineer and in accordance with the following:

Blasting will be permitted only when proper precautions are taken for the safety of all persons, work, and property. All damage done to the work or property shall be repaired by the Contractor. The cost of repair is incidental to this item. All operations of the Contractor in connection with the transportation, storage, and use of explosives shall conform to all federal, state and local regulations and explosive manufacturers' instructions, with applicable approved permits reviewed by the Engineer. Any approval will not relieve the Contractor of their responsibility in blasting operations.

Where blasting is approved, the Contractor shall employ a vibration consultant, approved by the Resident Engineer, to advise on explosive charge weights per delay and to analyze records from seismograph recordings. The seismograph shall be capable of producing a permanent record of the three (3) components of the motion in terms of particle velocity, and in addition shall be capable of internal dynamic calibration.

In each distinct blasting area, where pertinent factors affecting blast vibrations and their effects in the area remain the same, the Contractor shall submit a blasting plan of the initial blasts to the Resident Engineer for approval. This plan must consist of hole size, depth, spacing, burden, type of explosives, type of delay sequence, maximum amount of explosive on any one (1) delay period, depth of rock, and depth of overburden if any. The maximum explosive charge weights per delay included in the plan shall not be increased without the approval of the Engineer.

The Contractor shall keep a record of each blast: its date, time and location; the amount of explosives used, maximum explosive charge weight per delay period, and, where necessary, seismograph records identified by instrument number and location.

Blasting and explosive storage shall be in accordance with Section 70, paragraph 70-10 titled USE OF EXPLOSIVES and all federal, state, and local safety regulations.

These records shall be made available to the Resident Engineer on a monthly basis or in tabulated form at other times as required.

**152-3.2 Excavation.** No excavation shall be started until the work has been staked out by the Contractor and the Resident Engineer has obtained from the Contractor, the survey notes of the elevations and measurements of the ground surface. The Contractor and Resident Engineer shall agree that the original ground lines shown on the original topographic mapping are accurate, or agree to any adjustments made to the original ground lines.

All areas to be excavated shall be stripped of vegetation and topsoil. Topsoil shall be stockpiled for future use in areas specified in the contract documents or by the Engineer. All suitable excavated material shall be used in the formation of embankment, subgrade, or other purposes as specified in the contract documents. All unsuitable material shall be disposed of as specified in the contract documents.

The grade shall be maintained so that the surface is well drained at all times. When necessary, temporary drains and drainage ditches shall be installed to intercept or divert surface water that may affect the work.

When the volume of the excavation exceeds that required to construct the embankments to the grades as specified in the contract documents, the excess shall be used to grade the areas of ultimate development or disposed as directed by the Resident Engineer. When the volume of excavation is not sufficient for constructing the embankments to the grades indicated, the deficiency shall be obtained from borrow areas.

- a. **Selective grading.** When selective grading is specified in the contract documents, the more suitable material designated by the Engineer shall be used in constructing the embankment or in capping the pavement subgrade. If, at the time of excavation, it is not possible to place this material in its final location, it shall be stockpiled in approved areas until it can be placed. The more suitable material shall then be placed and compacted as specified. Selective grading shall be considered incidental to the work involved. The cost of stockpiling and placing the material shall be included in the various pay items of work involved.
- b. **Undercutting.** Rock, shale, hardpan, loose rock, boulders, or other material unsatisfactory for safety areas, subgrades, roads, shoulders, or any areas intended for turf shall be excavated to a minimum depth of 12 inches below the subgrade or to the depth specified by the Resident Engineer. Muck, peat, matted roots, or other yielding material, unsatisfactory for subgrade foundation, shall be removed to the depth specified. Unsuitable materials shall be disposed of at locations designated by the Resident Engineer. This excavated material shall be paid for at the contract unit price per cubic yard for "Unclassified Excavation". The excavated area shall be backfilled with suitable material obtained from the grading operations or borrow areas and compacted to specified densities. The necessary backfill will constitute a part of the embankment. Where rock cuts are made, backfill with

select material. Any pockets created in the rock surface shall be drained in accordance with the contract documents.

- c. **Over-break.** Over-break, including slides, is that portion of any material displaced or loosened beyond the finished work as planned or authorized by the Resident Engineer. All over-break shall be graded or removed by the Contractor and disposed of as directed by the Resident Engineer. The Resident Engineer shall determine if the displacement of such material was unavoidable and their own decision shall be final. Payment will not be made for the removal and disposal of over-break that the Resident Engineer determines as avoidable. Unavoidable over-break will be classified as "Unclassified Excavation."
- d. **Removal of utilities.** The removal of existing structures and utilities required to permit the orderly progress of work will be accomplished by someone other than the Contractor, for example, the utility unless otherwise specified in the contract documents. All existing foundations shall be excavated at least two (2) feet below the top of subgrade or as specified in the contract documents, and the material disposed of as directed by the Resident Engineer. All foundations thus excavated shall be backfilled with suitable material and compacted as specified for embankment or as specified in the contract documents.

**152-3.3 Borrow excavation.** Borrow areas within the airport property are specified in the contract documents. Borrow excavation shall be made only at these designated locations and within the horizontal and vertical limits as staked or as directed by the Engineer. All unsuitable material shall be disposed of by the Contractor as specified in the contract documents. All borrow pits shall be opened to expose the various strata of acceptable material to allow obtaining a uniform product. Borrow areas shall be drained and left in a neat, presentable condition with all slopes dressed uniformly. Borrow areas shall not create a hazardous wildlife attractant.

When there are no borrow sources within the boundaries of the airport property, the Contractor shall be responsible to locate and obtain borrow sources, subject to the approval of the Project Engineer. The Contractor shall notify the Resident Engineer at least 15 days prior to beginning the excavation so necessary measurements and tests can be made

**152-3.4 Drainage excavation.** Drainage excavation shall consist of excavating drainage ditches including intercepting, inlet, or outlet ditches; or other types as specified in the contract documents. The work shall be performed in proper sequence with the other construction. The location of all ditches or levees shall be established on the ground. Ditches shall be constructed prior to starting adjacent excavation operations. All satisfactory material shall be placed in embankment fills; unsuitable material, waste or surplus shall be placed in designated waste areas specified in the contract documents or as directed by the Resident Engineer. All necessary work shall be performed true to final line, elevation, and cross-section. The Contractor shall maintain ditches constructed on the project to the required cross-section and shall keep them free of debris or obstructions until the project is accepted. Where necessary, sufficient openings shall be provided through spoil banks to permit drainage from adjacent lands.

The Contractor shall construct temporary channel relocations to divert storm water from the locations of proposed drainage structures. These channel relocations shall be at the location and of a cross section designed by the Contractor. Excavation for the temporary channel relocations shall not be measured for payment.

**152-3.5 Preparation of cut areas or areas where existing pavement has been removed.** In those areas on which a subbase or base course is to be placed, the top 12 inches of subgrade shall be compacted to not less than 100 % of maximum density for non-cohesive soils, and 95% of maximum density for cohesive soils as determined by AASHTO T 99 for areas designated for aircraft with gross weights of 60,000 pounds or less and AASHTO T 180 for areas designated for aircraft with gross weights greater than 60,000 pounds. . As used in this specification, "non-cohesive" shall mean those soils having a plasticity index (PI) of less than three (3) as determined by AASHTO T 90.

**152-3.6 Preparation of embankment area.** When an embankment is to be constructed to a height of four (4) feet or less, all sod and vegetative matter shall be removed from the surface upon which the embankment is to be placed. The cleared surface shall be broken up by plowing or scarifying to a minimum depth of six (6) inches and shall then be compacted per paragraph 152-3.10 titled COMPACTION REQUIREMENTS.

Sloped surfaces steeper than one (1) vertical to four (4) horizontal shall be plowed, stepped, benched, or broken up so that the fill material will bond with the existing material. When the subgrade is part fill and part excavation or natural ground, the excavated or natural ground portion shall be scarified to a depth of 12 inches and compacted as specified for the adjacent fill.

No direct payment shall be made for the work performed under this section. The necessary clearing and grubbing and the quantity of excavation removed will be paid for under the respective items of work.

**152-3.7 Control strip.** The first half-day of construction of subgrade and/or embankment shall be considered as a control strip for the Contractor to demonstrate, in the presence of the Resident Engineer, that the materials, equipment, and construction processes meet the requirements of this specification. The sequence and manner of rolling necessary to obtain specified density requirements shall be determined. The maximum compacted thickness may be increased to a maximum of 12 inches upon the Contractor's demonstration that approved equipment and operations will uniformly compact the lift to the specified density. The Resident Engineer must witness this demonstration and approve the lift thickness prior to full production.

Control strips that do not meet specification requirements shall be reworked, re-compacted, or removed and replaced at the Contractor's expense. Full operations shall not begin until the control strip has been accepted by the Resident Engineer. The Contractor shall use the same equipment, materials, and construction methods for the remainder of construction, unless adjustments made by the Contractor are approved in advance by the Engineer.

**152-3.8 Formation of embankments.** The material shall be constructed in lifts as established in the control strip, but not less than six (6) inches nor more than 12 inches of compacted thickness.

When more than one (1) lift is required to establish the layer thickness specified in the contract documents, the construction procedure described here shall apply to each lift. No lift shall be covered by subsequent lifts until tests verify that compaction requirements have been met. The Contractor shall rework, recompact and retest any material placed which does not meet the specifications.

The lifts shall be placed, to produce a soil structure as shown on the typical cross-section or as directed by the Resident Engineer. Materials such as brush, hedge, roots, stumps, grass and other organic matter, shall not be incorporated or buried in the embankment.

Earthwork operations shall be suspended at any time when satisfactory results cannot be obtained due to rain, freezing, or other unsatisfactory weather conditions in the field. Frozen material shall not be placed in the embankment nor shall embankment be placed upon frozen material. Material shall not be placed on surfaces that are muddy, frozen, or contain frost. The Contractor shall drag, blade, or slope the embankment to provide surface drainage at all times.

The material in each lift shall be within  $\pm 2\%$  of optimum moisture content before rolling to obtain the prescribed compaction. The material shall be moistened or aerated as necessary to achieve a uniform moisture content throughout the lift. Natural drying may be accelerated by blending in dry material or manipulation alone to increase the rate of evaporation.

The Contractor shall make the necessary corrections and adjustments in methods, materials or moisture content to achieve the specified embankment density.

The Contractor will take samples of excavated materials which will be used in embankment for testing and develop a Moisture-Density Relations of Soils Report (Proctor) in accordance with AASHTO T 99 for areas designated for aircraft with gross weights of 60,000 pounds or less and

AASHTO T 180 for areas designated for aircraft with gross weights greater than 60,000 pounds. A new Proctor shall be developed for each soil type based on visual classification.

Density tests will be taken by the Resident Engineer for every 1,000 square yards of compacted embankment for each lift which is required to be compacted, or other appropriate frequencies as determined by the Resident Engineer.

If the material has greater than 30% retained on the three-quarters (3/4) inch sieve, follow AASHTO T 180 Annex Correction of maximum dry density and optimum moisture for oversized particles.

Rolling operations shall be continued until the embankment is compacted to a depth of 12" not less than 100% of maximum density for non-cohesive soils, and 95% of maximum density for cohesive soils as determined by AASHTO T 99 for areas designated for aircraft with gross weights of 60,000 pounds or less and AASHTO T 180 for areas designated for aircraft with gross weights greater than 60,000 pounds. As used in this specification, "non-cohesive" shall mean those soils having a plasticity index (PI) of less than three (3) as determined by AASHTO T 90.

On all areas outside of the pavement areas, no compaction will be required on the top four (4) inches which shall be prepared for a seedbed in accordance with Item 901, titled SEEDING.

The in-place field density shall be determined in accordance with AASHTO T 310 (Direct Transmission Density/Backscatter Moisture). The machine shall be calibrated in accordance with AASHTO T 310. The Resident Engineer shall perform all density tests for acceptance. If the specified density is not attained, the area represented by the test or as designated by the Resident Engineer shall be reworked and/or re-compacted and additional random tests made. This procedure shall be followed until the specified density is reached.

Compaction areas shall be kept separate, and no lift shall be covered by another lift until the proper density is obtained.

During construction of the embankment, the Contractor shall route all construction equipment evenly over the entire width of the embankment as each lift is placed. Lift placement shall begin in the deepest portion of the embankment fill. As placement progresses, the lifts shall be constructed approximately parallel to the finished pavement grade line.

When rock, concrete pavement, asphalt pavement, and other embankment material are excavated at approximately the same time as the subgrade, the material shall be incorporated into the outer portion of the embankment and the subgrade material shall be incorporated under the future paved areas. Stones, fragmentary rock, and recycled pavement larger than four (4) inches in their greatest dimensions will not be allowed in the top 12 inches of the subgrade. Rockfill shall be brought up in lifts as specified or as directed by the Resident Engineer and the finer material shall be used to fill the voids forming a dense, compact mass, rock, cement concrete pavement, asphalt pavement, and other embankment material shall not be disposed of except at places and in the manner specified in the contract documents or as directed by the Resident Engineer.

When the excavated material consists predominantly of rock fragments of such size that the material cannot be placed in lifts of the prescribed thickness without crushing, pulverizing or further breaking down the pieces, such material may be placed in the embankment as directed in lifts not exceeding two (2) feet in thickness. Each lift shall be leveled and smoothed with suitable equipment by distribution of spalls and finer fragments of rock. The lift shall not be constructed above an elevation four (4) feet below the finished subgrade.

The Contractor shall be responsible for the stability of all embankments made under the contract and shall replace any portion, which, in the opinion of the Resident Engineer, has become displaced due to carelessness or negligence on the part of the Contractor.

There will be no separate measurement of payment for compacted embankment. All costs incidental to placing in lifts, compacting, discing, watering, mixing, sloping, and other operations necessary for construction of embankments will be included in the contract price for excavation,



borrow, or other items. Payment for compacted embankment will be made under embankment in-place and no payment will be made for excavation, borrow, or other items.

**152-3.9 Proof rolling.** The purpose of proof rolling the subgrade is to identify any weak areas in the subgrade and not for compaction of the subgrade. After compaction is completed, the subgrade area shall be proof rolled with a 20-ton tandem axle dual wheel dump truck loaded to the legal limit with tires inflated to 125 pounds per square inch in the presence of the Resident Engineer. Apply a minimum of 40 coverage, or as specified by the Resident Engineer, under pavement areas. A coverage is defined as the application of one (1) tire print over the designated area. Soft areas of subgrade that deflect more than one (1) inch or show permanent deformation greater than one (1) inch shall be removed and replaced with suitable material or reworked to conform to the moisture content and compaction requirements in accordance with these specifications. Removal and replacement of soft areas is incidental to this item.

**152-3.10 Compaction requirements.** The subgrade under areas to be paved shall be compacted to a depth of 12 inches and to a density of not less than 100% of the maximum dry density as determined by AASHTO T 99 for areas designated for aircraft with gross weights of 60,000 pounds or less and AASHTO T 180 for areas designated for aircraft with gross weights of greater than 60,000 pounds. The subgrade in areas outside the limits of the pavement areas shall be compacted to a depth of 12 inches and to a density of not less than 95% of the maximum density as determined by AASHTO T 99.

The material to be compacted shall be within  $\pm 2\%$  of optimum moisture content before being rolled to obtain the prescribed compaction (except for expansive soils). When the material has greater than 30% retained on the three-quarters (3/4) inch sieve, follow the methods in AASHTO T 99, AASHTO T 180, or procedures in AASHTO T 180 Annex for correction of maximum dry density and optimum moisture for oversized particles. One (1) test shall be made for moisture content and compaction for each 1,500 square yards of subgrade. All quality assurance testing shall be done by the Resident Engineer.

The in-place field density shall be determined in accordance with AASHTO T 310 (Direct Transmission Density/Backscatter Moisture). The machine shall be calibrated in accordance with AASHTO T 310 within 12 months prior to its use on this contract. The gage shall be field standardized daily.

Maximum density refers to maximum dry density at optimum moisture content unless otherwise specified.

If the specified density is not attained, the entire lot shall be reworked and/or re-compacted and additional random tests made. This procedure shall be followed until the specified density is reached.

All cut-and-fill slopes shall be uniformly dressed to the slope, cross-section, and alignment specified in the contract documents or as directed by the Resident Engineer and the finished subgrade shall be maintained.

**152-3.11 Finishing and protection of subgrade.** Finishing and protection of the subgrade is incidental to this item. Grading and compacting of the subgrade shall be performed so that it will drain readily. All low areas, holes or depressions in the subgrade shall be brought to grade. Scarifying, blading, rolling and other methods shall be performed to provide a thoroughly compacted subgrade shaped to the lines and grades specified in the contract documents. All ruts or rough places that develop in the completed subgrade shall be graded, re-compacted, and retested. The Contractor shall protect the subgrade from damage and limit hauling over the finished subgrade to only traffic essential for construction purposes.

The Contractor shall maintain the completed course in satisfactory condition throughout placement of subsequent layers. Storage or stockpiling of materials on the top of the subgrade will not be permitted. No subbase, base, or surface course shall be placed on the subgrade until the subgrade has been accepted by the Resident Engineer.

**152-3.12 Geotextile fabric.** When specified, fabric shall be delivered to the job site in such a manner as to facilitate handling and incorporation into the work without damage. Material shall be stored in such a manner as to prevent exposure to direct sunlight and damage by other construction activities.

Prior to installation of the fabric, the application surface shall be cleared of debris, sharp objects and trees. Tree stumps shall be cut to the level of the ground surface. If the stumps cannot be cut to the ground level, they shall be completely removed. In the case of subgrades, all wheel tracks or ruts in excess of three (3) inches in depth shall be graded smooth or otherwise filled with soil to provide a reasonably smooth surface.

Fabric may be installed on the application surface either by hand or by mechanical method, provided that the fabric is not torn or the surface rutted.

Fabric of insufficient width or length to fully cover the specified area shall be lapped or sewn. The minimum laps for the lap only areas are two (2) feet and for sewn areas are four (4) inches. If sewn, the seam strength shall be equal to or exceed the minimum grab tensile strength of the fabric when tested wet.

The granular blanket shall be constructed to the width and depth specified in the contract documents. Granular embankment, special shall be used in conjunction with the geotechnical fabric. The material shall be back dumped on the fabric in a sequence of operations beginning at the outer edges of the treatment area with subsequent placement towards the middle.

Placement of material on the fabric shall be accomplished by spreading dumped material off of previously placed material with a bulldozer blade or end loader, in such a manner as to prevent tearing or shoving of the cloth. Dumping of material directly on the fabric will only be permitted to establish an initial working platform. No vehicles or construction equipment shall be allowed on the fabric prior to placement of the granular blanket.

The granular material shall be placed to the full required thickness and compacted before any loaded trucks are allowed on the blanket.

Fabric which is damaged during installation or subsequent placement of granular material, due to failure of the Contractor to comply with these provisions, shall be repaired or replaced.

Torn fabric may be patched in place by cutting and placing a piece of the same fabric over the tear. The dimensions of the patch shall be at least 2 feet larger than the tear in each direction, and shall be weighted or otherwise secured to prevent the granular material from causing lap separation.

**152-3.13 Haul.** All hauling will be considered a necessary and incidental part of the work. The Contractor shall include the cost in the contract unit price for the pay of items of work involved. No payment will be made separately or directly for hauling on any part of the work.

The Contractor's equipment shall not cause damage to any excavated surface, compacted lift or to the subgrade as a result of hauling operations. Any damage caused as a result of the Contractor's hauling operations shall be repaired at the Contractor's expense.

The Contractor shall take special precautions when hauling excavated material so as not to create deep ruts in the hauling areas designated by the Project Engineer. All existing graded, turfed, sodded and/or farmed areas that are disturbed or rutted by the Contractor during all of their hauling operations, shall be regraded, re-turfed and refinished at their own expense and to the satisfaction of the Resident Engineer. No claim for haul will be allowed the Contractor.

The Contractor will not be allowed to haul any materials across areas which are currently in crops and are designated by the Airport Management to be used for agriculture or which have been recently seeded under this or a previous contract.

The Contractor shall be responsible for providing, maintaining and removing any haul roads or routes within or outside of the work area, and shall return the affected areas to their former condition, unless otherwise authorized in writing by the Owner. No separate payment will be

made for any work or materials associated with providing, maintaining and removing haul roads or routes.

- 152-3.14 Surface tolerances.** In those areas on which a subbase or base course is to be placed, the surface shall be tested for smoothness and accuracy of grade and crown. Any portion lacking the required smoothness or failing in accuracy of grade or crown shall be scarified to a depth of at least three (3) inches, reshaped and re-compacted to grade until the required smoothness and accuracy are obtained and approved by the Resident Engineer. The Contractor shall perform all final smoothness and grade checks in the presence of the Resident Engineer. Any deviation in surface tolerances shall be corrected by the Contractor at the Contractor's expense.
- a. Smoothness.** The finished surface shall not vary more than  $\pm 1/2$  inch when tested with a 12 or 16-foot straightedge applied parallel with and at right angles to the centerline. The straightedge shall be moved continuously forward at half the length of the 12 or 16-foot straightedge for the full length of each line on a 50-foot grid.
- b. Grade.** The grade and crown shall be measured on a 50-foot grid and shall be within  $\pm 0.05$  feet of the specified grade.

On safety areas, turfed areas and other designated areas within the grading limits where no subbase or base is to be placed grade shall not vary more than 0.10 feet from specified grade. Any deviation in excess of this amount shall be corrected by loosening, adding or removing materials, and reshaping.

- 152-3.15 Topsoil.** When topsoil is specified or required as specified in the contract documents or under Item 905 titled TOPSOIL it shall be salvaged from stripping or other grading operations. The topsoil shall meet the requirements of Item 905 titled TOPSOIL. If, at the time of excavation or stripping, the topsoil cannot be placed in its final section of finished construction, the material shall be stockpiled at approved locations determined by the Airport at no additional cost to the contract. Stockpiles shall be located as specified in the contract documents and the approved CSPP, and shall not be placed on areas that subsequently will require any excavation or embankment fill. If, in the judgment of the Resident Engineer, it is practical to place the salvaged topsoil at the time of excavation or stripping, the material shall be placed in its final position without stockpiling or further re-handling.

Upon completion of grading operations, stockpiled topsoil shall be handled and placed as specified in the contract documents and as required in Item 905 titled TOPSOIL. Topsoil shall be paid for as provided in Item 905. No direct payment will be made for topsoil under this item.

- 152-3.16 Equipment.** All equipment necessary to move and compact the material shall be provided and must be approved by the Engineer. The equipment shall be of such capacity that the construction schedule can be maintained in accordance with the total calendar days bid for the project. The Contractor shall furnish, operate and maintain such equipment as is necessary to control uniform density, layers, section and smoothness of grade.
- 152-3.17 Field tile.** Any farm drain tile or other underground construction encountered in the work shall be located and staked and reported to the Resident Engineer in writing. Any drainage lines, which are cut or damaged by grading, trenching, excavation or other construction activities, shall be repaired and connected to the proposed storm sewer system, where practical, by the Contractor at their expense in such manner as to render the lines usable for the purpose intended.
- 152-3.18 Work area conditions.** If the work area conditions become such that the health and safety of the Contractor's workers, the engineers, or the public are affected, the Contractor shall rectify the condition through watering, disking or blading of the work area or other suitable method, as approved by the Resident Engineer. This maintenance cost shall be considered incidental to the contract. As a minimum, Federal, State and Local laws, rules and regulations concerning construction safety and health standards shall be enforced.

## METHOD OF MEASUREMENT

**152-4.1 General.** Prior to beginning any work, the Contractor shall verify all earthwork quantities shown in the contract documents are in agreement with earthwork quantities from their own calculations. Existing grades on the design cross sections or DTM's, where they do not match the locations of actual spot elevations shown on the topographic map, were developed by computer interpolation from those spot elevations. Prior to disturbing original grade, Contractor shall verify the accuracy of the existing ground surface by verifying spot elevations at the same locations where original field survey data was obtained as indicated on the topographic map. Contractor shall recognize that, due to the interpolation process, the actual ground surface at any particular location may differ somewhat from the interpolated surface shown on the design cross sections or obtained from the DTM's. Contractor's verification of original ground surface, however, shall be limited to verification of spot elevations as indicated herein, and no adjustments will be made to the original ground surface unless the Contractor demonstrates that spot elevations shown are incorrect. For this purpose, spot elevations which are within 0.1 foot of the stated elevations for ground surfaces, or within 0.04 foot for hard surfaces (pavements, buildings, foundations, structures, etc.) shall be considered "no change". Only deviations in excess of these will be considered for adjustment of the original ground surface. If the Contractor's verification identifies discrepancies in the topographic map, the Contractor shall notify the Resident Engineer in writing at least two (2) weeks before disturbance of existing grade to allow sufficient time to verify the submitted information and make adjustments to the design cross sections or DTM's. Disturbance of existing grade in any area shall constitute acceptance by the Contractor of the accuracy of the original elevations shown on the topographic map for that area.

When the project is constructed essentially to the lines, grades, or dimensions shown on the Plans, and the Contractor and the Resident Engineer have agreed in writing on form AER 981, *Agreement on Accuracy of Plan Quantities*, that the plan quantities are accurate, no further measurement will be required and payment will be made for the quantities shown in the contract for the various items involved. If an error in plan quantity is discovered after the work has been started, an appropriate adjustment will be made.

When the contract documents have been altered or when disagreement exists between the Contractor and the Engineer as to the accuracy of the plan quantities, either party shall, before any work is started which would affect the measurement, have the right to request in writing and thereby cause the quantities involved to be measured as herein specified.

**152-4.2** For payment specified by the cubic yard, measurement for all excavation or embankment shall be computed by the average end areas of design cross sections or the comparison of digital terrain model (DTM) surfaces for computation of neat line design quantities. The end area is that bound by the original ground line established by field cross-sections and the final theoretical pay line established by cross-sections specified in the contract documents, subject to verification by the Resident Engineer. After completion of all excavation or embankment operations and prior to the placing of base or subbase material, the final excavation or embankment shall be verified by the by means of field cross-sections taken randomly at intervals not exceeding 500 linear feet.

**152-4.3** The quantity of unclassified, rock, muck, or drainage excavation shall be measured for payment by the number of cubic yards in its original position. Measurement shall not include the quantity of materials excavated without authorization beyond normal slope lines, or the quantity of material used for purposes other than those directed.

**152-4.4** The quantity of embankment in place shall be measured for payment by the number of cubic yards in its final position.

**152-4.5** The quantity of borrow material shall be measured for payment by the number of cubic yards in its original position at the borrow pit.

- 152-4.6** The quantity of geotextile fabric shall be measured for payment by the number of square yards as specified, completed, and accepted by the Resident Engineer.

#### **BASIS OF PAYMENT**

- 152-5.1** Payment for accepted quantities of work performed by the Contractor and measured by the Resident Engineer shall be made at the contract unit price as specified in paragraphs 152-4.1 through 152-4.6 of this section. Payment shall be full compensation for furnishing all materials, labor, equipment, tools, and incidentals necessary to complete the work as specified.

#### **REFERENCES**

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

##### **ASTM International (ASTM)**

ASTM D 4355	Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture, and heat in a Xenon Arc-Type Apparatus
ASTM D 4491	Test Methods for Water Permeability of Geotextiles by Permittivity
ASTM D 4533	Standard Test Method for Trapezoid Tearing Strength of Geotextiles
ASTM D 4632	Standard Test Method for Grab Breaking Load and Elongation of Geotextiles
ASTM D 4751	Standard Test Methods for Determining Apparent Opening Size of a Geotextile
ASTM D 6241	Standard Test Method for Static Puncture Strength of Geotextiles and Geotextile-Related Products Using a 50-mm Probe

##### **American Association of State Highway and Transportation Officials (AASHTO)**

AASHTO M 288	Standard Specification for Geosynthetic Specification for Highway Applications
AASHTO T 90	Standard Method of Test for Determining the Plastic Limit and Plasticity Index of Soils
AASHTO T 99	Standard Method of Test for Moisture–Density Relations of Soils Using a 2.5-kg (5.5-lb) Rammer and a 305-mm (12-in.) Drop
AASHTO T 180	Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop
AASHTO T 310	Standard Method of Test for In-Place Density and Moisture Content of Soil and Soil–Aggregate by Nuclear Methods (Shallow Depth)

##### **Federal Aviation Administration Advisory Circulars (AC)**

AC 150/5370-2	Operational Safety on Airports During Construction Software
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##### **U.S. Department of Transportation**

FAA RD-76-66	Design and Construction of Airport Pavements on Expansive Soils
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**END OF ITEM 152**

### Item 153 Controlled Low-Strength Material (CLSM)

#### DESCRIPTION

- 153-1.1** This item shall consist of furnishing, transporting, and placing a controlled low-strength material (CLSM) as flowable backfill in trenches or at other locations specified in the contract documents or as directed by the Resident Engineer.

#### MATERIALS

**153-2.1 Materials.**

- a. **Cement.** Cement shall conform to the requirements of AASHTO M 85 Type I.
- b. **Fly ash.** Fly ash shall conform to AASHTO M 295, Class C or F.
- c. **Fine aggregate (sand).** The fine aggregate gradation shall be FA 1 or FA 2. Blending of fine aggregate will not be permitted.

#### Fine Aggregate Gradation

Sieve Size	Gradation Percent Passing	
	FA 1	FA 2
3/8	100	100
No. 4	97±3	97±3
No. 16	65±20	65±20
No. 50	16±13	20±10
No. 100	5±5	5±5

- d. **Water.** Water used in mixing or curing shall be from potable water sources. Other sources shall be tested in accordance with AASHTO T 26 and must be approved by the Engineer prior to use.

#### MIX DESIGN

- 153-3.1 Mix design criteria, mixing and proportioning.** The Contractor shall submit, to the Resident Engineer, a mix design including the proportions and source of aggregate, fly ash, cement, water, and approved admixtures. No CLSM mixture shall be produced for payment until the Engineer has given written approval of the proportions. The proportions shall be prepared by a laboratory and shall remain in effect for the duration of the project. The proportions shall establish a single percentage or weight for aggregate, fly ash, cement, water, and any admixtures proposed. Laboratory costs are incidental to this item. The mix design shall meet the following criteria.

### Mix Design Criteria

Parameter	Value
Flow	≥ 7 inches
Air Content	0 – 25%
Dynamic Cone Penetration (DCP) at 3 days	≤ 1.5 inches/blow
Compressive Strength at 28 days	100 psi to 200 psi, no significant strength gain after 28 days

- a. **Department mix design.** The Department mix design shall be Mix 1, 2, or 3 and shall be proportioned to yield approximately one (1) cubic yard and/or be on the current Illinois Department of Transportation's published Qualified Product List of *Controlled Low-Strength Material (CLSM) Proprietary Mix Designs by Contractors*.

#### Mix 1

Portland Cement	50 lb
Fly Ash – Class C or F	125 lb
Fine Aggregate – Saturated Surface Dry	2900 lb
Water	50-65 gal
Air Content	No air is entrained

#### Mix 2

Portland Cement	125 lb
Fine Aggregate – Saturated Surface Dry	2500 lb
Water	35-50 gal
Air Content	15-25%

#### Mix 3

Portland Cement	40 lb
Fly Ash – Class C or F	125 lb
Fine Aggregate – Saturated Surface Dry	2500 lb
Water	35-50 gal
Air Content	15-25%

- b. **Contractor mix design.** A Contractor may submit their own mix design and may propose alternate fine aggregate materials, fine aggregate gradations, or material proportions. A Level III PCC Technician shall develop the mix design.

The mix design shall include the following information.

- (1) Source of materials.

- (2) Gradation of fine aggregate.
- (3) Specific gravities, material proportions, and any other parameters used in the mix design process.
- (4) Target flow and air content.
- (5) Test data indicating compressive strength at 28 and 180 days.

If the Contractor submits a mix design which has not been previously verified by the Department, a trial batch shall be performed. The trial batch shall be scheduled a minimum of 30 calendar days prior to anticipated use and shall be performed in the presence of the Engineer. A minimum of one (1) cubic yard trial batch shall be produced and placed offsite. The trial batch shall be produced with the equipment and methods intended for construction. The trial batch will be evaluated for temperature, flow, air content, dynamic cone penetration (DCP), and 28-day compressive strength by the Engineer. The Engineer reserves the right to require a 180-day compressive strength test.

Verification of the mix design will include the trial batch test results, field observations (i.e. flowability and solid suspension), and other criteria as determined by the Engineer. The Contractor will be notified in writing of verification. Verification of a mix design by the Engineer shall in no manner be construed as acceptance of any CLSM produced.

## CONSTRUCTION METHODS

### 153-4.1 Placement.

- a. **Placement.** CLSM may be placed by any reasonable means from the mixing unit into the space to be filled. Agitation is required during transportation and waiting time. Placement shall be performed so structures or pipes are not displaced from their final position and intrusion of CLSM into unwanted areas is avoided. The material shall be brought up uniformly to the fill line specified in the contract documents or as directed by the Resident Engineer. Each placement of CLSM shall be as continuous an operation as possible. If CLSM is placed in more than one (1) lift, the base lift shall be free of surface water and loose foreign material prior to placement of the next lift.
- b. **Contractor quality control.** The Contractor shall collect all batch tickets to verify the CLSM delivered to the project conforms to the mix design. The Contractor shall verify daily that the CLSM is consistent with 153-3.1, titled MIX DESIGN CRITERIA, MIXING AND PROPORTIONING. Adjustments shall be made as necessary to the proportions and materials as needed. The Contractor shall provide all batch tickets to the Resident Engineer.
- c. **Limitations of placement.** CLSM shall not be placed on frozen ground. Mixing and placing may begin when the air or ground temperature is at least 35°F and rising. Mixing and placement shall stop when the air temperature is 40°F and falling or when the anticipated air or ground temperature will be 35°F or less in the 24-hour period following proposed placement. At the time of placement, CLSM shall have a temperature of at least 40°F.

### 153-4.2 Curing and protection.

- a. **Curing.** The air in contact with the CLSM shall be maintained at temperatures above freezing for a minimum of 72 hours. If the CLSM is subjected to temperatures below 32°F, the material may be rejected by the Resident Engineer if damage to the material is observed.
- b. **Protection.** The CLSM shall not be subject to loads and shall remain undisturbed by construction activities for a period of 48 hours or until a compressive strength of 15 pounds per square inch is obtained. The Contractor shall be responsible for providing evidence to the Resident Engineer that the material has reached the desired strength.



**153-4.3 Quality assurance (QA) acceptance.** CLSM QA acceptance shall be based upon batch tickets provided by the Contractor to the Resident Engineer to confirm that the delivered material conforms to the mix design.

**153-4.4 Sampling and testing.**

- a. The sampling and testing of CLSM shall be according to ITP 307, *Sampling and Testing of Controlled Low-Strength Material (CLSM)*.
- b. The dynamic cone penetration test (DCP) shall be according to ITP 501, *Dynamic Cone Penetration (DCP)*.

**METHOD OF MEASUREMENT**

**153-5.1** The quantity of controlled low-strength material (CLSM) shall be measured for payment by the number of cubic yards as specified, completed, and accepted by the Resident Engineer.

**BASIS OF PAYMENT**

**153-6.1** Payment for accepted quantities of work performed by the Contractor and measured by the Resident Engineer shall be made at the contract unit price as specified in paragraph 153-5.1 of this section. Payment shall be full compensation for all materials, equipment, labor, and incidentals required to complete the work as specified.

**REFERENCES**

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

**American Association of State Highway and Transportation Officials (AASHTO)**

AASHTO M 85	Standard Specification for Portland Cement
AASHTO M 295	Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
AASHTO T 26	Standard Method of Test for Quality of Water to Be Used in Concrete

**Illinois Department of Transportation, Bureau of Materials Illinois Laboratory Test Procedure (ITP)**

*Manual of Test Procedures for Materials*

ITP 307	Sampling and Testing of Controlled Low-Strength Material (CLSM)
ITP 501	Dynamic Cone Penetration (DCP)

**Illinois Department of Transportation, Bureau of Materials Qualified Product List**

Controlled Low-Strength Material (CLSM) Proprietary Mix Designs by Contractors

**END OF ITEM 153**

### Item 154 Subbase Course

#### DESCRIPTION

- 154-1.1** This item shall consist of a subbase course composed of granular materials constructed on a prepared subgrade or underlying course in accordance with these specifications, and in conformity with the dimensions and typical cross-section specified in the contract documents.

#### MATERIALS

- 154-2.1 Description.** The coarse aggregate shall be gravel, crushed gravel, crushed stone, crushed concrete, crushed slag, or crushed sandstone.

The coarse aggregate, if approved by the Engineer, may be produced by blending aggregates from more than one (1) source, provided the method of blending results in a uniform product. The components of a blend need not be of the same kind of material. The source of material or blending proportions shall not be changed during the progress of the work without written permission from the Engineer. Where a natural aggregate is deficient in fines, the material added to make up deficiencies shall be a fine aggregate of Class C quality or better.

- 154-2.2 Quality.** The coarse aggregate shall be Class D Quality or better.

#### Coarse Aggregate Quality

Quality Test	Class
	D
Na <sub>2</sub> SO <sub>4</sub> Soundness 5 Cycle, Illinois Modified AASHTO T 104 <sup>1</sup> , % Loss max.	25
Los Angeles Abrasion, Illinois Modified AASHTO T 96, % Loss max.	45

1. Does not apply to crushed concrete.

- 154-2.3 Gradation requirements.** The coarse aggregate gradations shall be as follows.

### Subbase Gradation Requirements

Sieve Size	Gradation Percent Passing			
	CA 6	CA 10	CA 12	CA 19
3 inch				100
1-1/2 inch	100			
1 inch	95±5	100		95±5
3/4 inch		95±5	100	
1/2 inch	75±15	80±15	95±5	
3/8 inch			85±10	
No. 4	43±13	50±10	60±10	60±15
No. 16	25±15	30±15	35±10	40±15
No. 50				20±10
No. 200	8±4	9±4	9±4	10±5

When non frost susceptible material is required, the maximum allowable material passing the No. 200 (75 µm) sieve shall be 10%. The Engineer should reference the geotechnical report.

- 154-2.4 Plasticity.** All material shall comply with the plasticity index requirements listed below. The plasticity index requirement for crushed gravel, crushed stone, and crushed slag may be waived if the ratio of the percent passing the No. 200 sieve to that passing the No. 40 sieve is 0.60 or less.

Use	Plasticity Index - Percent	
	Gravel	Crushed Gravel, Stone, & Slag
Granular Subbase	0 to 9	---

Plasticity Index shall be determined by the method given in AASHTO T 90. Where shale in any form exists in the producing ledges, crushed stone samples shall be soaked a minimum of 18 hours before processing for plasticity index or minus No. 40 material. When clay material is added to adjust the plasticity index, the clay material shall be in a minus No. 4 sieve size.

#### 154-2.5 Sampling and testing.

- a. **Aggregate base materials.** Samples shall be taken by the Contractor per the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 11-08, *Aggregate Gradation Control System (AGCS)*, for initial aggregate subbase requirements and gradation. Material shall meet the requirements in paragraphs 154-2.1 through 154-2.4. The Contractor shall submit to the Resident Engineer certified test results showing that the aggregate meets the material requirements of this section. Tests shall be representative of the material to be used for the project.
- b. **Gradation requirements.** The Contractor shall take at least one (1) aggregate subbase sample per day in the presence of the Resident Engineer to check the final gradation. Sampling shall be per the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 11-08, *Aggregate Gradation Control System (AGCS)*. Material shall meet the requirements in paragraph 154-2.1 through 154-2.4. The samples shall be taken from the in-place, un-compacted material at random sampling locations determined by the Resident Engineer. Results shall be furnished to the Resident Engineer by the Contractor each day during construction. Results shall be furnished to the Resident Engineer by the Contractor each day during construction.

**154-2.6 Geotextile fabric.** Geotextile fabric shall conform to the requirements of Item 152 titled EXCAVATION, SUBGRADE, AND EMBANKMENT.

**154-2.7 Geogrid.** Reserved.

### CONSTRUCTION METHODS

**154-3.1 General.** The subbase course shall be placed where specified in the contract documents or as directed by the Resident Engineer. The material shall be shaped and thoroughly compacted within the tolerances specified.

Granular subbases which, due to grain sizes or shapes, are not sufficiently stable to support the construction equipment without movement, shall be mechanically modified to the depth necessary to provide stability as directed by the Resident Engineer. The mechanical modification shall include the addition of a fine-grained medium to bind the particles of the subbase material sufficiently to furnish a bearing strength, so the course will not deform under construction equipment traffic.

**154-3.2 Preparing underlying course.** The underlying subgrade and/or subbase shall be checked and accepted by the Resident Engineer before base course placing and spreading operations begin. Re-proof rolling of the subgrade or proof rolling of the subbase in accordance with Item 152 titled EXCAVATION, SUBGRADE, AND EMBANKMENT, at the Contractor's expense, may be required by the Resident Engineer if the Contractor fails to ensure proper drainage or protect the subgrade and/or subbase. Any ruts or soft, yielding areas due to improper drainage conditions, hauling, or any other cause, shall be corrected before the base course is placed. To ensure proper drainage, the spreading of the base shall begin along the centerline of the pavement on a crowned section or on the high side of the pavement with a one-way slope.

**154-3.3 Control strip.** The first half-day of subbase construction shall be considered as a control strip for the Contractor to demonstrate, in the presence of the Engineer, that the materials, equipment, and construction processes meet the requirements of this specification. The sequence and manner of rolling necessary to obtain specified density requirements shall be determined. The maximum compacted thickness may be increased to a maximum of 12 inches upon the Contractor's demonstration that approved equipment and operations will uniformly compact the lift to the specified density. The Engineer must witness this demonstration and approve the lift thickness prior to full production.

Control strips that do not meet specification requirements shall be reworked, re-compacted, or removed and replaced at the Contractor's expense. Full operations shall not begin until the control strip has been accepted by the Resident Engineer. The Contractor shall use the same equipment, materials, and construction methods for the remainder of construction, unless adjustments made by the Contractor are approved in advance by the Engineer.

**154-3.4 Placement.** The material shall be placed and spread on the prepared underlying layer by spreader boxes or other devices as approved by the Resident Engineer, to a uniform thickness and width. The equipment shall have positive thickness controls to minimize the need for additional manipulation of the material. Dumping from vehicles that require re-handling shall not be permitted. Hauling over the uncompacted base course shall not be permitted. The material shall not be placed when the underlying course is soft or yielding.

The material shall meet gradation and moisture requirements prior to compaction. Material may be free-draining and the minimum moisture content shall be established for placement and compaction of the material.

The material shall be constructed in lifts as established in the control strip, but not less than four (4) inches nor more than eight (8) inches of compacted thickness.

When more than one (1) lift is required to establish the layer of thickness specified in the contract documents, the construction procedure described here shall apply to each lift. No lift shall be covered by subsequent lifts until tests verify that compaction requirements have been met. The Contractor shall rework, recompact and retest any material placed which does not meet the specifications.

- 154-3.5 Compaction.** Immediately after completion of the spreading operations, compact each layer of the subbase course, as specified, with approved compaction equipment. The number, type, and weight of rollers shall be sufficient to compact the material to the required density within the same day that the aggregate is placed on the subgrade.

The Contractor shall provide a qualified nuclear gauge and operator for Quality Control (QC) testing for density.

- 154-3.6 Weather limitation.** Material shall not be placed unless the ambient air temperature is at least 40°F and rising. Work on subbase course shall not be conducted when the subgrade is wet or frozen or the subbase material contains frozen material.

- 154-3.7 Maintenance.** No base or surface course shall be placed on the subbase until the subbase has been accepted by the Resident Engineer. The Contractor shall maintain the completed course in satisfactory condition throughout placement of subsequent layers. When material has been exposed to excessive rain, snow, or freeze-thaw conditions, the Contractor shall verify that materials still meet all specification requirements before placement of additional material. Equipment may be routed over completed sections of subbase course, provided the equipment does not damage the subbase course and the equipment is routed over the full width of the completed subbase course. Any damage to the subbase course from routing equipment over the subbase course shall be repaired by the Contractor. The maintenance cost shall be considered incidental to the contract and as a subsidiary obligation of the Contractor.

- 154-3.8 Surface tolerance.** In those areas on which a subbase or base course is to be placed, the surface shall be tested for smoothness and accuracy of grade and crown. Any portion lacking the required smoothness or failing in accuracy of grade or crown shall be scarified to a depth of at least three (3) inches, reshaped and re-compacted to grade until the required smoothness and accuracy are obtained and approved by the Resident Engineer. The Contractor shall perform all final smoothness and grade checks in the presence of the Resident Engineer. Any deviation in surface tolerances shall be corrected by the Contractor at the Contractor's expense.

**a. Smoothness.** The finished surface shall not vary more than  $\pm 1/2$  inch when tested with a 12 or 16-foot straightedge applied parallel with and at right angles to the centerline. The straightedge shall be moved continuously forward at half the length of the 12 or 16-foot straightedge for the full length of each line on a 50-foot grid.

**b. Grade.** The grade and crown shall be measured on a 50-foot grid and shall be within  $\pm 0.05$  feet of the specified grade.

- 154-3.9 Acceptance sampling and testing.** The aggregate base course shall be accepted for density and thickness on an area basis. Testing frequency shall be a minimum of one (1) compaction and thickness test per 1,500 square yards of subbase course. Random sampling locations will be determined by the Resident Engineer.

**a. Density.** The Resident Engineer shall perform all density tests. Each area shall be accepted for density when the field density is at least 100% of the maximum density of laboratory specimens compacted and tested as specified.

If not specified in the contract documents, laboratory specimens shall be compacted and tested per AASHTO T 99 for areas designated for aircraft with gross weights of 60,000 pounds or less and AASHTO T 180 for areas designated for aircraft with gross weights greater than 60,000 pounds. The moisture content of the material during compaction shall be within  $\pm 2\%$  of the optimum moisture content. The in-place field density shall be determined per AASHTO T 310 (Direct Transmission Density/Backscatter Moisture). The

machine shall be calibrated in accordance with AASHTO 310 within 12 months prior to its use on this contract. If the specified density is not attained, the area represented by the failed test shall be reworked and/or recompacted and two (2) additional random tests made. This procedure shall be followed until the specified density is reached. Maximum density refers to maximum dry density at optimum moisture content unless otherwise specified.

When the material has greater than 30% retained on the three-quarters (3/4) inch sieve, use methods in AASHTO T 99, AASHTO T 180, and the procedures in AASHTO T 180 Annex for correction of maximum dry density and optimum moisture for oversized particles.

- b. Thickness.** The thickness of the base course shall be within +0 and -3/16 inch of the specified thickness as determined by depth tests taken by the Contractor in the presence of the Resident Engineer for each area. Where the thickness is deficient by more than 3/16 inch, the Contractor shall correct such areas at no additional cost by scarifying to a depth of at least three (3) inches, adding new material of proper gradation, and the material shall be blended and recompacted to grade. The Contractor shall replace, at his expense, base material where depth tests have been taken.

### METHOD OF MEASUREMENT

- 154-4.1** The quantity of subbase course shall be measured for payment by the number of square yards of subbase course material placed and compacted to the specified density and plan thickness requirements in the completed course and accepted by the Resident Engineer.

### BASIS OF PAYMENT

- 154-5.1** Payment for accepted quantities of work performed by the Contractor and measured by the Resident Engineer shall be made at the contract unit price as specified in paragraph 154-4.1 of this section. Payment shall be full compensation for furnishing all materials; for all preparation, hauling, and placing of these materials; and for all labor, equipment, tools, and incidentals necessary to complete the work as specified.

### REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

#### ASTM International (ASTM)

ASTM D 3776	Standard Test Methods for Mass per Unit Area (Weight) of Fabric
ASTM D 4533	Standard Test Method for Trapezoid Tearing Strength of Geotextiles
ASTM D 4632	Standard Test Method for Grab Breaking Load and Elongation of Textiles

#### American Association of State Highway and Transportation Officials (AASHTO)

AASHTO T 90	Standard Method of Test for Determining the Plastic Limit and Plasticity Index of Soils
AASHTO T 99	Standard Method of Test for Moisture–Density Relations of Soils Using a 2.5-kg (5.5-lb) Rammer and a 305-mm (12-in.) Drop
AASHTO T 180	Standard Method of Test for Moisture–Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop
AASHTO T 310	Standard Method of Test for In-Place Density and Moisture Content of Soil and Soil–Aggregate by Nuclear Methods (Shallow Depth)

**Illinois Department of Transportation, Bureau of Materials Illinois Laboratory Test Procedure (ITP)***Manual of Test Procedures for Materials*

AASHTO T 11 Illinois Modified, Standard Method of Test for Materials Finer Than 75- $\mu$ m (No. 200) Sieve in Mineral Aggregates by Washing

*Manual of Aggregate Quality Test Procedures*

AASHTO T 96 Illinois Modified, Standard Method of Test for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine

AASHTO T 104 Illinois Modified, Standard Method of Test for Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate

AASHTO T 113 Illinois Modified, Standard Method of Test for Lightweight Pieces in Aggregate

ITP 203 Deleterious Particles in Coarse Aggregate

**Illinois Department of Transportation, Bureau of Materials Policy Memoranda (PM)**

PM 11-08 Aggregate Gradation Control System (AGCS)

**END OF ITEM 154**

**Item 155 Lime-Treated Subgrade****DESCRIPTION**

- 155-1.1** This item shall be used for soil modification that require strength gain to a specific level. This item shall consist of constructing one (1) or more courses of a mixture of soil, lime, and water in accordance with this specification, and in conformity with the lines, grades, thicknesses, and typical cross-sections specified in the contract documents. The lime modified subgrade will be completed prior to the placement of the proposed pavements.

**MATERIALS**

- 155-2.1** **Lime.** Quicklime, hydrated lime, and either high-calcium dolomitic, or magnesium lime, as defined by ASTM C51, shall conform to the requirements of ASTM C977. Lime not produced from calcining limestone is not permitted.
- 155-2.2** **Commercial lime slurry.** Commercial lime slurry shall be a pumpable suspension of solids in water. The water or liquid portion of the slurry shall not contain dissolved material injurious or objectionable for the intended purpose. The solids portion of the mixture, when considered on the basis of "solids content," shall consist principally of hydrated lime of a quality and fineness sufficient to meet the following chemical composition and residue requirements.
- a. Chemical composition.** The "solids content" of the lime slurry shall consist of a minimum of 70%, by weight, of calcium and magnesium oxides.
- b. Residue.** The percent by weight of residue retained in the "solids content" of lime slurry shall conform to the following requirements:
- Residue retained on a No. 6 sieve = maximum 0.0%
  - Residue retained on a No. 10 sieve = maximum 1.0%
  - Residue retained on a No. 30 sieve = maximum 2.5%
- c. Grade.** Commercial lime slurry shall conform to one (1) of the following two (2) grades:
- Grade 1. The "dry solids content" shall be at least 31% by weight, of the slurry.
  - Grade 2. The "dry solids content" shall be at least 35%, by weight, of the slurry.
- 155-2.3** **Water.** Water used in mixing or curing shall be from potable water sources. Other sources shall be tested in accordance with AASHTO T 26 and must be approved by the Engineer prior to use.
- 155-2.4** **Soil.** The soil for this work shall consist of on-site materials free of roots, sod, weeds, and stones larger than 2-1/2 inches and have a sulfate content of less than 0.3%.

**COMPOSITION OF MIXTURE**

- 155-3.1** **Soil-lime mixture.** Lime shall be applied at an approximate rate of 5% dry unit weight of soil for the depth of subgrade treatment specified in the contract documents. The Engineer reserves the right to make such adjustments of lime proportioning as are considered necessary during the progress of the work and based on the results of the geotechnical report within a range of  $\pm 2\%$ , without additional compensation to the Contractor.



- 155-3.2 Tolerances.** At final compaction, the lime and water content for each course of subgrade treatment shall conform to the following tolerances:

#### Tolerances

Material	Tolerance
Lime	+ 0.5%
Water	+ 2%, -0%

#### WEATHER LIMITATIONS

- 155-4.1 Weather limitation.** Subgrade shall not be constructed when weather conditions detrimentally affect the quality of the materials. The modified soil shall be constructed when the temperature of the soil, measured six (6) inches below the surface is above 50°F. Lime shall not be applied unless the ambient air temperature in the shade is at least 45°F and rising. Lime shall not be applied to soils that are frozen or contain frost. Protect completed lime-treated areas by approved methods against the detrimental effects of freezing if the air temperature falls below 35°F. Remove and replace any damaged portion of the completed soil-lime treated area with new soil-lime material in accordance with this specification.

#### EQUIPMENT

- 155-5.1 Equipment.** All equipment necessary to grade, scarify, spread, mix and compact the material shall be provided. The Engineer must approve the Contractor's proposed equipment prior to the start of the treatment.

#### CONSTRUCTION METHODS

- 155-6.1 General.** This specification is to construct a subgrade consisting of a uniform lime mixture which shall be free from loose or segregated areas. The subgrade shall be of uniform density and moisture content, well mixed for its full depth, and have a smooth surface suitable for placing subsequent lifts. The Contractor shall be responsible to meet the above requirements.

Prior to any treatment, the subgrade shall be constructed as specified in Item 152 titled EXCAVATION, SUBGRADE AND EMBANKMENT, and shaped to conform to the typical sections, lines, and grades as specified in the contract documents.

The mixing equipment must give visible indication at all times that it is cutting, pulverizing and mixing the material uniformly to the proper depth over the full width of the cut.

- 155-6.2 Application.** Lime shall be uniformly spread only over an area where the initial mixing operations can be completed during the same work day. Lime shall not be applied when wind conditions are detrimental to proper application. A motor grader shall not be used to spread the lime. Adequate moisture shall be added to the cement/soil mixture to maintain the proper moisture content. Materials shall be handled, stored, and applied in accordance with all federal, state, and local requirements.

The surface of the grade shall be lightly scarified or disked prior to distribution of the lime. The lime shall then be distributed uniformly over the surface. The Engineer may reject any procedure which does not provide even distribution of lime. In the event that rain intervenes, causing cessation of work and exposure of the lime to washing or blowing, the Engineer may require additional lime to be spread at no cost to the Contract.

The lime shall be disked, if required, to prevent dusting as directed by the Engineer.

- 155-6.3 Mixing.** The mixing procedure shall be as described below:
- a. Preliminary mixing.** The full depth of the treated subgrade shall be mixed with an approved mixing machine. Lime shall not be left exposed for more than six (6) hours. The mixing machine shall make two (2) coverages. Water shall be added to the subgrade during mixing to provide a moisture content approximately 3% to 5% above the optimum moisture of the material and to ensure chemical reaction of the lime and subgrade. After mixing, the subgrade shall be lightly rolled to seal the surface and help prevent evaporation of moisture. The water content of the subgrade mixture shall be maintained at a moisture content above the optimum moisture content for a minimum of four (4) to 24 hours or until the material becomes friable. During the mellowing period, the material shall be sprinkled as directed by the Resident Engineer.
  - b. Final mixing.** After the required mellowing time, the material shall be uniformly mixed by approved methods. Any clods shall be reduced in size by blading, discing, harrowing, scarifying, or by the use of other approved pulverization methods. After curing, pulverize lime treated material until 100% of soil particles pass a one (1) inch sieve and 60% pass the No. 4 sieve when tested dry by laboratory sieves. If resultant mixture contains clods, reduce their size by scarifying, remixing, or pulverization to meet specified gradation.
- 155-6.4 Control strip.** The first half-day of construction shall be considered the control strip. The Contractor shall demonstrate, in the presence of the Engineer, that the materials, equipment, and construction processes meet the requirements of the specification. The sequence and manner of rolling necessary to obtain specified density requirements shall be determined. Control strips that do not meet specification requirements shall be reworked, re-compacted, or removed and replaced at the Contractor's expense. Full operations shall not continue until the control strip has been accepted by the Engineer. Upon acceptance of the control strip by the Engineer, the Contractor shall use the same equipment, materials, and construction methods for the remainder of construction, unless adjustments made by the Contractor are approved in advance by the Engineer.
- 155-6.5 Treatment application and depth checks.** The depth and amount of stabilization shall be measured by the Contractor with no less than two (2) tests per day of material placed; test shall be witnessed by the Resident Engineer. Measurements shall be made in test holes excavated to show the full depth of mixing and the pH checked by spraying the side of the test hole with a pH indicator such as phenolphthalein. Phenolphthalein changes from clear to red between pH 8.3 and ten (10). The color change indicates the location of the bottom of the mixing zone. pH indicators other than phenolphthalein can be used to measure pH levels. If the pH is not at least 8.3 and/or if the depth of the treated subgrade is more than 3/16-inch deficient, additional lime treatment shall be added and the material remixed. The Contractor shall correct all such areas in a manner satisfactory to the Resident Engineer.
- 155-6.6 Compaction.** Compaction of the mixture shall immediately follow the final mixing operation with the mixture compacted within one (1) to four (4) hours after final mixing. Perform in-place density test to determine degree of compaction between 24 and 72 hours after final compaction and the 24-hour moist cure period.
- The Contractor shall provide a qualified nuclear gauge and operator for Quality Control (QC) testing for density.
- 155-6.7 Finishing and curing.** After the final lift or course of lime-treated subgrade has been compacted, it shall be brought to the required lines and grades in accordance with the typical sections. The completed section shall then be finished by rolling, as directed by the Resident Engineer, with a pneumatic or other suitable roller sufficiently light to prevent hairline cracking. The finished surface shall not vary more than one-half (1/2) inch when tested with a 12 or 16-foot straightedge applied parallel with and at right angles to the pavement centerline. Any variations in excess of this tolerance shall be corrected by the Contractor at the Contractor's expense in a manner satisfactory to the Resident Engineer.

The completed section shall be moist-cured for a minimum of seven (7) days before further courses are added or any traffic is permitted, unless otherwise directed by the Resident Engineer. The final lift should not be exposed for more than 14 days without protection or the placement of a base course material.

**155-6.8 Maintenance.** The Contractor shall protect and maintain the lime-treated subgrade from yielding from the start of work until all the work has been completed, cured, and accepted by the Engineer. When material has been exposed to excessive rain, snow, or freeze-thaw conditions, prior to placement of additional material, the Contractor shall verify that materials still meets all specification requirements. The maintenance cost shall be considered incidental to the contract and as a subsidiary obligation of the Contractor.

**155-6.9 Surface tolerance.** In those areas on which a subbase or base course is to be placed, the surface shall be tested for smoothness and accuracy of grade and crown. Any portion lacking the required smoothness or failing in accuracy of grade or crown shall be scarified to a depth of at least three (3) inches, reshaped and re-compacted to grade until the required smoothness and accuracy are obtained and approved by the Engineer. The Contractor shall perform all final smoothness and grade checks in the presence of the Resident Engineer. Any deviation in surface tolerances shall be corrected by the Contractor at the Contractor's expense.

**a. Smoothness.** The finished surface shall not vary more than  $\pm 1/2$  inch when tested with a 12 or 16-foot straightedge applied parallel with and at right angles to the centerline. The straightedge shall be moved continuously forward at half the length of the 12 or 16 foot-straightedge for the full length of each line on a 50-foot grid.

**b. Grade.** The grade and crown shall be measured on a 50-foot grid and shall be within +/- 0.05 feet of the specified grade.

**155-6.10 Acceptance sampling and testing.** The lime treated subgrade shall be accepted for density and thickness on an area basis. Testing frequency shall be a minimum of one (1) compaction and thickness test per 1,500 square yards of lime treated subgrade, but not less than four (4) tests per day of production. Random sampling locations will be determined by the Resident Engineer.

**a. Density.** All testing shall be done by the Resident Engineer.

The field density of the compacted mixture shall be at least 95% of the maximum density of laboratory specimens prepared from samples taken from the material in place. The specimens shall be compacted and tested in accordance with AASHTO T 99 to determine maximum density and optimum moisture content. The moisture content of the material during compaction shall as specified in paragraph 155-3.2 titled TOLERANCES. The in-place field density shall be determined in accordance with AASHTO T 310 (Direct Transmission Density/Backscatter Moisture). If the material fails to meet the density requirements, the area represented by the failed test shall be reworked to meet the density requirements. Maximum density refers to maximum dry density at optimum moisture content unless otherwise specified.

**b. Thickness.** The thickness of the course shall be within +0 and -3/16 inch of the specified thickness as determined by depth tests taken by the Contractor in the presence of the Resident Engineer for each area. Where the thickness is deficient by more than 3/16 inch, the Contractor shall correct such areas at no additional cost. The Contractor shall replace, at his expense, material where depth tests have been taken.

**155-6.11 Handling and safety.** The Contractor shall obtain and enforce the lime supplier's instructions for proper safety and handling of the lime to prevent physical eye or skin contact with lime during transport or application.

### METHOD OF MEASUREMENT

- 155-7.1** The quantity of lime-treated subgrade shall be measured for payment by the number of square yards as specified, completed, and accepted by the Resident Engineer.
- 155-7.2** The quantity of lime shall be measured by the number of tons of Hydrated Lime applied at the application rate specified in paragraph 155-3.1 titled SOIL-LIME MIXTURE.
- a. Hydrated lime delivered to the project in dry form will be measured according to the actual tonnage either spread on the subgrade or batched on site into a slurry, whichever is applicable.
  - b. Quicklime delivered to the project in dry form will be measured for payment on the basis of the tons of equivalent hydrated lime using the following formula:  
Equivalent Hydrated Lime (Ca(OH)<sub>2</sub>) = Total Quicklime (CaO) × 1.32
  - c. Lime delivered to the project in slurry form will be measured for payment in tons, dry weight of hydrated lime or equivalent hydrated lime in accordance with paragraph b above.

### BASIS OF PAYMENT

- 155-8.1** Payment for accepted quantities of work performed by the Contractor and measured by the Resident Engineer shall be made at the contract unit price as specified in paragraphs 155-7.1 and 155-7.2 of this section. Payment shall be full compensation for furnishing all material, except the lime, and for all mobilization, preparation, delivering, placing and mixing these materials, and all labor, equipment, tools and incidentals necessary to complete the work as specified.

### REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

#### ASTM International (ASTM)

ASTM C 51	Standard Terminology Relating to Lime and Limestone (as used by the Industry)
ASTM C 977	Standard Specification for Quicklime and Hydrated Lime for Soil Stabilization

#### American Association of State Highway and Transportation Officials (AASHTO)

AASHTO T 26	Standard Method of Test for Quality of Water to Be Used in Concrete
AASHTO T 99	Standard Method of Test for Moisture–Density Relations of Soils Using a 2.5-kg (5.5-lb) Rammer and a 305-mm (12-in.) Drop
AASHTO T 310	Standard Method of Test for In-Place Density and Moisture Content of Soil and Soil–Aggregate by Nuclear Methods (Shallow Depth)

### END OF ITEM 155

## Item 156 Cement Treated Subgrade

### DESCRIPTION

- 156-1.1** This item shall consist of constructing one (1) or more courses of a mixture of soil, stabilizer, and water in accordance with this specification, and in conformity with the lines, grades, thickness, and typical cross-sections specified in the contract documents.

### MATERIALS

- 156-2.1** **Cement.** Cement shall conform to the requirements of AASHTO M 85, Type I.
- 156-2.2** **Water.** Water used in mixing or curing shall be from potable water sources. Other sources shall be tested in accordance with AASHTO T 26 and must be approved by the Engineer prior to use.
- 156-2.3** **Soil.** The soil for this work shall consist of on-site materials free of roots, sod, weeds, and stones larger than 2-1/2 inches and have a sulfate content of less than 0.3%.

### COMPOSITION OF MIXTURE

- 156-3.1** **Soil-cement mixture.** Cement shall be added at an application rate of approximately 4% of dry unit weight of soil. The Engineer reserves the right to make such adjustments of cement proportioning as are considered necessary during the progress of the work and based on the results of the geotechnical report within a range of  $\pm 1\%$ , without additional compensation to the Contractor.
- 156-3.2** **Tolerances.** At final compaction, the cement and water content for each course of subgrade treatment shall conform to the following tolerances:

### Tolerances

Material/Properties	Target	Tolerance
Cement	4%	0 to +1%
Moisture Content	Optimum +2%	0 to +1%

### WEATHER LIMITATIONS

- 156-4.1** **Weather limitation.** Do not construct subgrade when weather conditions detrimentally affect the quality of the materials. The modified soil shall be constructed when the temperature of the soil, measured six (6) inches below the surface is above 50°F. Do not apply cement unless the ambient air temperature in the shade is at least 45°F and rising. Do not apply cement to soils that are frozen or contain frost. Do not apply cement when conditions are too windy to allow even distribution of the cement to the subgrade. If the air temperature falls below 35°F, protect completed treated areas against freezing. Remove and replace any damaged portion of the completed treated area with new material in accordance with this specification.

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## EQUIPMENT

- 156-5.1 Equipment.** All equipment necessary to grade, scarify, spread, mix and compact the material shall be provided. The Engineer must approve the Contractor's proposed equipment prior to the start of the treatment.

## CONSTRUCTION METHODS

- 156-6.1 General.** This specification is to construct a subgrade consisting of a uniform cement mixture which shall be free from loose or segregated areas. The subgrade shall be of uniform density and moisture content, well mixed for its full depth and have a smooth surface suitable for placing subsequent courses. The Contractor shall be responsible for meeting the above requirements.

Prior to any treatment, the subgrade shall be constructed as specified in Item 152 titled EXCAVATION, SUBGRADE AND EMBANKMENT, and shaped to conform to the typical sections, lines, and grades as specified in the contract documents.

The mixing machine must give visible indication at all times that it is cutting, pulverizing and mixing the material uniformly to the proper depth over the full width of the cut.

- 156-6.2 Application.** Cement shall be uniformly spread only over an area where the initial mixing operations and compaction can be completed during the same workday. The cement shall not be applied when wind conditions are detrimental to proper application. A motor grader shall not be used to spread the lime. Adequate moisture shall be added to the cement/soil mixture to maintain the proper moisture content. Materials shall be handled, stored, and applied in accordance with all federal, state, and local requirements.

- 156-6.3 Mixing procedure.** The full depth of the treated subgrade shall be mixed with equipment as approved by the Engineer. Cement shall not be left exposed for more than one (1) hour after distribution. Mixing and pulverization shall continue until the soil cement mixture contains no clods greater than 1-1/2 inches in size. Final moisture content of the mix shall be determined by the Contractor immediately prior to compaction in accordance with ASTM D2216 or ASTM D4959.

- 156-6.4 Control strip.** The first half-day of construction shall be considered the control strip. The Contractor shall demonstrate, in the presence of the Engineer, that the materials, equipment, and construction processes meet the requirements of the specification. The sequence and manner of rolling necessary to obtain specified density requirements shall be determined. Control strips that do not meet specification requirements shall be reworked, re-compacted, or removed and replaced at the Contractor's expense. Full operations shall not continue until the control strip has been accepted by the Engineer. Upon acceptance of the control strip by the Engineer, the Contractor shall use the same equipment, materials, and construction methods for the remainder of construction, unless adjustments made by the Contractor are approved in advance by the Engineer.

- 156-6.5 Treatment application and depth checks.** The amount of cement applied shall be monitored by the Contractor to assure that no less than the amount of cement required by the mix design is applied. The depth of stabilization shall be measured by the Contractor no less than two (2) tests per day of material placed; test shall be witnessed by the Resident Engineer. Measurements shall be made in test holes excavated to show the full depth of mixing.

- 156-6.6 Compaction.** Compaction of the soil/cement mixture shall begin within 30 minutes after mixing the cement into the subgrade. All compaction operations shall be completed within two (2) hours from the start of mixing.

The Contractor shall provide a qualified nuclear gauge and operator for Quality Control (QC) testing for density.

- 156-6.7 Finishing and curing.** After the final lift or course of treated subgrade has been compacted, it shall be brought to the required lines and grades in accordance with the typical sections.

Finished portions of treated subgrade shall be protected to prevent equipment from marring, permanently deforming, or damaging completed work.

Not later than 24 hours after completion of final finishing, the surface shall be cured by application of an emulsified asphalt or by being kept continuously moist for a period of seven (7) days with a fog-type water spray.

Sufficient protection from freezing shall be provided for at least seven (7) days after its construction or as approved by the Resident Engineer.

**156-6.8 Maintenance.** The Contractor shall protect and maintain the entire treated subgrade in good condition from the start of work until all the work has been completed, cured, and accepted by the Engineer. When material has been exposed to excessive rain, snow, or freeze-thaw conditions, prior to placement of additional material, the Contractor shall verify that materials still meets all specification requirements. The maintenance cost shall be considered incidental to the contract and as a subsidiary obligation of the Contractor.

**156-6.9 Surface tolerance.** In those areas on which a subbase or base course is to be placed, the surface shall be tested for smoothness and accuracy of grade and crown. Any portion lacking the required smoothness or failing in accuracy of grade or crown shall be scarified to a depth of at least three (3) inches, reshaped and re-compacted to grade until the required smoothness and accuracy are obtained and approved by the Engineer. The Contractor shall perform all final smoothness and grade checks in the presence of the Resident Engineer. Any deviation in surface tolerances shall be corrected by the Contractor at the Contractor's expense.

**a. Smoothness.** The finished surface shall not vary more than  $\pm 1/2$  inch when tested with a 12 or 16-foot straightedge applied parallel with and at right angles to the centerline. The straightedge shall be moved continuously forward at half the length of the 12 or 16-foot straightedge for the full length of each line on a 50-foot grid.

**b. Grade.** The grade and crown shall be measured on a 50-foot grid and shall be within  $\pm 0.05$  feet of the specified grade.

**156-6.10 Acceptance sampling and testing.** Aggregate base course shall be accepted for density and thickness on an area basis. Testing frequency shall be a minimum of one (1) compaction and thickness test per 1,500 square yards of stabilized subgrade, but not less than four (4) tests per day of production. Random sampling locations will be determined by the Resident Engineer.

**a. Density.** All testing shall be done by Resident Engineer.

Each area shall be accepted for density when the field density of the compacted mixture shall be at least 95% of the maximum density as determined by AASHTO T 134. The moisture content of the material during compaction shall as specified in paragraph 156-3.2 titled TOLERANCES. The in-place field density shall be determined in accordance with AASHTO T 310 (Direct Transmission Density/Backscatter Moisture). The machine shall be calibrated in accordance with AASHTO 310 within 12 months prior to its use on this contract. If the material fails to meet the density requirements, compaction shall continue or the material shall be removed and replaced. Maximum density refers to maximum dry density at optimum moisture content unless otherwise specified.

**b. Thickness.** The thickness of the base course shall be within  $+0$  and  $-3/16$  inch of the specified thickness as determined by depth tests taken by the Contractor in the presence of the Resident Engineer for each subplot. Where the thickness is deficient by more than  $3/16$  inch, the material shall be removed to full depth and replaced, at Contractor's expense.

#### METHOD OF MEASUREMENT

**156-7.1** The quantity of cement treated subgrade shall be measured for payment by the number of square yards as specified, completed, and accepted by the Resident Engineer.

- 156-7.2** The quantity of cement used is based upon an application rate as specified in paragraph 156-3.1, titled SOIL-CEMENT MIXTURE. The amount of cement shall be measured by the number of tons of cement used in the completed and accepted work.

#### **BASIS OF PAYMENT**

- 156-8.1** Payment for accepted quantities of work performed by the Contractor and measured by the Resident Engineer shall be made at the contract unit price as specified in paragraphs 156-7.1 and 156-7.2 of this section. Payment shall be full compensation for all preparation, delivering, placing and mixing these materials, and all labor, equipment, tools and incidentals necessary to complete the work as specified.

#### **REFERENCES**

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

##### **ASTM International (ASTM)**

ASTM D 2216	Test Methods for Laboratory Determination of Water (Moisture) Soil and Rock by Mass
ASTM D 4959	Standard Test Method for Determination of Water Content of Soil by Direct Heating

##### **American Association of State Highway and Transportation Officials (AASHTO)**

AASHTO M 85	Standard Specification for Portland Cement
AASHTO T 26	Standard Method of Test for Quality of Water to Be Used in Concrete
AASHTO T 134	Standard Method of Test for Moisture–Density Relations of Soil–Cement Mixtures
AASHTO T 310	Standard Method of Test for In-Place Density and Moisture Content of Soil and Soil–Aggregate by Nuclear Methods (Shallow Depth)

**END OF ITEM 156**



## Item 157 Lime Kiln Dust (LKD) Treated Subgrade

### DESCRIPTION

- 157-1.1** This item shall consist of constructing one (1) or more courses of a mixture of soil, stabilizer, and water in accordance with this specification, and in conformity with the lines, grades, thickness, and typical cross-sections specified in the contract documents.

### MATERIALS

- 157-2.1** **Lime kiln dust (LKD).** LKD used for stabilization shall meet the following chemical and physical requirements:

#### LKD Properties

Total Calcium & Magnesium Oxides (non-volatile basis); minimum	60%
Available Calcium Hydroxide (ASTM C25) plus total MgO content to be equivalent to CaOH <sub>2</sub> ; minimum	30%
Free Water (as received); maximum	4%
Loss on Ignition (as received, carbon dioxide plus moisture, combined and free); maximum	40%

Lime kiln dust shall be stored and handled in closed waterproof containers until immediately before distribution. Lime kiln dust exposed to moisture prior to mixing with soils shall be discarded.

- 157-2.2** **Water.** Water used in mixing or curing shall be from potable water sources. Other sources shall be tested in accordance with AASHTO T 26 and must be approved by the Engineer prior to use.
- 157-2.3** **Soil.** The soil shall consist of on-site materials and shall be free of roots, sod, weeds, and stones larger than 2-1/2 inches with a sulfate content of less than 0.3%.

### COMPOSITION OF MIXTURE

- 157-3.1** **Soil-kiln dust mixture.** Kiln dust shall be added at an application rate of 4% dry unit weight of soil. Payment will be based on the amount of kiln dust required to obtain the minimum soil properties specified.
- 157-3.2** **Tolerances.** At final compaction, the kiln dust and water content for each course of subgrade treatment shall conform to the following tolerances:

#### Tolerances

Material/Properties	Target	Tolerance
Kiln Dust	4%	0 to +2%
Moisture Content	Optimum	0% to 4%

### WEATHER LIMITATIONS

- 157-4.1 Weather limitation.** Do not construct subgrade when weather conditions detrimentally affect the quality of the materials. The modified soil shall be constructed when the temperature of the soil, measured six (6) inches below the surface is above 50°F. Do not apply kiln dust unless the ambient air temperature in the shade is at least 45°F and rising. Do not apply kiln dust to soils that are frozen or contain frost. Do not apply kiln dust when conditions are too windy to allow even distribution of the kiln dust to the subgrade. If the air temperature falls below 35°F, protect completed kiln dust-treated areas by approved methods against the detrimental effects of freezing. Remove and replace any damaged portion of the completed soil-kiln dust treated area in accordance with this specification.

### EQUIPMENT

- 157-5.1 Equipment.** All equipment necessary to grade, scarify, spread, mix and compact the material shall be provided. The Engineer must approve the Contractor's proposed equipment prior to the start of the treatment.

### CONSTRUCTION METHODS

- 157-6.1 General.** This specification is to construct a subgrade consisting of a uniform kiln dust/soil mixture which shall be free from loose or segregated areas. The subgrade shall be of uniform density and moisture content, well mixed for its full depth and have a smooth surface suitable for placing subsequent courses. The Contractor shall be responsible for meeting the above requirements.

Prior to any treatment, the subgrade shall be constructed as specified in Item 152 titled EXCAVATION, SUBGRADE, AND EMBANKMENT, and shaped to conform to the typical sections, lines, and grades as specified in the contract documents.

The machine must give visible indication at all times that it is cutting, pulverizing and mixing the material uniformly to the proper depth over the full width of the cut.

- 157-6.2 Application.** Kiln dust shall be uniformly spread only over an area where the initial mixing operations and compaction can be completed during the same workday. The kiln dust shall not be applied when wind conditions are detrimental to proper application. Adequate moisture shall be added to the kiln dust-soil mixture to maintain the proper moisture content. Materials shall be handled, stored, and applied in accordance with all federal, state, and local requirements.
- 157-6.3 Mixing procedure.** The full depth of the treated subgrade shall be mixed with equipment as approved by the Engineer. Kiln dust shall not be left exposed for more than one (1) hour after distribution. Mixing shall continue until the mixture contains no clods greater than 1-1/2 inches in size. Final moisture content of the mix shall be determined by the Contractor immediately prior to compaction in accordance with ASTM D2216 or ASTM D4959. Not more one (1) to four (4) hours shall be allowed between start of moist mixing and start of compaction for LKD treated layer to ensure complete hydration prior to compaction.
- 157-6.4 Control strip.** The first half-day of construction shall be considered the control strip. The Contractor shall demonstrate, in the presence of the Engineer, that the materials, equipment, and construction processes meet the requirements of the specification. The sequence and manner of rolling necessary to obtain specified density requirements shall be determined. Control strips that do not meet specification requirements shall be reworked, re-compacted, or removed and replaced at the Contractor's expense. Full operations shall not continue until the control strip has been accepted by the Engineer. Upon acceptance of the control strip by the Engineer, the Contractor shall use the same equipment, materials, and construction methods for the remainder of construction, unless adjustments made by the Contractor are approved in advance by the Engineer.

- 157-6.5 Treatment application and depth checks.** The amount of kiln dust applied shall be monitored by the Contractor to assure that no less than the amount of kiln dust as specified in paragraph 157-3.1 titled SOIL-KILN DUST MIXTURE. The depth of stabilization shall be measured by the Contractor no less than two (2) tests per day of material placed; test shall be witnessed by the Engineer. Measurements shall be made in test holes excavated to show the full depth of mixing.
- 157-6.6 Compaction.** Compaction of the soil/cement mixture shall begin within 30 minutes after mixing the cement into the subgrade. All compaction operations shall be completed within two (2) hours from the start of mixing.
- The Contractor shall provide a qualified nuclear gauge and operator for Quality Control (QC) testing for density.
- 157-6.7 Finishing and curing.** After the final lift or course of treated subgrade has been compacted, it shall be brought to the required lines and grades in accordance with the typical sections.
- Finished portions of treated subgrade shall be protected to prevent equipment from marring, permanently deforming, or damaging completed work.
- Not later than 24 hours after completion of final finishing, the surface shall be cured by application of an emulsified asphalt or by being kept continuously moist for a period of seven (7) days with a fog-type water spray.
- Sufficient protection from freezing shall be provided for at least seven (7) days after its construction or as approved by the Resident Engineer.
- 157-6.8 Maintenance.** The Contractor shall maintain the entire treated subgrade in good condition from the start of work until all the work has been completed, cured, and accepted by the Engineer. When material has been exposed to excessive rain, snow, or freeze-thaw conditions, prior to placement of additional material, the Contractor shall verify that materials still meets all specification requirements. The maintenance cost shall be considered incidental to the contract and as a subsidiary obligation of the Contractor.
- 157-6.9 Surface tolerance.** In those areas on which a subbase or base course is to be placed, the surface shall be tested for smoothness and accuracy of grade and crown. Any portion lacking the required smoothness or failing in accuracy of grade or crown shall be scarified to a depth of at least three (3) inches, reshaped and re-compacted to grade until the required smoothness and accuracy are obtained and approved by the Resident Engineer. The Contractor shall perform all final smoothness and grade checks in the presence of the Resident Engineer. Any deviation in surface tolerances shall be corrected by the Contractor at the Contractor's expense.
- a. Smoothness.** The finished surface shall not vary more than  $\pm 1/2$  inch when tested with a 12 or 16-foot straightedge applied parallel with and at right angles to the centerline. The straightedge shall be moved continuously forward at half the length of the 12 or 16-foot straightedge for the full length of each line on a 50-foot grid.
- b. Grade.** The grade and crown shall be measured on a 50-foot grid and shall be within  $\pm 0.05$  feet of the specified grade.
- 157-6.10 Acceptance sampling and testing.** Treated subgrade shall be accepted for density and thickness on an area basis. Testing frequency shall be a minimum of one (1) compaction and thickness test per 1,500 square yards of stabilized subgrade, but not less than four (4) tests per day of production. Random sampling locations will be determined by the Resident Engineer.
- a. Density.** The Resident Engineer shall perform all density tests.
- Each area shall be accepted for density when the field density is at least 95% of the maximum density of laboratory specimens compacted and tested per AASHTO T 99 for areas designated for aircraft with gross weights of 60,000 pounds or less and AASHTO T 180 for areas designated for aircraft with gross weights greater than 60,000 pounds. The moisture content of the material during compaction shall as specified in paragraph 157-3.2 titled TOLERANCES. The in-place field density shall be determined per AASHTO T 310

(Direct Transmission Density/Backscatter Moisture). The machine shall be calibrated in accordance with AASHTO T 310 within 12 months prior to its use on this contract. Perform in-place density test immediately after completion of compaction to determine compaction. If the material fails to meet the density requirements, compaction shall continue, or the material shall be removed and replaced. Maximum density refers to maximum dry density at optimum moisture content unless otherwise specified.

- b. Thickness.** The thickness of the base course shall be within +0 and -3/16 inch of the specified thickness as determined by depth tests taken by the Contractor in the presence of the Resident Engineer for each area. Where the thickness is deficient by more than 3/16 inch, the Contractor shall correct such areas at no additional cost by scarifying to a depth of at least three (3) inches, adding new material of proper gradation, and the material shall be blended and recompacted to grade. The Contractor shall replace, at his expense, base material where depth tests have been taken.

#### METHOD OF MEASUREMENT

- 157-7.1** The quantity of kiln dust treated subgrade shall be measured for payment by the number of square yards as specified, completed, and accepted by the Resident Engineer.
- 157-7.2** The quantity of kiln dust shall be measured for payment by the number of tons to achieve the application rate specified in paragraph 157-3.1 titled SOIL-KILN DUST MIXTURE as specified, completed, and accepted by the Resident Engineer.

#### BASIS OF PAYMENT

- 157-8.1** Payment for accepted quantities of work performed by the Contractor and measured by the Resident Engineer shall be made at the contract unit price as specified in paragraphs 157-7.1 and 156-7.2 of this section. The price shall be full compensation for furnishing all material, and for all preparation, delivering, placing and mixing these materials, and all labor, equipment, tools and incidentals necessary to complete the work as specified.

#### REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

##### ASTM International (ASTM)

ASTM C 25	Standard Test Methods for Chemical Analysis of Limestone, Quicklime, and Hydrated Lime
ASTM D 2216	Test Methods for Laboratory Determination of Water (Moisture) Soil and Rock by Mass
ASTM D 4959	Standard Test Method for Determination of Water Content of Soil by Direct Heating

##### American Association of State Highway and Transportation Officials (AASHTO)

AASHTO T 26	Standard Method of Test for Quality of Water to Be Used in Concrete
AASHTO T 99	Standard Method of Test for Moisture–Density Relations of Soils Using a 2.5-kg (5.5-lb) Rammer and a 305-mm (12-in.) Drop
AASHTO T 180	Standard Method of Test for Moisture–Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop

AASHTO T 310

Standard Method of Test for In-Place Density and Moisture Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

**END OF ITEM 157**

## Item 158 Fly Ash Treated Subgrade

### DESCRIPTION

- 158-1.1** This item shall consist of constructing one (1) or more courses of a mixture of soil, fly ash, and water in accordance with this specification, and in conformity with the lines, grades, thicknesses, and typical cross-sections specified in the contract documents.

### MATERIALS

- 158-2.1 Fly ash.** Fly ash shall meet AASHTO M 295, Class C and contain a minimum of 25% CaO. Sample and test the fly ash in accordance with the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 18-08, *Acceptance Procedure for Finely Divided Minerals Used in Concrete and Other Applications*. The source of the fly ash shall be identified by the Contractor and approved by the Resident Engineer in advance of modification operations so laboratory tests can be completed prior to beginning work.

Fly ash shall be handled and stored in closed weatherproof containers until immediately before distribution. Fly ash exposed to moisture prior to mixing with soils shall be discarded.

- 158-2.2 Water.** Water used in mixing or curing shall be from potable water sources. Other sources shall be tested in accordance with AASHTO T 26 and must be approved by the Engineer prior to use.
- 158-2.3 Soil.** The soil shall consist of on-site materials and shall be free of roots, sod, weeds, and stones larger than 2-1/2 inches with a sulfate content of less than 0.3%.

### COMPOSITION OF MIXTURE

- 158-3.1 Fly ash mixture.** Fly ash shall be applied at an approximate rate of 12% dry weight, at a depth of 12 inches of subgrade treatment. The Engineer reserves the right to make such adjustments of fly ash proportioning as are considered necessary during the progress of the work and based on the results of the geotechnical report within a range of  $\pm 2\%$ , without additional compensation to the Contractor.
- 158-3.2 Tolerances.** At final compaction, the fly ash and water content for each course of subgrade treatment shall conform to the following tolerances:

#### Tolerances

Material	Target	Tolerance
Fly ash	12 %	0 to + 2%
Moisture Content	Optimum	0 to +2%

### WEATHER LIMITATIONS

- 158-4.1 Weather limitation.** Do not construct subgrade when weather conditions detrimentally affect the quality of the materials. The modified soil shall be constructed when the temperature of the soil, measured six (6) inches below the surface is above 50°F. Do not apply fly ash unless the ambient air temperature in the shade is at least 45°F and rising. Do not apply fly ash to soils

that are frozen or contain frost. If the air temperature falls below 35°F, protect completed fly ash-treated areas by approved methods against the detrimental effects of freezing.

### EQUIPMENT

- 158-5.1 Equipment.** All equipment necessary to grade, scarify, spread, mix and compact the material shall be provided. The Engineer must approve the Contractor's proposed equipment prior to the start of the treatment.

### CONSTRUCTION METHODS

- 158-6.1 General.** This specification is to construct a complete subgrade with a uniform fly ash/soil mixture which shall be free from loose or segregated areas. The subgrade shall be of uniform density and moisture content uniformly mixed for its full depth, and have with a smooth surface suitable for placing subsequent courses. The Contractor shall be responsible to meet these requirements.

Prior to any treatment, the subgrade shall be constructed as specified in Item 152 titled EXCAVATION, SUBGRADE AND EMBANKMENT, and shaped to conform to the typical sections, lines, and grades as specified in the contract documents.

The machine must give visible indication at all times that it is cutting, pulverizing and mixing the material uniformly to the proper depth over the full width of the cut.

- 158-6.2 Application.** Fly ash shall be uniformly spread only over an area where the initial mixing and compaction operations can be completed within the same workday. Fly ash shall not be applied when wind conditions are detrimental to proper application. A motor grader shall not be used to spread the fly ash. Adequate moisture shall be added to the fly ash/soil mixture to maintain the proper moisture content. Materials shall be handled, stored, and applied in accordance with all federal, state, and local requirements.
- 158-6.3 Mixing.** The full depth of the treated subgrade shall be mixed with equipment as approved by the Engineer. Fly ash shall not be left exposed for more than one (1) hour after distribution. Mixing and pulverization shall continue until the mixture contains no clods greater than 1-1/2 inches in size. Final moisture content of the mix shall be determined by the Contractor immediately prior to compaction in accordance with ASTM D2216 or ASTM D4959. Not more than 60 minutes shall elapse between start of moist mixing and start of compaction of the treated layer.
- 158-6.4 Control strip.** The first half-day of construction shall be considered the control strip. The Contractor shall demonstrate, in the presence of the Engineer, that the materials, equipment, and construction processes meet the requirements of the specification. The sequence and manner of rolling necessary to obtain specified density requirements shall be determined. Control strips that do not meet specification requirements shall be reworked, re-compacted, or removed and replaced at the Contractor's expense. Full operations shall not continue until the control strip has been accepted by the Engineer. Upon acceptance of the control strip by the Engineer, the Contractor shall use the same equipment, materials, and construction methods for the remainder of construction, unless adjustments made by the Contractor are approved in advance by the Engineer.
- 158-6.5 Treatment application and depth checks.** The amount of fly ash applied shall be monitored by the Contractor to assure that no less than the amount of fly ash specified in paragraph 158-3.1 titled FLY ASH MIXTURE is applied. The depth of modification shall be measured by the Contractor no less than two (2) tests per day of material placed; test shall be witnessed by the Engineer. Measurements shall be made in test holes excavated to show the full depth of mixing.

**158-6.6 Compaction.** Compaction of the fly ash mixture shall begin within 30 minutes after mixing the fly ash into the subgrade. All compaction operations shall be completed within two (2) hours from the start of mixing.

The Contractor shall provide a qualified nuclear gauge and operator for Quality Control (QC) testing for density.

**158-6.7 Finishing and curing.** After the final lift or course of treated subgrade has been compacted, it shall be brought to the required lines and grades in accordance with the typical sections.

Finished portions of treated subgrade shall be protected to prevent equipment from marring, permanently deforming, or damaging completed work.

Sufficient protection from freezing shall be provided for at least seven (7) days after its construction or as approved by the Engineer.

**158-6.8 Maintenance.** The Contractor shall maintain the fly ash treated subgrade in good condition until all the work has been completed, cured, and accepted by the Engineer. When material has been exposed to excessive rain, snow, or freeze-thaw conditions, prior to placement of additional material, the Contractor shall verify that materials still meets all specification requirements. The maintenance cost shall be considered incidental to the contract and as a subsidiary obligation of the Contractor.

**158-6.9 Surface tolerance.** In those areas on which a subbase or base course is to be placed, the surface shall be tested for smoothness and accuracy of grade and crown. Any portion lacking the required smoothness or failing in accuracy of grade or crown shall be scarified to a depth of at least three (3) inches, reshaped and re-compacted to grade until the required smoothness and accuracy are obtained and approved by the Engineer. The Contractor shall perform all final smoothness and grade checks in the presence of the Resident Engineer. Any deviation in surface tolerances shall be corrected by the Contractor at the Contractor's expense.

**a. Smoothness.** The finished surface shall not vary more than  $\pm 1/2$  inch when tested with a 12 or 16-foot straightedge applied parallel with and at right angles to the centerline. The straightedge shall be moved continuously forward at half the length of the 12 or 16-foot straightedge for the full length of each line on a 50-foot grid.

**b. Grade.** The grade and crown shall be measured on a 50-foot grid and shall be within  $\pm 0.05$  feet of the specified grade.

**158-6.10 Acceptance sampling and testing.** Subgrade shall be accepted for density and thickness on an area basis. Testing frequency shall be a minimum of one (1) compaction and thickness test per 1,500 square yards of stabilized subgrade, but not less than four (4) tests per day of production. Random sampling locations will be determined by the Resident Engineer.

**a. Density.** The Resident Engineer shall perform all density tests.

Each area shall be accepted for density when the field density is at least 95% of the maximum density of laboratory specimens compacted and tested per AASHTO T 99 for areas designated for aircraft with gross weights of 60,000 pounds or less and AASHTO T 180 for areas designated for aircraft with gross weights greater than 60,000 pounds. The moisture content of the material during compaction shall as specified in paragraph 158-3.2 titled TOLERANCES. The in-place field density shall be determined per AASHTO T 310 (Direct Transmission Density/Backscatter Moisture). The machine shall be calibrated in accordance with AASHTO T 310 within 12 months prior to its use on this contract. If the specified density is not attained, the area represented by the failed test must be reworked and/or recompacted and two (2) additional random tests made. This procedure shall be followed until the specified density is reached. Maximum density refers to maximum dry density at optimum moisture content unless otherwise specified.

**b. Thickness.** The thickness of the base course shall be within  $+0$  and  $-3/16$  inch of the specified thickness as determined by depth tests taken by the Contractor in the presence of



the Resident Engineer for each area. Where the thickness is deficient by more than 3/16 inch, the Contractor shall correct such areas at no additional cost by scarifying to a depth of at least three (3) inches, adding new material of proper gradation, and the material shall be blended and recompact to grade. The Contractor shall replace, at his expense, base material where depth tests have been taken.

#### METHOD OF MEASUREMENT

- 158-7.1** The quantity of fly ash treated subgrade shall be measured for payment by the number of square yards as specified, completed, and accepted by the Resident Engineer.
- 158-7.2** The quantity of fly ash shall be measured for payment by the number of tons to achieve the application rate specified in paragraph 158-3.1, titled FLY ASH MIXTURE as specified, completed, and accepted by the Resident Engineer.

#### BASIS OF PAYMENT

- 158-8.1** Payment for accepted quantities of work performed by the Contractor and measured by the Resident Engineer shall be made at the contract unit price as specified in paragraphs 158-7.1 and 158-7.2 of this section. Payment shall be full compensation for furnishing all material, except the fly ash, and for all preparation, delivering, placing and mixing these materials, and all labor, equipment, tools and incidentals necessary to complete the work as specified.

#### REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

##### ASTM International (ASTM)

ASTM D 2216	Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
ASTM D 4959	Standard Test Method for Determination of Water Content of Soil by Direct Heating

##### American Association of State Highway and Transportation Officials (AASHTO)

AASHTO M 295	Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
AASHTO T 26	Standard Method of Test for Quality of Water to Be Used in Concrete
AASHTO T 99	Standard Method of Test for Moisture–Density Relations of Soils Using a 2.5-kg (5.5-lb) Rammer and a 305-mm (12-in.) Drop
AASHTO T 180	Standard Method of Test for Moisture–Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop
AASHTO T 310	Standard Method of Test for In-Place Density and Moisture Content of Soil and Soil–Aggregate by Nuclear Methods (Shallow Depth)

##### Illinois Department of Transportation, Bureau of Materials Policy Memoranda (PM)

PM 18-08	Acceptance Procedure for Finely Divided Minerals Used in Concrete and Other Applications
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#### END OF ITEM 158

## Part 4 – Base Courses

### Item 207 In-place Full Depth Reclamation (FDR) Recycled Asphalt Aggregate Base Course

#### DESCRIPTION

- 207-1.1** This item shall consist of a recycled asphalt aggregate base course resulting from the in-place full depth reclamation (FDR) of the existing pavement section (asphalt wearing surface and aggregate base), plus mechanical stabilization with additional aggregate or chemical stabilization with cement, asphalt emulsion or fly ash when required as specified in the contract documents.

This item may be used as a base course under flexible and rigid pavements when pavement loads are 60,000 pounds or less, or when used as a base under stabilized bases.

#### MATERIALS

- 207-2.1 Aggregate.** The FDR shall consist of materials produced by recycling (pulverizing and mixing) the existing asphalt pavement, aggregate base, subgrade, and any additional aggregate as necessary. Material larger than two (2) inches in any dimension shall not be permitted in the recycle asphalt aggregate base course. The FDR shall meet the gradation in the table below.

#### FDR Gradation

Sieve	Minimum Percentage by weight passing sieves
2 inch	100
No. 4	55
No. 200	0-15

- a. Deleterious substances.** Materials for aggregate base shall be kept free from weeds, sticks, grass, roots and other foreign matter.
- b. Uniformity.** The materials shall be thoroughly recycled (pulverized and mixed) to ensure a uniform gradation.
- 207-2.2 Stabilization. Unless otherwise specified in the contract documents, the Resident Engineer or a Geotechnical Engineer shall select and designate the method of stabilization.**
- a. Mechanical stabilization.** Addition of corrective aggregate material to adjust gradation shall be in accordance with Item 208 titled AGGREGATE BASE COURSE.
- b. Chemical Stabilization.** Where a stabilizing agent is required, materials shall meet the following requirements.
- (1) Cement shall meet the requirements of AASHTO M 85.
  - (2) Fly ash shall meet the requirements of AASHTO M 295.
  - (3) Emulsified asphalt cement shall meet the requirements of AASHTO M 140.

Materials shall be handled, stored, and applied in accordance with all federal, state, and local requirements.

- 207-2.3 Water.** Water used in mixing or curing shall be from potable water sources. Other sources shall be tested in accordance with AASHTO T 26 and must be approved by the Engineer prior to use.
- 207-2.4 Quality control (QC) sampling and testing.** The Contractor shall take at least two (2) FDR samples per day of production in the presence of the Resident Engineer to check the gradation. Sampling shall be per the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 11-08, *Aggregate Gradation Control System (AGCS)*. Material shall meet the requirements in paragraph 207-2.1 titled AGGREGATE. Samples shall be taken from the in-place, un-compacted material at random sampling locations determined by the Resident Engineer.

### CONSTRUCTION METHODS

- 207-3.1 Milling.** The existing asphalt pavement shall be milled below surface grade to the depth specified in the contract documents.
- 207-3.2 Control strip.** The first half-day of construction shall be considered the control strip. The Contractor shall demonstrate, in the presence of the Engineer, that the materials, equipment, and construction processes meet the requirements of the specification. The sequence and manner of rolling necessary to obtain specified density requirements shall be determined. Control strips that do not meet specification requirements shall be reworked, re-compacted, or removed and replaced at the Contractor's expense. Full operations shall not begin until the control strip has been accepted by the Engineer. Upon acceptance of the control strip by the Engineer, the Contractor shall use the same equipment, materials, and construction methods for the remainder of construction, unless adjustments made by the Contractor are approved in advance by the Engineer.
- 207-3.3 Recycling (Pulverization and mixing).** The asphalt pavement, aggregate base and subgrade shall be recycled (pulverized and mixed) into a uniformly blended mixture with four (4) inches of Item 208 aggregate base and 6% cement, 3% of emulsified asphalt or 12% fly ash by dry unit weight and water, unless otherwise specified, to the depth specified in the contract documents. All material over approximately two (2) inches shall be removed by the Contractor. The mixture shall be brought to the desired moisture content.
- The maximum lift thickness of the recycled aggregate base course material to be compacted shall be 12 inches.
- 207-3.4 Compaction.** Immediately upon completion of recycling (pulverization and mixing), the material shall be shaped and graded in accordance with the contract documents. The number, type, and weight of rollers shall be sufficient to compact the material to the required density within the same day that the aggregate is placed on the subgrade.
- The Contractor shall provide a qualified nuclear gauge and operator for Quality Control (QC) testing for density.
- 207-3.5 Finishing.** The surface of the aggregate base course shall be finished by blading or with automated equipment designed for this purpose. If the top layer is one-half (1/2) inch or more below grade, the top layer shall be scarified to a depth of at least three (3) inches, new material added, and the layer blended and re-compacted to bring it to grade. The addition of layers less than three (3) inches shall not be allowed.
- 207-3.6 Proof rolling.** Compacted asphalt aggregate base course shall be proof rolled with a tandem axle dual wheel dump truck loaded to the legal limit with tires inflated to 80 pounds per square inch in the presence of the Resident Engineer. Soft areas that deflect greater than one-half (1/2) inch or show permanent deformation greater than one-half (1/2) inch shall be removed and reworked at the Contractor's expense.

- 207-3.7 Weather limitations.** When weather conditions detrimentally affect the construction process and/or quality of the materials, the Contractor shall stop construction. Cement or fly ash shall not be applied when wind conditions affect the distribution of the materials. When the aggregates contain frozen materials or when the underlying course is frozen or wet, the construction shall be stopped. Construction shall not be performed unless the atmospheric temperature is above 35°F and rising or approved by the Resident Engineer. When the temperature falls below 35°F, protect all completed areas against detrimental effects of freezing by approved methods. Correct completed areas damaged by freezing, rainfall, or other weather conditions to meet specified requirements.
- 207-3.8 Maintenance.** The asphalt aggregate base course shall be maintained in a satisfactory condition until the work is accepted by the Engineer. Equipment used in the construction of an adjoining section may be routed over completed sections of asphalt aggregate base course, provided that no damage results and equipment is routed over the full width of the completed asphalt aggregate base course. Any damage to the recycled asphalt aggregate base course shall be repaired by the Contractor. The maintenance cost shall be considered incidental to the contract and as a subsidiary obligation of the Contractor.
- 207-3.9 Surface tolerances.** The finished surface shall be tested for smoothness and accuracy of grade. Any area failing smoothness or grade shall be scarified to a depth of at least three 3 inches, reshaped and re-compacted by the Contractor at the Contractor's expense.
- a. **Smoothness.** The finished surface shall not vary more than three-eighths (3/8) t inch when tested with a 12 or 16-foot straightedge applied parallel with and at right angles to the centerline. The straightedge shall be moved continuously forward at half the length of the 12 or 16-foot straightedge for the full length of each line on a 50-foot grid.
  - b. **Grade.** The grade shall be measured on a 50-foot grid and shall be within +0 and 0.05 feet - of the specified grade.
- 207-3.10 Acceptance sampling and testing for density.** FDR base course shall be accepted for density and thickness on an area basis. Testing frequency shall be a minimum one (1) compaction and thickness test per 1,500 square yards per lift of aggregate. Random sampling locations will be determined by the Resident Engineer.
- a. **Density.** The Resident Engineer shall perform all density.  
  
Each area will be accepted for density when the field density is at least 95% of the maximum density of the FDR base course in accordance with AASHTO T 99 for areas designated for aircraft with gross weights of 60,000 pounds or less and AASHTO T 180 for areas designated for aircraft with gross weights greater than 60,000 pounds. Where cement stabilization is specified, each area will be accepted for density when the field density is at least 95% of the maximum density in accordance with AASHTO T 134. The moisture content of the material during compaction shall be within ±2% of the optimum moisture content. The in-place field density shall be determined in accordance with AASHTO T 310 (Direct Transmission Density/Backscatter Moisture). The machine shall be calibrated in accordance with AASHTO T 310 within 12 months prior to its use on this contract. If the specified density is not attained, the area represented by the failed test must be reworked and/or recompacted and two (2) additional random tests made. This procedure shall be followed until the specified density is reached. Maximum density refers to maximum dry density at optimum moisture content unless otherwise specified.  
  
The Contractor shall provide a qualified nuclear gauge and operator for Quality Control (QC) testing for density.
  - b. **Thickness.** The thickness of the base course shall be within +0 and -3/16 inch of the specified thickness as determined by depth tests taken by the Contractor in the presence of the Resident Engineer for each area. Where the thickness is deficient by more than 3/16 inch, the Contractor shall correct such areas at no additional cost by scarifying to a depth of

at least three (3) inches, adding new material, and recompact to grade. The Contractor shall replace, at his expense, base material where depth tests have been taken.

#### METHOD OF MEASUREMENT

- 207-4.1** The quantity of full depth reclamation asphalt aggregate base course shall be measured for payment by the number of square yards for recycling the existing asphalt pavement, aggregate base course, subgrade and mixing with stabilizing agent, if required, spreading, compacting, and maintaining the recycled material to the compacted thickness as specified, completed, and accepted by the Resident Engineer.
- 207-4.2** The quantity of corrective aggregate material shall be measured by the ton.
- 207-4.3** The quantity of emulsified asphalt shall be measured for payment by the number of tons accepted by the Resident Engineer.
- 207-4.4** The quantity of cement shall be measured for payment by the number of tons accepted by the Resident Engineer.
- 207-4.5** The quantity of fly ash shall be measured for payment by the number of tons accepted by the Resident Engineer.

#### BASIS OF PAYMENT

- 207-5.1** Payment for accepted quantities of work performed by the Contractor and measured by the Resident Engineer shall be made at the contract unit price as specified in paragraphs 207-4.1 through 207-4.5 of this section. Payment shall be full compensation for furnishing all materials, for preparing and placing these materials, and for all labor, equipment tools and incidentals to complete the work as specified.

#### REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

##### **American Association of State Highway and Transportation Officials (AASHTO)**

AASHTO M 85	Standard Specification for Portland Cement
AASHTO M 140	Standard Specification for Emulsified Asphalt
AASHTO M 295	Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
AASHTO T 26	Standard Method of Test for Quality of Water to Be Used in Concrete
AASHTO T 99	Standard Method of Test for Moisture–Density Relations of Soils Using a 2.5-kg (5.5-lb) Rammer and a 305-mm (12-in.) Drop
AASHTO T 134	Standard Method of Test for Moisture–Density Relations of Soil–Cement Mixtures
AASHTO T 180	Standard Method of Test for Moisture–Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop
AASHTO T 310	Standard Method of Test for In-Place Density and Moisture Content of Soil and Soil–Aggregate by Nuclear Methods (Shallow Depth)

**Illinois Department of Transportation, Bureau of Materials Policy Memoranda (PM)**

PM 11-08

Aggregate Gradation Control System (AGCS)

**END OF ITEM 207**

## Item 208 Aggregate Base Course

### DESCRIPTION

**208-1.1** This item shall consist of a base course composed of course aggregate bonded with fine aggregate base constructed on a prepared subgrade or subbase course as specified in the contract documents.

This item may be used as a base course when pavement loads are 60,000 pounds or less, or when this item is placed as a subbase under Item 209 titled CRUSHED AGGREGATE BASE COURSE or other stabilized bases.

The Contractor shall provide recent, within the same year that the aggregate base course is constructed, representative Proctor for each aggregate source and gradation approved for use on the project. All associated labor, equipment, materials and incidentals associated with obtaining the Proctor information shall be considered incidental to the contract and as a subsidiary obligation of the Contractor. If, in the opinion of the Resident Engineer, the Proctor information is determined to be non-representative of the material being placed, the Resident Engineer may require the Contractor to provide an additional Proctor that is representative of the materials used.

### MATERIALS

**208-2.1** **Aggregate base.** The aggregate base material shall consist of both fine and coarse aggregate. Material shall be clean, sound, durable particles and fragments of stone or gravel, crushed stone, crushed gravel, crushed slag, or crushed concrete mixed or blended with sand, screenings, or other materials from approved sources. Materials shall be handled and stored in accordance with all federal, state, and local requirements. The aggregate shall be free from clay lumps, organic matter, or other deleterious materials or coatings. The method used to produce the crushed gravel shall result in the fractured particles in the finished product as nearly constant and uniform as practicable. The fine aggregate portion, defined as the portion passing the No. 4 sieve produced in crushing operations, shall be incorporated in the base material to the extent permitted by the gradation requirements.

The natural and manufactured materials used as coarse aggregate are defined as follows.

- a. **Gravel.** Gravel shall be the coarse granular material resulting from the reduction of rock by the action of the elements and having subangular to rounded surfaces. It may be partially crushed.
- b. **Crushed stone.** Crushed stone shall be the angular fragments resulting from crushing undisturbed, consolidated deposits of rock by mechanical means. Crushed stone shall be divided into the following, when specified.
  - (1) **Carbonate crushed stone.** Carbonate crushed stone shall be either dolomite or limestone. Dolomite shall contain 11.0% or more magnesium oxide (MgO). Limestone shall contain less than 11.0% magnesium oxide (MgO).
  - (2) **Crystalline crushed stone.** Crystalline crushed stone shall be either metamorphic or igneous stone, including but is not limited to, quartzite, granite, rhyolite and diabase.
- c. **Crushed gravel.** Crushed gravel shall be the product resulting from crushing, by mechanical means, and shall consist entirely of particles obtained by crushing gravel. The acceptance and use of crushed gravel shall be according to the current Illinois Department

of Transportation, Bureau of Materials Policy Memorandum (PM) 12-08 *Crushed Gravel Producer Self-Testing Program*.

- d. **Crushed slag.** Crushed slag shall be the graded product resulting from the processing of air-cooled blast furnace slag. Air-cooled blast furnace slag shall be the nonmetallic product, consisting essentially of silicates and aluminosilicates of lime and other bases, which is developed in a molten condition simultaneously with iron in a blast furnace. It shall be air-cooled and shall have a compact weight (ITP 19) of not less than 70 pounds per cubic foot. The acceptance and use of air-cooled blast furnace slag shall be according to the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 13-08, *Slag Producer Self-Testing Program*.

- 208-2.2 Quality.** The coarse aggregate shall be Class B Quality or better according to the quality standards listed in the following table.

**Coarse Aggregate Quality**

Quality Test	Class
	B
Na <sub>2</sub> SO <sub>4</sub> Soundness 5 Cycle, Illinois Modified AASHTO T 104 <sup>1</sup> , % Loss max.	15
Los Angeles Abrasion, Illinois Modified AASHTO T 96, % Loss max.	40 <sup>2</sup>
Deleterious Materials <sup>3</sup>	
Shale, % max.	2.0
Clay Lumps, % max.	0.5
Coal & Lignite, % max.	---
Soft & Unsound Fragments, % max.	6.0
Other Deleterious, % max.	2.0
Total Deleterious, % max.	6.0

1. Does not apply to crushed concrete.
2. Does not apply to crushed slag or crushed steel slag.
3. Test shall be run according to ITP 203.

- 208-2.3 Gradation requirements.** The gradation of the aggregate base material shall meet the requirements of the gradation given in the following table when tested per the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 11-08, *Aggregate Gradation Control System (AGCS)*.



### Gradation of Aggregate Base

Sieve Size	Gradation Percent Passing		
	CA 4	CA 6	CA 10
2 inch	100		
1-1/2 inch	95±5	100	
1 inch	85±10	95±5	100
3/4 inch			95±5
1/2 inch	60±15	75±15	80±15
No. 4	40±10	43±13	50±10
No. 16	20±15	25±15	30±15
No. 200 <sup>1</sup>	0-5	0-5	0-5

1. Modified for FAA requirement associated with non frost susceptible material. Maximum allowable material passing No. 200 sieve shall be 5%.

The gradations represent the limits which shall determine suitability of aggregate for use from the sources of supply. The final gradation shall be well graded from coarse to fine within the limits designated in the table and shall not vary from the lower limit on one (1) sieve to the high limit on an adjacent sieve or vice versa.

The selection of any of the gradations shall be such that the maximum size aggregate used in any course shall be not more than two-thirds the thickness of the layer of the course being constructed.

**208-2.4 Plasticity.** All material shall comply with the plasticity index requirements listed below. The plasticity index requirement for crushed gravel, crushed stone, and crushed slag may be waived if the ratio of the percent passing the No. 200 sieve to that passing the No. 40 sieve is 0.60 or less.

Use	Plasticity Index - Percent	
	Gravel	Crushed Gravel, Stone, & Slag
Aggregate Base Course	0 to 6	---

Plasticity Index shall be determined by the method given in AASHTO T 90. Where shale in any form exists in the producing ledges, crushed stone samples shall be soaked a minimum of 18 hours before processing for plasticity index or minus No. 40 material. When clay material is added to adjust the plasticity index, the clay material shall be in a minus No. 4 sieve size.

#### 208-2.5 Sampling and testing.

- Aggregate base materials.** The Contractor shall take samples of the aggregate base in accordance with the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 11-08, Aggregate Gradation Control System (AGCS), to verify initial aggregate base requirements and gradation. Material shall meet the requirements in paragraphs 208-2.1 through 208-2.4. This sampling and testing will be the basis for approval of the aggregate base quality requirements.
- Gradation requirements.** The Contractor shall take at least two (2) aggregate base samples per day in the presence of the Resident Engineer to check the final gradation. Sampling shall be per the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 11-08, *Aggregate Gradation Control System (AGCS)*. Material shall meet the requirements in paragraph 208-2.3 titled GRADATION REQUIREMENTS.

The samples shall be taken from the in-place, un-compacted material at random sampling locations determined by the Resident Engineer. Results shall be furnished to the Resident Engineer by the Contractor each day during construction.

- 208-2.6 Geotextile fabric.** Geotextile fabric shall conform to the requirements of Item 152 titled EXCAVATION, SUBGRADE, AND EMBANKMENT.

### CONSTRUCTION METHODS

- 208-3.1 Control strip.** The first half-day of construction shall be considered the control strip. The Contractor shall demonstrate, in the presence of the Engineer, that the materials, equipment, and construction processes meet the requirements of the specification. The sequence and manner of rolling necessary to obtain specified density requirements shall be determined. The base course shall be constructed in lifts not more than four (4) inches thick when compacted, except that the maximum compacted thickness may be increased to a maximum of eight (8) inches upon the Contractor's demonstration that approved equipment and operations will uniformly compact the lift to the specified density. The Engineer must witness this demonstration and approve the lift thickness prior to full production.

Control strips that do not meet specification requirements shall be reworked, re-compacted or removed and replaced at the Contractor's expense. Full operations shall not continue until the control strip has been accepted by the Engineer. The Contractor shall use the same equipment, materials, and construction methods for the remainder of construction, unless adjustments made by the Contractor are approved by the Engineer.

- 208-3.2 Preparing underlying subgrade and/or subbase.** The underlying subgrade and/or subbase shall be checked and accepted by the Resident Engineer before base course placing and spreading operations begin. Re-proof rolling of the subgrade or proof rolling of the subbase in accordance with Item 152 titled EXCAVATION, SUBGRADE, AND EMBANKMENT, at the Contractor's expense, may be required by the Resident Engineer if the Contractor fails to ensure proper drainage or protect the subgrade and/or subbase. Any ruts or soft, yielding areas due to improper drainage conditions, hauling, or any other cause, shall be corrected before the base course is placed. To ensure proper drainage, the spreading of the base shall begin along the centerline of the pavement on a crowned section or on the high side of the pavement with a one-way slope.

- 208-3.3 Production.** The aggregate shall be uniformly blended and, when at a satisfactory moisture content per paragraph 208-3.5 titled COMPACTION, the approved material may be transported directly to the placement.

- 208-3.4 Placement.** The aggregate shall be placed and spread on the prepared underlying layer by spreader boxes or other devices as approved by the Engineer, to a uniform thickness and width. The equipment shall have positive thickness controls to minimize the need for additional manipulation of the material. Dumping from vehicles that require re-handling shall not be permitted. Hauling over the uncompacted base course shall not be permitted.

The aggregate shall meet gradation and moisture requirements prior to compaction. The base course layer shall be constructed in lifts as established in the control strip, but not less than four (4) inches nor more than eight (8) inches of compacted thickness.

When more than one (1) lift is required to establish the layer thickness specified in the contract documents, the construction procedure described here shall apply to each lift. No lift shall be covered by subsequent lifts until tests verify that compaction requirements have been met. The Contractor shall rework, recompact and retest any material placed which does not meet the specifications at the Contractor's expense.

- 208-3.5 Compaction.** Immediately upon completion of the spreading operations, compact each layer of the base course, as specified, with approved compaction equipment. The number, type, and

weight of rollers shall be sufficient to compact the material to the required density within the same day that the aggregate is placed on the subgrade.

The Contractor shall provide a qualified nuclear gauge and operator for Quality Control (QC) testing for density.

**208-3.6 Weather limitations.** Material shall not be placed unless the ambient air temperature is at least 40°F and rising. Work on base course shall not be conducted when the subgrade or subbase is wet or frozen or the base material contains frozen material.

**208-3.7 Maintenance.** The base course shall be maintained in a condition that will meet all specification requirements. When material has been exposed to excessive rain, snow, or freeze-thaw conditions, prior to placement of additional material, the Contractor shall verify that materials still meet all specification requirements. Equipment may be routed over completed sections of base course, provided that no damage results and the equipment is routed over the full width of the completed base course. Any damage resulting to the base course from routing equipment over the base course shall be repaired by the Contractor. The maintenance cost shall be considered incidental to the contract and as a subsidiary obligation of the Contractor.

**208-3.8 Surface tolerances.** After the course has been compacted, the surface shall be tested for smoothness and accuracy of grade and crown. Any portion lacking the required smoothness or failing in accuracy of grade or crown shall be scarified to a depth of at least three (3) inches, reshaped and recompact to grade until the required smoothness and accuracy are obtained and approved by the Resident Engineer. Any deviation in surface tolerances shall be corrected by the Contractor at the Contractor's expense. The smoothness and accuracy requirements specified here apply only to the top layer when base course is constructed in more than one (1) layer.

**a. Smoothness.** The finished surface shall not vary more than three-eighths (3/8)- inch when tested with a 12 or 16-foot straightedge applied parallel with and at right angles to the centerline. The straightedge shall be moved continuously forward at half the length of the 12 or 16-foot straightedge for the full length of each line on a 50-foot grid.

**b. Grade.** The grade and crown shall be measured on a 50-foot grid and shall be within +0 and 0.05 feet- of the specified grade.

**208-3.9 Acceptance sampling and testing.** Aggregate base course shall be accepted for density and thickness on an area basis. Testing frequency shall be a minimum one (1) compaction and thickness test per 1,500 square yards per lift of aggregate. Random sampling locations will be determined by the Resident Engineer.

**a. Density.** The Resident Engineer shall perform all density tests.

Each area shall be accepted for density when the field density is at least 100% of the maximum density of laboratory specimens compacted and tested per AASHTO T 99 for areas designated for aircraft with gross weights of 60,000 pounds or less and AASHTO T 180 for areas designated for aircraft with gross weights greater than 60,000 pounds. The moisture content of the material during placing operations shall be within  $\pm 2\%$  of the optimum moisture content. The in-place field density shall be determined per AASHTO T 310 (Direct Transmission Density/Backscatter Moisture). The machine shall be calibrated in accordance with AASHTO T 310 within 12 months prior to its use on this contract. If the specified density is not attained, the area represented by the failed test must be reworked and/or recompact and two (2) additional random tests made. This procedure shall be followed until the specified density is reached. Maximum density refers to maximum dry density at optimum moisture content unless otherwise specified.

**b. Thickness.** Depth tests shall be made by test holes at least three (3) inches in diameter that extend through the base. The thickness of the base course shall be within +0 and -3/16 inch of the specified thickness as determined by depth tests taken by the Contractor in the presence of the Resident Engineer for each area. Where the thickness is deficient by more

than 3/16 inch, the Contractor shall correct such areas at no additional cost by scarifying to a depth of at least three (3) inches, adding new material of proper gradation, and the material shall be blended and recompact to grade. The Contractor shall replace, at his expense, base material where depth tests have been taken.

#### METHOD OF MEASUREMENT

- 208-4.1** The quantity of aggregate base course shall be measured for payment by the number of square yards of base course material placed and compacted to the specified density and plan thickness requirements in the completed course and accepted by the Resident Engineer. Base materials shall not be included in any other excavation quantities.

#### BASIS OF PAYMENT

- 208-5.1** Payment for accepted quantities of work performed by the Contractor and measured by the Resident Engineer shall be made at the contract unit price as specified in paragraph 208-4.1 of this section. Payment shall be full compensation for furnishing all materials and for all operations, hauling, placing, and compacting of these materials, and for all labor, equipment, tools, and incidentals necessary to complete the work as specified.

#### REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

##### **American Association of State Highway and Transportation Officials (AASHTO)**

AASHTO T 90	Standard Method of Test for Determining the Plastic Limit and Plasticity Index of Soils
AASHTO T 99	Standard Method of Test for Moisture–Density Relations of Soils Using a 2.5-kg (5.5-lb) Rammer and a 305-mm (12-in.) Drop
AASHTO T 180	Standard Method of Test for Moisture–Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop
AASHTO T 310	Standard Method of Test for In-Place Density and Moisture Content of Soil and Soil–Aggregate by Nuclear Methods (Shallow Depth)

##### **Illinois Department of Transportation, Bureau of Materials Illinois Laboratory Test Procedure (ITP)**

###### *Manual of Test Procedures for Materials*

AASHTO T 11	Illinois Modified, Standard Method of Test for Materials Finer Than 75- $\mu$ m (No. 200) Sieve in Mineral Aggregates by Washing
ITP 19	Bulk Density (“Unit Weight”) and Voids in Coarse Aggregate

###### *Manual of Aggregate Quality Test Procedures*

AASHTO T 96	Illinois Modified, Standard Method of Test for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
AASHTO T 104	Illinois Modified, Standard Method of Test for Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate

AASHTO T 113 Illinois Modified, Standard Method of Test for Lightweight Pieces in Aggregate

ITP 203 Deleterious Particles in Coarse Aggregate

**Illinois Department of Transportation, Bureau of Materials Policy Memoranda (PM)**

PM 11-08 Aggregate Gradation Control System (AGCS)

PM 12-08 Crushed Gravel Producer Self-Testing Program

PM 13-08 Slag Producer Self-Testing Program

**END OF ITEM 208**

## Item 209 Crushed Aggregate Base Course

### DESCRIPTION

- 209-1.1** This item shall consist of a base course composed of crushed aggregate base constructed on a prepared course as specified in the contract documents.

The Contractor shall provide recent, within the same year that the aggregate base course is constructed, representative Proctor for each aggregate source and gradation approved for use on the project. All associated labor, equipment, materials and incidentals associated with obtaining the Proctor information shall be considered incidental to the contract and as a subsidiary obligation of the Contractor. If, in the opinion of the Resident Engineer, the Proctor information is determined to be non-representative of the material being placed, the Resident Engineer may require the Contractor to provide an additional Proctor that is representative of the materials used.

### MATERIALS

- 209-2.1 Crushed aggregate base.** Crushed aggregate shall consist of clean, sound, durable particles of crushed stone, crushed gravel, crushed slag, or crushed concrete from approved sources and shall be free from coatings of clay, silt, organic material, clay lumps or balls or other deleterious materials or coatings. The method used to produce the crushed gravel shall result in the fractured particles in the finished product as consistent and uniform as practicable. Fine aggregate portion, defined as the portion passing the No. 4 sieve shall consist of fines from the coarse aggregate crushing operation. The fine aggregate shall be produced by crushing stone, gravel, or slag that meet the coarse aggregate requirements for wear and soundness.

The natural and manufactured materials used as coarse aggregate are defined as follows.

- a. **Crushed stone.** Crushed stone shall be the angular fragments resulting from crushing undisturbed, consolidated deposits of rock by mechanical means. Crushed stone shall be divided into the following, when specified.
  - (1) **Carbonate crushed stone.** Carbonate crushed stone shall be either dolomite or limestone. Dolomite shall contain 11.0% or more magnesium oxide (MgO). Limestone shall contain less than 11.0% magnesium oxide (MgO).
  - (2) **Crystalline crushed stone.** Crystalline crushed stone shall be either metamorphic or igneous stone, including but is not limited to, quartzite, granite, rhyolite and diabase.
- b. **Crushed gravel.** Crushed gravel shall be the product resulting from crushing, by mechanical means, and shall consist entirely of particles obtained by crushing gravel. The acceptance and use of crushed gravel shall be according to the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 12-08 *Crushed Gravel Producer Self-Testing Program*.
- c. **Crushed slag.** Crushed slag shall be the graded product resulting from the processing of air-cooled blast furnace slag. Air-cooled blast furnace slag shall be the nonmetallic product, consisting essentially of silicates and alumino-silicates of lime and other bases, which is developed in a molten condition simultaneously with iron in a blast furnace. It shall be air-cooled and shall have a compact weight (ITP 19) of not less than 70 pounds per cubic foot. The acceptance and use of air-cooled blast furnace slag shall be according to the current

Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 13-08, *Slag Producer Self-Testing Program*.

- d. Crushed concrete.** Crushed concrete shall be the angular fragments resulting from crushing Portland cement concrete by mechanical means. The acceptance and use of crushed concrete shall be according to Item 219 titled RECYCLED CONCRETE AGGREGATE BASE COURSE.

- 209-2.2 Quality.** The coarse aggregate shall be Class B Quality or better according to the quality standards listed in the following table.

### Coarse Aggregate Quality

Quality Test	Class
	B
Na <sub>2</sub> SO <sub>4</sub> Soundness 5 Cycle, Illinois Modified AASHTO T 104 <sup>1</sup> , % Loss max.	15
Los Angeles Abrasion, Illinois Modified AASHTO T 96, % Loss max.	40 <sup>2</sup>
Deleterious Materials <sup>3</sup>	
Shale, % max.	2.0
Clay Lumps, % max.	0.5
Coal & Lignite, % max.	---
Soft & Unsound Fragments, % max.	6.0
Other Deleterious, % max.	2.0
Total Deleterious, % max.	6.0

1. Does not apply to crushed concrete.
2. Does not apply to crushed slag or crushed steel slag.
3. Test shall be run according to ITP 203.

- 209-2.3 Gradation requirements.** The gradation of the aggregate base material shall meet the requirements of the gradation given in the following table when tested per the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 11-08, *Aggregate Gradation Control System (AGCS)*.

### Gradation of Crushed Aggregate Base

Sieve Size	Gradation Percent Passing
	CA 6
1-1/2 inch	100
1 inch	95±5
1/2 inch	75±15
No. 4	43±13
No. 16	25±15
No. 200 <sup>1</sup>	0-5

1. Modified for FAA requirement associated with non frost susceptible material. Maximum allowable material passing No. 200 sieve shall be 5%.

The gradations represent the limits which shall determine suitability of aggregate for use from the sources of supply. The final gradation shall be well graded from coarse to fine within the limits designated in the table and shall not vary from the lower limit on one (1) sieve to the high limit on an adjacent sieve or vice versa.

- 209-2.4 Plasticity.** All material shall comply with the plasticity index requirements listed below. The plasticity index requirement for crushed gravel, crushed stone, and crushed slag may be waived if the ratio of the percent passing the No. 200 sieve to that passing the No. 40 sieve is 0.60 or less.

Use	Plasticity Index - Percent	
	Gravel	Crushed Gravel, Stone, & Slag
Aggregate Base Course	0 to 6	---

Plasticity Index shall be determined by the method given in AASHTO T 90. Where shale in any form exists in the producing ledges, crushed stone samples shall be soaked a minimum of 18 hours before processing for plasticity index or minus No. 40 material. When clay material is added to adjust the plasticity index, the clay material shall be in a minus No. 4 sieve size.

**209-2.5 Sampling and Testing.**

- a. Aggregate base materials.** The Contractor shall take samples of the aggregate base in accordance with the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 11-08, *Aggregate Gradation Control System (AGCS)*, to verify initial aggregate base requirements and gradation. Material shall meet the requirements in paragraphs 209-2.1 through 209-2.4. This sampling and testing will be the basis for approval of the aggregate base quality requirements.
- b. Gradation requirements.** The Contractor shall take at least two (2) aggregate base samples per day in the presence of the Resident Engineer to check the final gradation. Sampling shall be per the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 11-08, *Aggregate Gradation Control System (AGCS)*. Material shall meet the requirements in paragraph 209-2.3 titled GRADATION REQUIREMENTS. The samples shall be taken from the in-place, un-compacted material at random sampling locations determined by the Resident Engineer. Results shall be furnished to the Resident Engineer by the Contractor each day during construction.

- 209-2.6 Geotextile fabric.** Geotextile fabric shall conform to the requirements of Item 152 titled EXCAVATION, SUBGRADE, AND EMBANKMENT.

## CONSTRUCTION METHODS

- 209-3.1 Control strip.** The first half-day of construction shall be considered the control strip. The Contractor shall demonstrate, in the presence of the Engineer, that the materials, equipment, and construction processes meet the requirements of the specification. The sequence and manner of rolling necessary to obtain specified density requirements shall be determined. The base course shall be constructed in lifts not more than four (4) inches thick when compacted, except that the maximum compacted thickness may be increased to a maximum of eight (8) inches upon the Contractor's demonstration that approved equipment and operations will uniformly compact the lift to the specified density. The Engineer must witness this demonstration and approve the lift thickness prior to full production.

Control strips that do not meet specification requirements shall be reworked, re-compacted or removed and replaced at the Contractor's expense. Full operations shall not continue until the control strip has been accepted by the Engineer. The Contractor shall use the same equipment,



materials, and construction methods for the remainder of construction, unless adjustments made by the Contractor are approved by the Engineer.

**209-3.2 Preparing underlying subgrade and/or subbase.** The underlying subgrade and/or subbase shall be checked and accepted by the Resident Engineer before base course placing and spreading operations begin. Re-proof rolling of the subgrade or proof rolling of the subbase in accordance with Item 152 titled EXCAVATION, SUBGRADE, AND EMBANKMENT, at the Contractor's expense, may be required by the Resident Engineer if the Contractor fails to ensure proper drainage or protect the subgrade and/or subbase. Any ruts or soft, yielding areas due to improper drainage conditions, hauling, or any other cause, shall be corrected before the base course is placed. To ensure proper drainage, the spreading of the base shall begin along the centerline of the pavement on a crowned section or on the high side of the pavement with a one-way slope.

**209-3.3 Production.** The aggregate shall be uniformly blended and, when at a satisfactory moisture content per paragraph 209-3.5 titled COMPACTION, the approved material may be transported directly to the placement.

**209-3.4 Placement.** The aggregate shall be placed and spread on the prepared underlying layer by spreader boxes or other devices as approved by the Engineer, to a uniform thickness and width. The equipment shall have positive thickness controls to minimize the need for additional manipulation of the material. Dumping from vehicles that require re-handling shall not be permitted. Hauling over the uncompacted base course shall not be permitted.

The aggregate shall meet gradation and moisture requirements prior to compaction. The base course shall be constructed in lifts as established in the control strip, but not less than four (4) inches nor more than eight (8) inches of compacted thickness.

When more than one (1) lift is required to establish the layer thickness specified in the contract documents, the construction procedure described here shall apply to each lift. No lift shall be covered by subsequent lifts until tests verify that compaction requirements have been met. The Contractor shall rework, recompact and retest any material placed which does not meet the specifications at the Contractor's expense.

**209-3.5 Compaction.** Immediately after completion of the spreading operations, compact each layer of the base course, as specified, with approved compaction equipment. The number, type, and weight of rollers shall be sufficient to compact the material to the required density within the same day that the aggregate is placed on the subgrade.

The Contractor shall provide a qualified nuclear gauge and operator for Quality Control (QC) testing for density.

**209-3.6 Weather limitations.** Material shall not be placed unless the ambient air temperature is at least 40°F and rising. Work on base course shall not be conducted when the subgrade or subbase is wet or frozen or the base material contains frozen material.

**209-3.7 Maintenance.** The base course shall be maintained in a condition that will meet all specification requirements. When material has been exposed to excessive rain, snow, or freeze-thaw conditions, prior to placement of additional material, the Contractor shall verify that materials still meet all specification requirements. Equipment may be routed over completed sections of base course, provided that no damage results and the equipment is routed over the full width of the completed base course. Any damage resulting to the base course from routing equipment over the base course shall be repaired by the Contractor. The maintenance cost shall be considered incidental to the contract and as a subsidiary obligation of the Contractor.

**209-3.8 Surface tolerances.** After the course has been compacted, the surface shall be tested for smoothness and accuracy of grade and crown. Any portion lacking the required smoothness or failing in accuracy of grade or crown shall be scarified to a depth of at least three (3) inches, reshaped and recompact to grade until the required smoothness and accuracy are obtained and approved by the Resident Engineer. Any deviation in surface tolerances shall be corrected

by the Contractor at the Contractor's expense. The smoothness and accuracy requirements specified here apply only to the top layer when base course is constructed in more than one (1) layer.

- a. **Smoothness.** The finished surface shall not vary more than three-eighths (3/8) inch when tested with a 12 or 16 foot straightedge applied parallel with and at right angles to the centerline. The straightedge shall be moved continuously forward at half the length of the 12 or 16 foot straightedge for the full length of each line on a 50-foot grid.
- b. **Grade.** The grade and crown shall be measured on a 50-foot grid and shall be within +0 and 0.05 feet - of the specified grade.

**209-3.9 Acceptance sampling and testing.** Crushed aggregate base course shall be accepted for density and thickness on an area basis. Testing frequency shall be a minimum one (1) compaction and thickness test per 1,500 square yards per lift of aggregate. Random sampling locations will be determined by the Resident Engineer.

- a. **Density.** The Resident Engineer shall perform all density tests.

Each area shall be accepted for density when the field density is at least 100% of the maximum density of laboratory specimens compacted and tested per AASHTO T 99 for areas designated for aircraft with gross weights of 60,000 pounds or less and AASHTO T 180 for areas designated for aircraft with gross weights greater than 60,000 pounds. The moisture content of the material during placing operations shall be within  $\pm 2\%$  of the optimum moisture content. The in-place field density shall be determined per AASHTO T 310 (Direct Transmission Density/Backscatter Moisture). The machine shall be calibrated in accordance with AASHTO T 310 within 12 months prior to its use on this contract. If the specified density is not attained, the area represented by the failed test must be reworked and/or recompacted and two (2) additional random tests made. This procedure shall be followed until the specified density is reached. Maximum density refers to maximum dry density at optimum moisture content unless otherwise specified.

- b. **Thickness.** Depth tests shall be made by test holes at least three (3) inches in diameter that extend through the base. The thickness of the base course shall be within +0 and -3/16 inch of the specified thickness as determined by depth tests taken by the Contractor in the presence of the Resident Engineer for each area. Where the thickness is deficient by more than 3/16 inch, the Contractor shall correct such areas at no additional cost by scarifying to a depth of at least three (3) inches, adding new material of proper gradation, and the material shall be blended and recompacted to grade. The Contractor shall replace, at his expense, base material where depth tests have been taken.

#### METHOD OF MEASUREMENT

**209-4.1** The quantity of crushed aggregate base course shall be measured for payment by the number of square yards of base course material placed and compacted to the specified density and plan thickness requirements in the completed course and accepted by the Resident Engineer. Base materials shall not be included in any other excavation quantities.

#### BASIS OF PAYMENT

**209-5.1** Payment for accepted quantities of work performed by the Contractor and measured by the Resident Engineer shall be made at the contract unit price as specified in paragraph 209-4.1 of this section. Payment shall be full compensation for furnishing all materials, for preparing and placing these materials, and for all labor, equipment tools, and incidentals necessary to complete the work as specified.

## REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

### **American Association of State Highway and Transportation Officials (AASHTO)**

AASHTO T 90	Standard Method of Test for Determining the Plastic Limit and Plasticity Index of Soils
AASHTO T 90	Standard Method of Test for Determining the Plastic Limit and Plasticity Index of Soils
AASHTO T 99	Standard Method of Test for Moisture–Density Relations of Soils Using a 2.5-kg (5.5-lb) Rammer and a 305-mm (12-in.) Drop
AASHTO T 180	Standard Method of Test for Moisture–Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop
AASHTO T 310	Standard Method of Test for In-Place Density and Moisture Content of Soil and Soil–Aggregate by Nuclear Methods (Shallow Depth)

### **Illinois Department of Transportation, Bureau of Materials Illinois Laboratory Test Procedure (ITP)**

#### *Manual of Test Procedures for Materials*

AASHTO T 11	Illinois Modified, Standard Method of Test for Materials Finer Than 75- $\mu$ m (No. 200) Sieve in Mineral Aggregates by Washing
ITP 19	Bulk Density (“Unit Weight”) and Voids in Coarse Aggregate

#### *Manual of Aggregate Quality Test Procedures*

AASHTO T 96	Illinois Modified, Standard Method of Test for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
AASHTO T 104	Illinois Modified, Standard Method of Test for Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate
AASHTO T 113	Illinois Modified, Standard Method of Test for Lightweight Pieces in Aggregate
ITP 203	Deleterious Particles in Coarse Aggregate

### **Illinois Department of Transportation, Bureau of Materials Policy Memoranda (PM)**

PM 11-08	Aggregate Gradation Control System (AGCS)
PM 12-08	Crushed Gravel Producer Self-Testing Program
PM 13-08	Slag Producer Self-Testing Program

**END OF ITEM 209**

**Item 215 Rubblized Concrete Pavement Base Course**

**THE TEMPLATE FOR THIS SPECIFICATION IS FROM THE FAA ENGINEERING BRIEF NO. 66**

**DESCRIPTION**

- 215-1.1** This item shall consist of rubblizing and seating (rolling) the existing Portland cement concrete (PCC) pavement prior to placing a new bituminous concrete or PCC pavement as specified in the contract documents.

**MATERIALS**

- 215-2.1** **General.** Only approved materials, conforming to the requirements of these specifications, shall be used in the work. They may be subjected to inspection and tests at any time during the progress of their preparation or use. The source of supply of each of the materials shall be approved by the Resident Engineer before delivery or use is started. Representative preliminary samples of the materials shall be submitted by the Contractor, when required, for examination and test.

Materials shall be stored and handled to insure, the preservation of their quality and fitness for use and shall be located to facilitate prompt inspection. All equipment for handling and transporting materials and concrete must be clean before any material or concrete is placed therein.

- 215-2.2** **Plant mix bituminous concrete.** Bituminous concrete for patching will be as described in Item 401 titled ASPHALT MIX PAVEMENT SURFACE COURSE. The weight in tons of the bituminous concrete patching material actually used in the work shall be determined in accordance with Item 401 titled ASPHALT MIX PAVEMENT SURFACE COURSE.
- 215-2.3** **Crushed aggregate base.** Aggregate base course for patching will be as described in Item 209 titled CRUSHED AGGREGATE BASE COURSE. The weight in tons of the aggregate base course patching material actually used in the work shall be determined in accordance with Item 209 titled CRUSHED AGGREGATE BASE COURSE.
- 215-2.4** **Unclassified excavation.** Unclassified excavation for patching will be the volume of materials removed in accordance with Item 152 titled EXCAVATION, SUBGRADE, AND EMBANKMENT. The volume of material will be determined in accordance with Item 152 titled EXCAVATION, SUBGRADE, AND EMBANKMENT.

**CONSTRUCTION METHODS**

- 215-3.1** **General.** The Contractor shall furnish all labor, materials, and services necessary for, and incidental to, the completion of all work as shown on the drawings and specified herein. All machinery and equipment owned or controlled by the Contractor, which he proposes to use on the work, shall be of sufficient size to meet the requirements of the work, and shall be such as to produce satisfactory work; all work shall be subject to the inspection and approval of the Engineer.
- 215-3.2** **Rubblization and seating equipment.** Rubblization shall be accomplished by the use of a pavement breaker machine that is capable of delivering sufficient energy to rubblize the pavement full-depth in a manner that completely destroys the concrete slab and all slab action.

Sufficient seating equipment shall be used to thoroughly settle the rubblized concrete and to provide a smooth surface for the bituminous concrete overlay. The type of rubblization machine and the minimum types of associated rolling equipment used in the rubblization process shall be either the resonant breaker process or the multi-header breaker process. If necessary, to achieve rubblization size requirements, Contractor may pre-fracture with a guillotine breaking device.

### 215-3.3 Resonant breaker process.

- a. **Resonant breaker machine.** This is a self-contained, self-propelled resonant frequency breaker specifically designed for the purpose of rubblizing PCC pavement. The machine shall be capable of producing low-amplitude (one (1) inch maximum) blows of 2000 pounds force and delivering blows to the existing PCC surface at a rate of not less than 44 cycles per second. If necessary, the breaker shall be equipped with a screen to protect nearby structures, vehicles or aircraft from flying chips during the fracturing process.
- b. **Resonant breaker seating equipment.** The contractor shall provide and use a smooth double steel drum vibratory roller. The roller shall have a gross weight of at least ten (10) tons and be operated in the high frequency low amplitude vibratory mode, to settle and seat the rubblized pavement and provide a smooth surface for the bituminous concrete overlay.

### 215-3.4 Multi-head breaker process.

- a. **Multi-head breaker machine.** This is a self-contained, self-propelled multi-head breaker specifically designed for the purpose of rubblizing PCC pavement. The machine shall be capable of rubblizing the pavement a minimum width of 13 feet per pass. Pavement-breaking hammers shall be mounted laterally in pairs, with half the hammers in a forward row and the remainder diagonally offset in a rear row so there is continuous breakage from side to side.

The lift height of the hammers shall be independently adjustable. If necessary, the breaker shall be equipped with a screen to protect vehicles from flying chips during the fracturing process.

- b. **Multi-head breaker seating equipment.** The contractor shall provide and use the following seating equipment:
  - (1) **Z-grid roller.** This is a vibratory steel drum roller fitted with a "Z" pattern grid on the drum face. The roller shall have a gross weight of at least ten (10) tons, as operated in the vibratory mode, to settle and seat the rubblized pavement, and provide a smooth surface for the bituminous concrete overlay.
  - (2) **Pneumatic-tire roller.** A pneumatic-tire roller with a gross weight of at least 25 tons shall be used after the Z-grid roller to further settle and seat the rubblized pavement.

A ten (10) ton pneumatic roller is typically specified for PCC pavements with thicknesses ranging from eight (8) to 12 inches. A larger roller (up to 25 tons) may be required to properly seat rubblized material resulting from very thick pavements. A smaller pneumatic tire roller may be necessary for use on light duty pavements or pavement with very poor subgrades.
  - (3) **Smooth steel drum vibratory roller.** The contractor shall provide and use a smooth steel drum vibratory roller. The roller shall have a gross weight of at least ten (10) tons as operated in the vibratory mode, to settle and seat the rubblized pavement and provide a smooth surface for the bituminous concrete overlay.

Rubblization machines and rollers of other design that will accomplish similar results may also be used with the approval of the Engineer. All rubblization and seating equipment necessary to perform the work will be considered essential to the completion of the project and will not be paid for separately.

**215-3.5 Construction requirements.****a. Preparation prior to rubblization.**

- (1) **Drainage system installation.** Prior to rubblization operations, drainage systems as specified in the contract documents shall be installed. Drainage systems shall be properly functioning for a minimum of two (2) weeks prior to rubblization.
- (2) **Removal of existing asphalt surfaces.** Prior to the rubblization operations, existing asphalt overlays and patches shall be removed from the PCC pavement surfaces to be rubblized. Existing full-depth asphalt patches shall remain in place, unless directed for removal by the Resident Engineer.
- (3) **Saw-cut joints.** A new full-depth saw-cut joint shall be made along an existing joint at all pavements where rubblized PCC abuts pavement that will remain in place. All load transfer devices between the planned rubblization and PCC pavement remaining in place shall be severed.
- (4) **Shouldering.** Shoulder adjustments and/or any pavement widening shall be completed up to the elevation of the existing pavement grade prior to beginning the rubblization operations. These areas can be used to support the rubblization machines while the existing PCC pavement is being rubblized.

**b. Test strip and test pit to establish procedure.**

- (1) **Test Strip.** Before the rubblization operations begin, the Resident Engineer will designate a test section of approximately 150 feet by 12 feet. The Contractor shall rubblize the test section using varying degrees of energy and/or various striking heights until a procedure is established that will rubblize the pavement to the required extent as contained in these specifications.
- (2) **Test Pit.** A four (4) foot square test pit shall be excavated in the middle of the test strip, at a location selected by the Resident Engineer, to determine that the breaker is producing pieces of the specified sizes as contained in these specifications. The rubblized particle sizes shall be checked throughout the entire depth of the pavement. The test pit material shall be removed from the project and the hole filled using coarse aggregate material as determined by the Resident Engineer. The replacement material shall be placed and properly compacted by the Contractor.

- c. The Engineer and the Contractor shall mutually agree upon the rubblization procedure based upon compliance with the performance criteria contained here within. The established procedure shall be used to rubblize the remainder of the pavement. The Contractor shall continuously monitor the rubblization operation, and make minor adjustments in the striking pattern, striking energy, number of passes, and other factors necessary to continually achieve acceptable breaking throughout the project. The Contractor shall inform the Engineer of any major adjustments that may be required in the process to provide rubblized pavement that conforms to the specification requirements contained herein. Additional test pits may be required by the Engineer to confirm that the PCC pavement is adequately rubblized.

**215-3.6 Rubblization criteria.**

- a. The existing concrete pavement shall be rubblized into particles with at least 75% (as determined by visual observation) particles smaller than: three (3) inches at surface; 12 inches in bottom half. For reinforced Portland cement concrete (RPC) pavement, the reinforcing steel shall be substantially debonded from the concrete and left in place, unless protruding above the surface. Concrete pieces below the reinforcing steel shall be reduced to the greatest possible extent, and no individual piece shall exceed 15 inches in any dimension.

- b. Due to lack of edge support, concrete pieces below the reinforcing steel up to 15 inches in any dimension will be accepted along the outside edge of the existing PCC pavement, up to 15 inches from the edge.

**215-3.7 General rubblization procedures.**

- a. The rubblization shall be done in partial widths when necessary to maintain traffic as specified in the contract documents.
- b. When the rubblization process is adjacent to active pavement, measures shall be taken to prevent debris from entering the active pavement.
- c. In areas where the pavement is to be overlaid prior to completion of the rubblization, the initial rubblization will extend a minimum of two (2) feet beyond the width of the pavement to be overlaid.
- d. For the resonant breaker process, rubblizing shall begin at a free edge or previously broken edge and progress toward the opposite shoulder or longitudinal centerline of the pavement. Continuous coverage of the entire PCC pavement surface, overlapped if necessary, to achieve adequate rubblization with the breaking shoe shall be required. Additional passes of the resonant breaker machine may be required if larger concrete pieces remain above the reinforcement.

**215-3.8 Dust control.** The Contractor shall minimize the dispersion of dust from the rubblization operation until the rubblized surface is overlaid with bituminous concrete. The Contractor shall provide a water truck, operator, and all water necessary for dust-control purposes. Excessive water shall not be applied to the rubblized surface. Dust control is incidental to the rubblization process and will not be paid for separately. The Resident Engineer shall approve dust- mitigation measures.

**215-3.9 Damage to base, underlying structures, and other facilities.** The rubblization machine and rollers shall be operated in a manner that will avoid damaging the base, underlying structures, utilities, drainage facilities, bridge approach slabs, bridge decks, and other facilities on the project. If any damage occurs, the Contractor shall immediately cease his operations, notify the Resident Engineer, and repair the damage at the direction of the Resident Engineer. Repairs shall be made in a timely manner and at the expense of the Contractor.

**215-3.10 Removal of exposed reinforcing steel.** Reinforcing steel in the rubblized pavement, if any, shall generally be left in place. Reinforcing steel that becomes exposed at the surface during the rubblization process or rolling operations shall be cut flush with the rubblized surface, or slightly below the surface, and removed from the project by the Contractor. The Contractor shall also remove any loose joint filler, expansion materials, or other similar items.

**215-3.11 Seating procedures.** The Contractor shall use the rolling equipment contained in these specifications as described below.

- a. **Resonant breaker process.** The rubblized PCC pavement shall be rolled with a minimum of three (3) passes over the entire width of the pavement with a vibratory steel drum roller. For this operation, a pass is defined as forward and back over the entire surface area. The Resident Engineer may require additional passes to satisfactorily seat the rubblized pavement and provide a smooth surface that is ready for the bituminous concrete overlay. The roller shall be operated at a speed not to exceed six (6) feet per second.
- b. **Multi-head breaker process.** Prior to placing the bituminous concrete overlay, the entire width of the pavement shall be rolled by vibratory and pneumatic-tire rollers following the sequence contained herein. For this operation, a pass is defined as forward and back over the entire surface area.
  - (1) After rubblizing, a minimum of two (2) passes with the Z-grid roller shall follow the multi-head breaker machine, followed by a minimum of one (1) pass with the pneumatic-tire roller.

- (2) Immediately prior to bituminous concrete overlay, roll a minimum of one (1) pass with the vibratory steel drum roller.

The Resident Engineer may require additional passes of the rolling equipment to satisfactorily compact the rubblized pavement and provide a smooth surface that is ready for the bituminous concrete overlay. Additional rolling at the direction of the Resident Engineer shall be considered incidental to the work, and will not be paid for separately. Rolling should not be performed in wet conditions.

- 215-3.12 Unstable area patching.** If unstable areas occur because of expansion of the existing concrete pavement, they shall be removed to a maximum length of four (4) feet in length by 12 feet in width and replaced with full-depth bituminous concrete (patching) at the direction of the Resident Engineer. Patching procedures shall conform to the standard specifications, and shall be completed prior to placing the bituminous concrete overlay. Patching will be paid for as a separate bid item as specified.

Areas of poor subgrade support that are identified during the rubblization and seating process shall be patched at the direction of the Resident Engineer. Generally, the rubblized pavement, base course, and subgrade material will be removed from unstable areas. The material will be replaced with aggregate base course or hot mix asphalt as directed and compacted in lifts as specified.

- 215-3.13 Progress of the work.** In no instance shall more than 48 hours elapse between rubblizing the pavement and the placement of the bituminous concrete overlay. If rain occurs between these operations, this time limitation may be waived to allow sufficient time for the rubblized pavement to dry to the satisfaction of the Resident Engineer.

#### METHOD OF MEASUREMENT

- 215-4.1** The quantity of rubblization of concrete pavement shall be measured for payment by the number of square yards as specified, completed, and accepted by the Resident Engineer.

#### BASIS OF PAYMENT

- 215-5.2** Payment for accepted quantities of work performed by the Contractor and measured by the Resident Engineer shall be made at the contract unit price as specified in paragraph 215-4.1 of this section. Payment shall be full compensation for all labor, equipment, tools, and incidentals necessary to furnish and apply water for dust control, provide test sections and test pits, saw-cut joints, cut and remove exposed concrete reinforcing material, remove joint filler and other debris, cleanup, waste removal and disposal, and preparation of the rubblized surface prior to the bituminous concrete overlay and to complete the work as specified.

#### END OF ITEM 215



## Item 216 Crack and Seat Pavement

### DESCRIPTION

- 216-1.1** This item shall consist of cracking and seating the existing Portland cement concrete (PCC) pavement prior to placing a new bituminous concrete or PCC pavement as specified in the contract documents.

### EQUIPMENT

- 216-2.1** **Cracking hammer.** The equipment used for cracking the designated pavements shall be capable of producing the desired cracking pattern as specified in the contract documents. Should the equipment used not produce the desired cracking pattern, it shall be replaced. The Engineer shall have final approval of the equipment used and shall be able to reject the cracking equipment.

- 216-2.2** **Rollers.** Seating shall be accomplished with either a vibratory roller or a heavy pneumatic- tire roller.

The vibratory roller shall have a drum diameter of 48 inches, a drum length of 66 inches, vibrators with 1,600 vibrations per minute, a total applied force of 325 pounds per lineal inch; unit static force of 125 pounds per lineal inch, and adjustable eccentrics.

A heavy pneumatic-tired roller shall have a gross weight of not less than 25 tons and shall consist of not less than four (4) pneumatic-tired wheels revolving in one (1) transverse line. The width of the roller shall be not less than eight (8) feet, and it shall be constructed in two (2) or more sections in such a manner that each section is free to oscillate or move independently. Under working conditions, the roller shall develop a compression of not less than 650 pounds per inch width of tire tread.

### CONSTRUCTION METHODS

- 216-3.1** **Cracking.** The existing concrete pavement, where specified in the contract documents or as directed by the Engineer, shall be broken in place to produce individual pavement elements approximately of the size specified in the contract documents without dislodging the cracked pieces or causing surface spalling.

The cracking shall be performed only to the extent that will produce random fractures the full depth and width of the slab at the specified intervals, yet maintain aggregate interlock in the fractured faces, all to the satisfaction of the Engineer. Continued longitudinal cracks shall be prevented by varying the cracked method.

It is not the intent of this project to crush or shatter the existing concrete, but only to crack it as specified.

The Contractor shall furnish a water truck to wet down the concrete pavement to highlight the cracks in the pavement. The intent of this requirement is to prevent over fracturing the concrete pavement and to verify the specified crack pattern.

The pavement breaking hammer shall be operated on a test section designated by the Engineer. The hammer shall make a sufficient number of passes spaced equally across the pavement to produce the desired cracking pattern. The forward speed, number of flows of the hammer, and

level of impact energy shall be adjusted on this test section to produce the specified cracking pattern.

**216-3.2 Seating.** Seating of the cracked pavement shall be accomplished by a minimum of five (5) passes of the roller or until no additional vertical drop in the pavement is discernible by the Engineer. A single pass shall consist of the coverage of a fixed point twice, once up and back.

**216-3.3 Pavement cleaning.** Following the cracking and seating operation, the pavement surface shall be cleaned of all spalled and/or loose concrete by means of a power broom and compressed air equipment. It is the intent of this specification to thoroughly clean the pavement prior to the installation of the tack coat. Any localized holes or voids shall be tacked and filled with aggregate-bituminous or sand-bituminous material as directed by the Resident Engineer.

#### **METHOD OF MEASUREMENT**

**216-4.1** The quantity of cracking and seating of concrete pavement shall be measured for payment by the number of square yards as specified, completed, and accepted by the Resident Engineer.

#### **BASIS OF PAYMENT**

**216-5.1** Payment for accepted quantities of work performed by the Contractor and measured by the Resident Engineer shall be made at the contract unit price as specified in paragraph 216-4.1 of this section. Payment shall be full compensation for furnishing all equipment and materials, and for all preparation, modification of equipment as needed, cleaning watering and for all labor, equipment, tools, and incidentals necessary to complete the work as specified.

#### **END OF ITEM 216**

## Item 217 Aggregate-Turf Runway/Taxiway

### DESCRIPTION

- 217-1.1** This item shall consist of an aggregate-turf composed of a base course of soil-bound crushed stone, soil-bound gravel, or soil-bound sand, and a seedbed of suitable soil or combination of soil and aggregate, constructed on a prepared subgrade or a previously constructed underlying course as specified in the contract documents.

This item may include the furnishing and applying of fertilizer, lime, top-soil, or other plant nutrients; the furnishing and planting of seed; and the furnishing and spreading of mulch. When any turfing materials are required, the quality, quantity, and construction methods shall be per paragraph 217-3.10 titled TURF. When turf is to be established, the seedbed soil or topsoil shall be a natural friable soil, possessing characteristics of the best locally obtainable soils, which can produce a fairly heavy growth of crops, grass, or other vegetation.

The prepared composite mixture of aggregates used for the base course shall be Type A, B, or C, of the table below titled GRADATION OF MIXTURE. The stabilizer aggregate Type D, E, or F of the table below titled GRADATION OF STABILIZER AGGREGATE shall be mixed with in-place materials.

The Contractor shall provide a recent, within the same year that the aggregate base course is constructed, representative Proctor for each aggregate source and gradation approved for use on the project. All associated labor, equipment, materials and incidentals associated with obtaining the Proctor information shall be considered incidental to the contract and as a subsidiary obligation of the Contractor. If, in the opinion of the Resident Engineer, the Proctor information is determined to be non-representative of the material being placed, the Resident Engineer may require the Contractor to provide an additional Proctor that is representative of the materials used.

### MATERIALS

- 217-2.1** **Stabilized mixes.** The designated stabilized base course mixtures shall conform to the following requirements.

Type A materials shall be natural or artificial mixtures of clay or soil binder and gravel, stone or sand, proportioned to meet the requirements specified.

Type B and Type C materials shall be natural or artificial mixtures of gravel, stone, or slag and soil, proportioned to meet the requirement specified. The aggregate shall consist of clean, hard durable particles of crushed or uncrushed gravel, stone, or slag, and shall be free from soft, thin, elongated, or laminated pieces, and vegetable or other deleterious substances.

- 217-2.2** **Gradation requirements.** The prepared composite mixture used shall meet the applicable gradation requirements presented in the table below when tested per the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 11-08, *Aggregate Gradation Control System (AGCS)*.

### Gradation of Mixture

Sieve Size	Gradation Percent Passing		
	A	B	C
2 inch			100
1 inch	100	100	70-95
3/4 inch		70-100	
No. 4		40-70	
No.10	60-100	40-70	32-60
No. 20	50-90		
No. 40	40-75	20-45	20-40
No. 200	12-30	10-20	10-20

The fraction passing the No. 50 mesh sieve shall have a liquid limit not greater than 30 and a plasticity index not greater than eight (8) when tested per AASHTO T 90.

- 217-2.3 Stabilizer aggregate.** Stabilizer aggregate conforming to the gradations(s) specified in the table below when tested per the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 11-08, *Aggregate Gradation Control System (AGCS)*, shall be placed upon the existing soil or base course in the specified quantity per square yard. The aggregate shall be uniformly blended with the soil or base course material to the depth required or as specified in the contract documents. The aggregate shall consist of crushed stone, crushed or uncrushed gravel, or crushed slag, and meet the requirements of Item 208 titled AGGREGATE BASE COURSE. The aggregate shall be free from soft, thin, elongated, or laminated pieces, disintegrated material, or other deleterious substances.

### Gradation of Stabilizer Aggregate

Sieve Size	Gradation Percent Passing		
	D	E	F
2 inch		100	
1.5 inch	100		
1 inch	90-100		
1/2 inch		0-15	100
No.4	20-50		85-100
No. 10	0-10		
No. 100			0-30

Where sand, as existing subgrade or base, requires modification, it shall be modified by the addition of clay or lime rock. The operation of spreading and mixing shall be handled as stated under construction methods.

**217-2.4 Sampling and testing.**

- a. **Aggregate base materials.** The Contractor shall take samples of the aggregate base in accordance with the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 11-08, *Aggregate Gradation Control System (AGCS)*, to verify initial aggregate base requirements and gradation. Material shall meet the requirements in paragraph 217-2.1 titled STABILIZED MIXES. This sampling and testing will be the basis for approval of the aggregate base quality requirements.

**b. Gradation requirements.** The Contractor shall take at least two (2) aggregate base samples per day in the presence of the Resident Engineer to check the final gradation. Sampling shall be per the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 11-08, *Aggregate Gradation Control System (AGCS)*. Material shall meet the requirements in paragraph 217-2.2. The samples shall be taken from the in-place, un-compacted material at random sampling locations determined by the Resident Engineer. Results shall be furnished to the Resident Engineer by the Contractor each day during construction.

**217-2.5 Geotextile fabric.** Geotextile fabric shall conform to the requirements of Item 152 titled EXCAVATION, SUBGRADE, AND EMBANKMENT.

### CONSTRUCTION METHODS

**217-3.1 Control strip.** The first half-day of construction shall be considered the control strip. The Contractor shall demonstrate, in the presence of the Engineer, that the materials, equipment, and construction processes meet the requirements of the specification. The sequence and manner of rolling necessary to obtain specified density requirements shall be determined.

Control strips that do not meet specification requirements shall be reworked, re-compacted, or removed and replaced at the Contractor's expense. Full operations shall not begin until the control strip has been accepted by the Engineer. Upon acceptance of the control strip by the Engineer, the Contractor shall use the same equipment, materials, and construction methods for the remainder of construction, unless adjustments made by the Contractor are approved in advance by the Engineer.

**217-3.2 Preparing underlying course.** The underlying course shall be checked and accepted by the Resident Engineer before placing and spreading operations begin. Any ruts or soft, yielding places caused by improper drainage conditions, hauling, or any other cause, shall be corrected before the base course is placed. To protect the underlying course and to ensure proper drainage, the spreading of the base shall begin along the centerline of the pavement on a crowned section or on the high side of the pavement with a one-way slope. Material shall not be placed on frozen subgrade or subbase.

**217-3.3 Placement.** The material shall be placed and spread on the prepared underlying layer by spreader boxes or other devices as approved by the Engineer, to a uniform thickness and width. The material shall be thoroughly pulverized and mixed to produce a homogeneous mass forming a layer. The equipment shall have positive thickness controls to minimize the need for additional manipulation of the material. Dumping from vehicles that require re-handling shall not be permitted. Hauling over the uncompacted base course shall not be permitted.

The material shall meet gradation and moisture requirements prior to compaction. The layer shall be constructed in lifts as established in the control strip, but not less than four (4) inches nor more than eight (8) inches of compacted thickness.

When more than one (1) lift is required to establish the layer of thickness specified in the contract documents, the construction procedure described here shall apply to each lift. No lift shall be covered by subsequent lifts until tests verify that compaction requirements have been met. The Contractor shall rework, recompact and retest any material placed which does not meet the specifications.

**217-3.4 Compaction.** Immediately upon completion of the spreading operations, compact each layer of the base course, as specified, with approved compaction equipment. The number, type, and weight of rollers shall be sufficient to compact the material to the required density within the same day that the aggregate is placed on the subgrade.

The Contractor shall provide a qualified nuclear gauge and operator for Quality Control (QC) testing for density.

- 217-3.5 Finishing.** The surface of the base course shall be finished by blading or other approved equipment designed for this purpose. Adding thin layers of material to the top layer of base course to meet grade shall not be allowed. If the elevation of the top layer is one-half (1/2) inch or more below grade, the top layer of base shall be scarified to a depth of at least three (3) inches, new material added, and the layer blended and recompacted to bring it to grade at the Contractor's expense. If the finished surface is above plan grade, it shall be cut to grade and rerolled.
- 217-3.6 Weather limitations.** Material shall not be placed unless the ambient air temperature is at least 40°F and rising. Work on base course shall not be conducted when the subgrade or subbase is wet or frozen or the base material contains frozen material.
- 217-3.7 Maintenance.** The layer shall be maintained in a condition that will meet all specification requirements until the work is accepted. When material has been exposed to excessive rain, snow, or freeze-thaw conditions, prior to placement of additional material, the Contractor shall verify that materials still meets all specification requirements. Equipment may be routed over completed sections of base course, provided that no damage results and the equipment is routed over the full width of the completed base course. Any damage resulting to the base course from routing equipment over the base course shall be repaired by the Contractor. The maintenance cost shall be considered incidental to the contract and as a subsidiary obligation of the Contractor.
- 217-3.8 Surface tolerance.** After the course has been compacted, the surface shall be tested for smoothness and accuracy of grade and crown. Any portion lacking the required smoothness or failing in accuracy of grade or crown shall be scarified to a depth of at least three (3) inches, reshaped and recompacted to grade. until the required smoothness and accuracy are obtained and approved by the Resident Engineer. Any deviation in surface tolerances shall be corrected by the Contractor at the Contractor's expense. The smoothness and accuracy requirements specified here apply only to the top layer when base course is constructed in more than one (1) layer.
- a. Smoothness.** The finished surface shall not vary more than one-half (1/2) inch when tested with a 12 or 16-foot straightedge applied parallel with and at right angles to the centerline. The straightedge shall be moved continuously at half the length of the 12 or 16-foot straightedge for the full length of each line on a 50-foot grid.
- b. Grade.** The grade and crown shall be measured on a 50-foot grid and shall be within +0 and 0.05 feet- of the specified grade.
- 217-3.9 Acceptance sampling and testing.** Aggregate-Turf course shall be accepted for density and thickness on an area basis. Testing frequency shall be a minimum one (1) compaction and thickness test per 1,500 square yards per lift of aggregate. Random sampling locations will be determined by the Resident Engineer.
- a. Density.** The Resident Engineer shall perform all density tests.
- Each lot shall be accepted for density when the field density is at least 90% of the maximum density of laboratory specimens compacted and tested per AASHTO T 99 for areas designated for aircraft with gross weights of 60,000 pounds or less and AASHTO T 180 for areas designated for aircraft with gross weights greater than 60,000 pounds. The moisture content of the material during placing operations shall be within  $\pm 2\%$  of the optimum moisture content. The in-place field density shall be determined per AASHTO T 310 (Direct Transmission Density/Backscatter Moisture). The machine shall be calibrated in accordance with AASHTO T 310 within 12 months prior to its use on this contract. If the specified density is not attained, the area represented by the failed test must be reworked and/or recompacted and two (2) additional random tests made. This procedure shall be followed until the specified density is reached. Maximum density refers to maximum dry density at optimum moisture content unless otherwise specified.

- b. Thickness.** Depth tests shall be made by test holes or cores at least three (3) inches in diameter that extend through the base. The thickness of the base course shall be within +0 and -3/16 inch of the specified thickness as determined by depth tests taken by the Contractor in the presence of the Resident Engineer for each area. Where the thickness is deficient by more than 3/16 inch, the Contractor shall correct such areas at no additional cost by scarifying to a depth of at least three (3) inches, adding new material of proper gradation, and the material shall be blended and recompacted to grade. The Contractor shall replace, at his expense, base material where depth tests have been taken.

- 217-3.10 Turf.** Turfing shall be in accordance with Item 901 titled SEEDING, Item 904 titled SODDING, Item 905 titled TOPSOIL, and Item 908 titled MULCHING as applicable.

#### METHOD OF MEASUREMENT

- 217-4.1** The quantity of soil-aggregate base course shall be measured for payment by the number of square yards of base course material placed and bonded in the completed course and accepted by the Resident Engineer. The quantity shall be measured in final position based on depth tests or cores. of subbase course material placed and compacted to specified density and plan thickness requirements in the completed course and accepted by the Resident Engineer
- 217-4.2** The quantity of stabilizer aggregate shall be measured for payment by the number of square yards of aggregate furnished and placed in the completed course and accepted by the Resident Engineer.
- 217-4.3** Topsoil, lime, fertilizer, seeding and mulching will be paid under the applicable specifications.

#### BASIS OF PAYMENT

- 217-5.1** Payment for accepted quantities of work performed by the Contractor and measured by the Resident Engineer shall be made at the contract unit price as specified in paragraphs 217-4.1 through 217-4.3 of this section. Payment shall be full compensation for furnishing all materials and for all preparation, hauling, and placing of these materials; and for all labor, equipment, tools, and incidentals necessary to complete the work as specified.

#### REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

##### American Association of State Highway and Transportation Officials (AASHTO)

AASHTO T 90	Standard Method of Test for Determining the Plastic Limit and Plasticity Index of Soils
AASHTO T 99	Standard Method of Test for Moisture–Density Relations of Soils Using a 2.5-kg (5.5-lb) Rammer and a 305-mm (12-in.) Drop
AASHTO T 180	Standard Method of Test for Moisture–Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop
AASHTO T 310	Standard Method of Test for In-Place Density and Moisture Content of Soil and Soil–Aggregate by Nuclear Methods (Shallow Depth)

##### Illinois Department of Transportation, Bureau of Materials Policy Memoranda (PM)

PM 11-08	Aggregate Gradation Control System (AGCS)
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**END OF ITEM 217**



## Item 219 Recycled Concrete Aggregate Base Course

### DESCRIPTION

- 219-1.1** This item shall consist of a base course composed of recycled concrete aggregate, crushed to meet a particular gradation, constructed on a prepared course as specified in the contract documents.

### MATERIALS

- 219-2.1 Aggregate.** Recycled concrete aggregate shall consist of cement concrete. The recycled concrete material shall be free of reinforcing steel and expansion material. Asphalt overlays and any full slab asphalt panels shall be removed from the concrete surface prior to removal and crushing.

Care must be taken, however, to assure that quality and gradation requirements are not compromised when recycled concrete is used in lieu of other aggregate materials. Concrete removal and crushed concrete stockpiling and handling must be performed in such a manner as to avoid contamination of the aggregate with dirt and foreign matter.

- 219-2.2 Quality.** Recycled concrete aggregate shall consist of at least 90%, by weight, cement concrete; virgin aggregates may be added to meet the 90% minimum concrete requirement. The remaining 10% may consist of the following materials:

#### Deleterious Materials

Material	% Deleterious, ITP 203
Asphalt concrete	10% maximum
Other	4% maximum
Total	10% maximum

- 219-2.3 Gradation requirements.** The gradation (job mix) of the final mixture shall fall within the design range indicated in the following table, when tested per the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 11-08, *Aggregate Gradation Control System (AGCS)*. The final gradation shall be continuously graded from coarse to fine and shall not vary from the low limit on one sieve to the high limit on an adjacent sieve or vice versa.

### Gradation of Recycled Concrete Aggregate Base

Sieve Size	Percentage by Weight Passing Sieves	Job Mix Tolerances Percent
2 inch	100	--
1-1/2 inch	95 - 100	±5
1 inch	70 - 95	±8
3/4 inch	55 - 85	±8
No. 4	30 - 60	±8
No. 30	12 - 30	±5
No. 200	0 - 10	±3

#### 219-2.4 Sampling and testing.

- a. **Aggregate base materials.** The Contractor shall take samples of the aggregate base in accordance with the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 11-08, *Aggregate Gradation Control System (AGCS)*, to verify initial aggregate base requirements and gradation. Material shall be per the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 7-08, *Recycling Portland Cement Concrete Into Aggregate*. This sampling and testing will be the basis for approval of the aggregate base quality requirements.
- b. **Gradation requirements.** The Contractor shall take at least two (2) aggregate base samples per day in the presence of the Resident Engineer to check the final gradation. Sampling shall be per the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 11-08, *Aggregate Gradation Control System (AGCS)*. Material shall meet the requirements in paragraph 219-2.3 titled GRADATION REQUIREMENTS. The lot will be consistent with the lot size used for density. The samples shall be taken from the in-place, un-compacted material at random sampling locations determined by the Resident Engineer. Results shall be furnished to the Resident Engineer by the Contractor each day during construction.

- 219-2.5 Geotextile fabric.** Geotextile fabric shall conform to the requirements of Item 152 titled EXCAVATION, SUBGRADE, AND EMBANKMENT.

### CONSTRUCTION METHODS

- 219-3.1 Acceptance at jobsite or central recycler.** Acceptance of crushed concrete begins with approval of the raw feed stockpile. Crushed concrete used as raw feed at a central recycling plant or at a jobsite shall not be contaminated with soil or foreign matter. A small amount of soil embedded in the base of the concrete slab is acceptable. A small amount of construction debris, steel, fabric, wood from forms, and a small amount of RAP leftover from milling is also acceptable. Raw feed piles shall not have excavated soil, bricks, slabs of asphalt mix pavement, or washout from concrete trucks. Previously approved crushed stone or crushed gravel from the jobsite is allowed but shall be limited to 25% of the total raw feed. Contamination in the stockpile area is as detrimental as contamination when picking up the broken concrete. Stockpile pads shall be provided, and haul roads and plant areas properly maintained to assure that acceptable material is not contaminated prior to use.

Stockpiling, hauling, and loading shall conform to the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 11-08, *Aggregate Gradation Control System (AGCS)*.

**219-3.2 Control Strip.** The first half-day of construction shall be considered the control strip. The Contractor shall demonstrate, in the presence of the Engineer, that the materials, equipment, and construction processes meet the requirements of the specification. The sequence and manner of rolling necessary to obtain specified density requirements shall be determined. The base course shall be constructed in lifts not more than four (4) inches thick when compacted, except that the maximum compacted thickness may be increased to a maximum of eight (8) inches upon the Contractor's demonstration that approved equipment and operations will uniformly compact the lift to the specified density. The Engineer must witness this demonstration and approve the lift thickness prior to full production.

Control strips that do not meet specification requirements shall be reworked, re-compacted or removed and replaced at the Contractor's expense. Full operations shall not continue until the control strip has been accepted by the Engineer. The Contractor shall use the same equipment, materials, and construction methods for the remainder of construction, unless adjustments made by the Contractor are approved by the Engineer.

**219-3.3 Preparing underlying course.** The underlying course shall be checked by the Resident Engineer before placing and spreading operations are started. Any ruts or soft yielding places caused by improper drainage conditions, hauling, or any other cause shall be corrected at the Contractor's expense before the base course is placed there. Material shall not be placed on frozen material.

To protect the existing layers and to ensure proper drainage, the spreading of the recycled concrete aggregate base course shall begin along the centerline of the pavement on a crowned section or on the greatest contour elevation of a pavement with a variable uniform cross slope.

**219-3.4 Placement.** The aggregate shall be placed and spread on the prepared underlying layer by spreader boxes or other devices as approved by the Engineer, to a uniform thickness and width. The equipment shall have positive thickness controls to minimize the need for additional manipulation of the material. Dumping from vehicles that require re-handling shall not be permitted. Hauling over the uncompacted base course shall not be permitted.

The aggregate shall meet gradation and moisture requirements prior to compaction. The subbase course shall be constructed in lifts as established in the control strip, but not less than four (4) inches nor more than eight (8) inches of compacted thickness.

When more than one (1) lift is required to establish the layer thickness specified in the contract documents, the construction procedure described here shall apply to each lift. No lift shall be covered by subsequent lifts until tests verify that compaction requirements have been met. The Contractor shall rework, recompact and retest any material placed which does not meet the specifications.

**219-3.5 Compaction.** Immediately upon completion of the spreading operations, compact each layer of the base course, as specified, with approved compaction equipment. The number, type, and weight of rollers shall be sufficient to compact the material to the required density within the same day that the aggregate is placed on the subgrade.

The Contractor shall provide a qualified nuclear gauge and operator for Quality Control (QC) testing for density.

**219-3.6 Weather limitations.** Material shall not be placed unless the ambient air temperature is at least 40°F and rising. Work on base course shall not be conducted when the subgrade or subbase is wet or frozen or the base material contains frozen material.

**219-3.7 Maintenance.** The base course shall be maintained in a condition that will meet all specification requirements. When material has been exposed to excessive rain, snow, or freeze-thaw conditions, prior to placement of additional material, the Contractor shall verify that materials still meet all specification requirements. Equipment may be routed over completed sections of base course, provided that no damage results and the equipment is routed over the full width of the completed base course. Any damage resulting to the base course from routing equipment

over the base course shall be repaired by the Contractor. The maintenance cost shall be considered incidental to the contract and as a subsidiary obligation of the Contractor.

**219-3.8 Surface tolerances.** After the course has been compacted, the surface shall be tested for smoothness and accuracy of grade and crown. Any portion lacking the required smoothness or failing in accuracy of grade or crown shall be scarified to a depth of at least three (3) inches, reshaped and recompact to grade until the required smoothness and accuracy are obtained and approved by the Resident Engineer. Any deviation in surface tolerances shall be corrected by the Contractor at the Contractor's expense. The smoothness and accuracy requirements specified here apply only to the top layer when base course is constructed in more than one (1) layer.

- a. **Smoothness.** The finished surface shall not vary more than three-eighths (3/8) inch when tested with a 12 or 16-foot straightedge applied parallel with and at right angles to the centerline. The straightedge shall be moved continuously forward at half the length of the 12 or 16-foot straightedge for the full length of each line on a 50-foot grid.
- b. **Grade.** The grade and crown shall be measured on a 50-foot grid and shall be within +0 and 0.05 feet - of the specified grade.

**219-3.9 Acceptance sampling and testing.** Recycled Concrete Aggregate base course shall be accepted for density and thickness on an area basis. Testing frequency shall be a minimum one (1) compaction and thickness test per 1,500 square yards per lift of aggregate. Random sampling locations will be determined by the Resident Engineer.

- a. **Density.** The Resident Engineer shall perform all density tests.

Each area shall be accepted for density when the field density is at least 100% of the maximum density of laboratory specimens compacted and tested per AASHTO T 99 for areas designated for aircraft with gross weights of 60,000 pounds or less and AASHTO T 180 for areas designated for aircraft with gross weights greater than 60,000 pounds. The moisture content of the material during placing operations shall be within  $\pm 2\%$  of the optimum moisture content. The in-place field density shall be determined per AASHTO T 310 (Direct Transmission Density/Backscatter Moisture). The machine shall be calibrated in accordance with within 12 months prior to its use on this contract. If the specified density is not attained, the area represented by the failed test must be reworked and/or recompact and two (2) additional random tests made. This procedure shall be followed until the specified density is reached. Maximum density refers to maximum dry density at optimum moisture content unless otherwise specified.

- b. **Thickness.** Depth tests shall be made by test holes at least three (3) inches in diameter that extend through the base. The thickness of the base course shall be within +0 and -3/16 inch of the specified thickness as determined by depth tests taken by the Contractor in the presence of the Resident Engineer for each area. Where the thickness is deficient by more than 3/16 inch, the Contractor shall correct such areas at no additional cost by scarifying to a depth of at least three (3) inches, adding new material of proper gradation, and the material shall be blended and recompact to grade. The Contractor shall replace, at his expense, base material where depth tests have been taken.

#### METHOD OF MEASUREMENT

**219-4.1** The quantity of recycled concrete aggregate base course shall be measured for payment by the number of square yards as specified, completed, and accepted by the Resident Engineer.

#### BASIS OF PAYMENT

**219-5.1** Payment for accepted quantities of work performed by the Contractor and measured by the Resident Engineer shall be made at the contract unit price as specified in paragraph 219-4.1 of

this section. Payment shall be full compensation for furnishing all materials, for preparing and placing these materials, and for all labor, equipment tools, and incidentals necessary to complete the work as specified.

### REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

#### **ASTM International (ASTM)**

ASTM C 142                      Standard Test Method for Clay Lumps and Friable Particles in Aggregates

#### **American Association of State Highway and Transportation Officials (AASHTO)**

AASHTO T 99                      Standard Method of Test for Moisture–Density Relations of Soils Using a 2.5-kg (5.5-lb) Rammer and a 305-mm (12-in.) Drop

AASHTO T 180                      Standard Method of Test for Moisture–Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop

AASHTO T 310                      Standard Method of Test for In-Place Density and Moisture Content of Soil and Soil–Aggregate by Nuclear Methods (Shallow Depth)

#### **Illinois Department of Transportation, Bureau of Materials Illinois Laboratory Test Procedure (ITP)**

*Manual of Aggregate Quality Test Procedures*

ITP 203                              Deleterious Particles in Coarse Aggregate

#### **Illinois Department of Transportation, Bureau of Materials Policy Memoranda (PM)**

PM 7-08                              Recycling Portland Cement Concrete Into Aggregate

PM 11-08                              Aggregate Gradation Control System (AGCS)

**END OF ITEM 219**

## Item 220 Cement Treated Soil Base Course

### DESCRIPTION

- 220-1.1** This item shall consist of constructing a base course by uniformly mixing soil, cement, and water. The mixed material shall be spread, shaped, and compacted as specified in the contract documents.

### MATERIALS

- 220-2.1 Cement.** Cement shall conform to the requirements of AASHTO M 85, Type I.
- 220-2.2 Water.** Water used in mixing or curing shall be from potable water sources. Other sources shall be tested in accordance with AASHTO T 26 and must be approved by the Engineer prior to use.
- 220-2.3 Soil.** The soil for this work shall consist of on-site materials and shall be free of roots, sod, weeds, and stones larger than 2-1/2 inches with a sulfate content of less than 0.3%.
- 220-2.4 Asphalt material.** The types, grades, controlling specifications, and application temperatures for the asphalt materials used for curing the soil-cement shall be from the table below.

#### Asphalt Material

Type and Grade	Specification	Application Temperature
Cutback Asphalt		
RC-70	AASHTO M 81	120°F – 225 °F
Emulsified Asphalt		
RS-1, SS-1	AASHTO M 140	75°F – 130 °F
CRS-1	AASHTO M 208	75°F – 130 °F

### COMPOSITION OF MIXTURE

- 220-3.1 Proportions.** Before the start of base course construction, tests shall be made on the soil or soil-aggregate material to be stabilized to determine the quantity of cement required for the mix design.

Test specimens containing various amounts of cement shall be compacted per AASHTO T 134, and the optimum moisture determined for each test specimen. Samples at the optimum moisture shall be subjected to the wet-dry and the freeze-thaw test in accordance with AASHTO T 135 and AASHTO T 136, respectively.

Cement shall be added at an application rate of 8% of dry unit weight of soil. The Engineer reserves the right to make such adjustments of cement proportioning as are considered necessary during the progress of the work and based on the results of the geotechnical report, without additional compensation to the Contractor. The actual proportions will be set by the Contractor before work begins.

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## CONSTRUCTION METHODS

**220-4.1 Control strip.** The first half-day of construction shall be considered the control strip. The Contractor shall demonstrate, in the presence of the Engineer, that the materials, equipment, and construction processes meet the requirements of the specification. The sequence and manner of rolling necessary to obtain specified density requirements shall be determined. The base course shall be constructed in lifts not more than four (4) inches thick when compacted, except that the maximum compacted thickness may be increased to a maximum of eight (8) inches upon the Contractor's demonstration that approved equipment and operations will uniformly compact the lift to the specified density. The Engineer must witness this demonstration and approve the lift thickness prior to full production.

Control strips that do not meet specification requirements shall be reworked, re-compacted or removed and replaced at the Contractor's expense. Full operations shall not continue until the control strip has been accepted by the Engineer. The Contractor shall use the same equipment, materials, and construction methods for the remainder of construction, unless adjustments made by the Contractor are approved by the Engineer.

**220-4.2 Weather limitations.** The material shall not be mixed or placed while the atmospheric temperature is below 40°F or when conditions indicate that the temperature may fall below 40°F within 24 hours, or when the weather is foggy or rainy, or to soils that are frozen or contain frost, or when the underlying material is frozen.

**220-4.3 Maintenance.** The material shall be maintained in a condition that will meet all specification requirements. When material has been exposed to excessive rain, snow, or freeze-thaw conditions, prior to placement of additional material, the Contractor shall verify that materials still meet all specification requirements. Equipment may be routed over completed sections of base course, provided that no damage results and the equipment is routed over the full width of the completed base course. Any damage resulting to the base course from routing equipment over the base course shall be repaired by the Contractor. The maintenance cost shall be considered incidental to the contract and as a subsidiary obligation of the Contractor.

**220-4.4 Equipment.** The course may be constructed with any equipment that will meet the requirements for soil pulverization, cement application, mixing, water application, incorporation of materials, compaction, finishing, and curing specified here.

**220-4.5 Preparation.** The area to be stabilized shall be graded and shaped to conform to the lines, grades and cross-section specified in the contract documents. Any soft or yielding areas in the subgrade shall be removed and replaced with acceptable soil and compacted to the specified density.

**220-4.6 Pulverization.** After completion of moist-mixing, the soil for the base course shall be pulverized so that 100% by dry weight passes a one (1) inch sieve and a minimum of 80% passes a No. 4 sieve.

**220-4.7 Cement application, mixing, and finishing.**

**a. Mixed-in-place method.** Mixing of the soil, cement, and water shall be accomplished by the mixed-in-place method. Shape pulverized material to the cross-section indicated. Cement shall be applied so that when uniformly mixed with the soil, the specified cement content is obtained, and a sufficient quantity of cement-treated soil is produced to construct a compacted cement-treated course conforming to the lines, grades, and cross-section indicated. Immediately after the cement has been distributed, it shall be mixed with the soil. The cement shall not be mixed below the required depth. Continue mixing until the cement has been sufficiently blended with the soil to prevent the formation of cement balls when water is applied. Determine moisture content of the mixture immediately after completion of mixing of the soil and cement. Provide water supply and pressure distributing equipment that will permit the application within three (3) hours of all mixing water on the section being processed. Incorporate water in the mix so that concentration of water near the surface does not occur. After all mixing water has been applied, continue mixing until the water is

uniformly distributed throughout the full depth of the mixture. Do not apply cement if the soil moisture content exceeds the optimum moisture content specified for the cement-treated mixture. After mixing is complete, the proportions of the mixture shall be in accordance with the approved mix design.

- b. Central plant mix.** Mixing of the soil, cement, and water shall be accomplished by the central-plant-mixed method. The soil, cement, and water shall be mixed in either a batch or continuous-flow type pugmill. The plant shall be equipped with feeding and metering devices that will add the soil, cement, and water into the mixer in the specified quantities. Soil and cement shall be mixed sufficiently to prevent cement balls from forming when water is added. Mixing shall continue until a uniform mixture of soil, cement, and water is obtained.

The mixture shall be hauled to the project in trucks equipped with protective covers. The mixture shall be placed on the moistened subgrade in a uniform layer by an approved spreader. Not more than 30 minutes shall elapse between the placement of soil-cement in adjacent lanes.

The layer of soil-cement shall be uniform in thickness and surface contour and of sufficient quantity that the completed base conforms to the required line, grade and cross-section. Dumping of the mixture in piles or windrows on the subgrade shall not be permitted.

Not more than 60 minutes shall elapse between the start of moist mixing and the start of compaction of soil-cement.

- 220-4.8 Compaction.** Compaction of the course shall begin within 30 minutes after mixing the cement into the subgrade. All compaction operations shall be completed within two (2) hours from the start of mixing.

The Contractor shall provide a qualified nuclear gauge and operator for Quality Control (QC) testing for density.

- 220-4.9 Finishing and curing.** After the final lift or course of treated subgrade has been compacted, it shall be brought to the required lines and grades in accordance with the typical sections.

Finished portions of treated subgrade shall be protected to prevent equipment from marring, permanently deforming, or damaging completed work.

Not later than 24 hours after completion of final finishing, the surface shall be cured by application of an emulsified asphalt uniformly applied to the surface of the completed base course at the rate of approximately 0.2 gallons per square yard or being kept continuously moist for a period of seven (7) days with a fog-type water spray. The curing material shall be maintained and applied as needed by the Contractor during the seven (7) day protection period.

Sufficient protection from freezing shall be provided for at least seven (7) days after its construction or as approved by the Engineer.

- 220-4.10 Construction limitations.** At the end of each day's construction and/or when operations after application of the cement are interrupted for more than 30 minutes, a straight transverse construction joint shall be formed by a header or by cutting back into the compacted material to form a true vertical face.

Completed portions may be opened to light traffic, if approved by the Resident Engineer, and provided the curing is not impaired.

- 220-4.11 Surface tolerance.** In those areas on which a subbase or base course is to be placed, the surface shall be tested for smoothness and accuracy of grade and crown. Any portion lacking the required smoothness or failing in accuracy of grade or crown shall be scarified to a depth of at least three (3) inches, reshaped and re-compacted to grade until the required smoothness and accuracy are obtained and approved by the Resident Engineer. The Contractor shall perform all final smoothness and grade checks in the presence of the Resident Engineer. Any deviation in surface tolerances shall be corrected by the Contractor at the Contractor's expense.



- a. **Smoothness.** The finished surface shall not vary more than  $\pm$  three-eighths ( $3/8$ ) inch when tested with a 12 or 16-foot straightedge applied parallel with and at right angles to the centerline. The straightedge shall be moved continuously forward at half the length of the 12 or 16-foot straightedge for the full length of each line on a 50-foot grid.
- b. **Grade.** The grade and crown shall be measured on a 50-foot grid and shall be within  $\pm 0.05$  feet of the specified grade.

**220-4.12 Acceptance sampling and testing.** Cement treated solid base course shall be accepted for density and thickness on an area basis. Testing frequency shall be a minimum of one (1) compaction and thickness test per 1,500 square yards, but not less than four (4) tests per day of production. Random sampling locations will be determined by the Resident Engineer.

- a. **Density.** The Resident Engineer shall perform all density tests.

Each area shall be accepted for density when the field density is at least 100% of the maximum density of laboratory specimens compacted and tested per AASHTO T 99 for areas designated for aircraft with gross weights of 60,000 pounds or less and AASHTO T 180 for areas designated for aircraft with gross weights greater than 60,000 pounds. The moisture content of the mixture at the start of compaction shall be within  $\pm 2\%$  of the optimum moisture content. The in-place field density shall be determined per AASHTO T 310 (Direct Transmission Density/Backscatter Moisture). The machine shall be calibrated in accordance with AASHTO T 310 within 12 months prior to its use on this contract. Perform in-place density test immediately after completion of compaction to determine degree of compaction. Maximum density refers to maximum dry density at optimum moisture content unless otherwise specified. If the specified density is not attained, the area represented by the failed test must be reworked and/or recompacted at the Contractor's expense and two (2) additional random tests made. This procedure shall be followed until the specified density is reached. Maximum density refers to maximum dry density at optimum moisture content unless otherwise specified.

- b. **Thickness.** Depth tests shall be made by test holes or cores at least three (3) inches in diameter that extend through the base. The thickness of the base course shall be within  $+0$  and  $-3/16$  inch of the specified thickness as determined by depth tests taken by the Contractor in the presence of the Resident Engineer for each subplot. Where the thickness is deficient by more than  $3/16$  inch, the material shall be removed to full depth and replaced at Contractor's expense.

#### METHOD OF MEASUREMENT

- 220-5.1** The quantity of cement treated soil base course shall be measured for payment by the number of square yards as specified, completed, and accepted by the Resident Engineer.
- 220-5.2** The quantity of cement shall be measured by the number of tons.

#### BASIS OF PAYMENT

- 220-6.1** Payment for accepted quantities of work performed by the Contractor and measured by the Resident Engineer shall be made at the contract unit price as specified in paragraphs 220-5.1 and 220-5.2 of this section. Payment shall be full compensation for furnishing all materials, except cement, and for all preparation, delivering, placing, and mixing of these materials; and for all labor, equipment, tools and incidentals necessary to complete the work as specified.

**REFERENCES**

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

**American Association of State Highway and Transportation Officials (AASHTO)**

AASHTO M 85	Standard Specification for Portland Cement
AASHTO M 81	Standard Specification for Cutback Asphalt (Rapid-Curing Type)
AASHTO M 140	Standard Specification for Emulsified Asphalt
AASHTO M 208	Standard Specification for Cationic Emulsified Asphalt
AASHTO T 26	Standard Method of Test for Quality of Water to Be Used in Concrete
AASHTO T 99	Standard Method of Test for Moisture–Density Relations of Soils Using a 2.5-kg (5.5-lb) Rammer and a 305-mm (12-in.) Drop
AASHTO T 134	Standard Method of Test for Moisture–Density Relations of Soil–Cement Mixtures
AASHTO T 135	Standard Method of Test for Wetting-and-Drying Test of Compacted Soil-Cement Mixtures
AASHTO T 136	Standard Method of Test for Freezing-and-Thawing Tests of Compacted Soil-Cement Mixtures
AASHTO T 180	Standard Method of Test for Moisture–Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop
AASHTO T 310	Standard Method of Test for In-Place Density and Moisture Content of Soil and Soil–Aggregate by Nuclear Methods (Shallow Depth)

**END OF ITEM 220**

## Part 5 – Stabilized Base Courses

### Item 304 Cement Treated Aggregate Base Course (CTB)

#### DESCRIPTION

- 304-1.1** This item shall consist of a cement-treated base (CTB) course composed of mineral aggregate and cement, uniformly blended and mixed with water. The mixed material shall be spread, shaped, and compacted as specified in the contract documents.

#### MATERIALS

- 304-2.1** **Aggregate.** The aggregate shall be select granular materials, comprised of crushed stone, crushed gravel, or crushed concrete from approved sources. The material shall be free of roots, sod, and weeds.

The natural and manufactured materials used as coarse aggregate are defined as follows.

- a. Crushed stone.** Crushed stone shall be the angular fragments resulting from crushing undisturbed, consolidated deposits of rock by mechanical means. Crushed stone shall be divided into the following, when specified.
- (1) Carbonate crushed stone.** Carbonate crushed stone shall be either dolomite or limestone. Dolomite shall contain 11.0% or more magnesium oxide (MgO). Limestone shall contain less than 11.0% magnesium oxide (MgO).
  - (2) Crystalline crushed stone.** Crystalline crushed stone shall be either metamorphic or igneous stone, including but is not limited to, quartzite, granite, rhyolite and diabase.
- b. Crushed gravel.** Crushed gravel shall be the product resulting from crushing, by mechanical means, and shall consist entirely of particles obtained by crushing gravel. The acceptance and use of crushed gravel shall be according to the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 12-08 *Crushed Gravel Producer Self-Testing Program*.
- c. Crushed concrete.** Crushed concrete shall be the angular fragments resulting from crushing Portland cement concrete by mechanical means. The acceptance and use of crushed concrete shall be according to Item 219 titled RECYCLED CONCRETE AGGREGATE BASE COURSE.
- 304-2.2** **Quality.** The coarse aggregate shall be Class B Quality or better according to the quality standards listed in the following table.

### Coarse Aggregate Quality

Quality Test	Class
	B
Na <sub>2</sub> SO <sub>4</sub> Soundness 5 Cycle, Illinois Modified AASHTO T 104 <sup>1</sup> , % Loss max.	15
Los Angeles Abrasion, Illinois Modified AASHTO T 96, % Loss max.	40 <sup>2</sup>
Deleterious Materials <sup>3</sup>	
Shale, % max.	2.0
Clay Lumps, % max.	0.5
Coal & Lignite, % max.	---
Soft & Unsound Fragments, % max.	6.0
Other Deleterious, % max.	2.0
Total Deleterious, % max.	6.0

1. Does not apply to crushed concrete.
2. Does not apply to crushed slag or crushed steel slag.
3. Test shall be run according to ITP 203.

**304-2.3 Gradation requirements.** The gradation of the aggregate material shall meet the requirements of the gradation given in the following table when tested per the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 11-08, *Aggregate Gradation Control System (AGCS)*.

### Aggregate Gradation for CTB Material

Sieve Size	Gradation Percent Passing
	CA 6
1-1/2 inch	100
1 inch	95±5
1/2 inch	75±15
No. 4	43±13
No. 16	25±15
No. 200	8±4

The gradation represents the limits which shall determine suitability of aggregate for use from the sources of supply. The final gradation shall be well graded from coarse to fine within the limits designated in the table and shall not vary from the low limit on one (1) sieve to the high limit on adjacent sieves, or vice versa.

**304-2.4 Plasticity.** All material shall comply with the plasticity index requirements listed below. The plasticity index requirement for crushed gravel, crushed stone, and crushed slag may be waived if the ratio of the percent passing the No. 200 sieve to that passing the No. 40 sieve is 0.60 or less.

Use	Plasticity Index - Percent	
	Gravel	Crushed Gravel, Stone, & Slag
Aggregate Base Course	0 to 6	---

Plasticity Index shall be determined by the method given in AASHTO T 90. Where shale in any form exists in the producing ledges, crushed stone samples shall be soaked a minimum of 18 hours before processing for plasticity index or minus No. 40 material. When clay material is added to adjust the plasticity index, the clay material shall be in a minus No. 4 sieve size.

### 304-2.5 Sampling and testing.

- a. **Aggregate base materials.** The Contractor shall take samples of the aggregate base stockpile in accordance with the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 11-08, *Aggregate Gradation Control System (AGCS)*, to verify initial aggregate base requirements and gradation. Material shall meet the requirements in paragraphs 304-2.1 through 304-2.4. This sampling and testing will be the basis for approval of the aggregate base quality requirements.

304-2.6 **Cement.** Cement shall conform to the requirements of AASHTO M 85, Type I.

304-2.7 **Cementitious additives.** Pozzolanic and slag cement may be added to the CTB mix. If used, each material must meet the following requirements:

- a. **Pozzolan.** Pozzolanic materials must meet the requirements of AASHTO M 295, Class C, or F with the exception of loss of ignition, where the maximum shall be less than 6%.
- b. **Slag cement (ground granulated blast furnace (GGBF) slag).** Slag shall conform to AASHTO M 302, Grade 100, or 120.

304-2.8 **Water.** Water used in mixing or curing shall be from potable water sources. Other sources shall be tested in accordance with AASHTO T 26 and must be approved by the Engineer prior to use.

### 304-2.9 Curing materials.

- a. **Concrete pavement.** The curing material shall be a white-pigmented, liquid membrane-forming compound conforming to ASTM C309, Type 2, Class A.

Curing material shall be pre-approved by the Department. The Contractor shall provide the Resident Engineer with a certificate of analysis (COA) and/or LA-15, Supplier's Certification of Shipment of Approved Materials certifying that the materials have been inspected and are approved by the Department. Each container shall be legibly marked with the name of the manufacturer, the type, date of manufacture, and the Test Identification, Lot, or Batch numbers.

Approved material shall not be used after (9) months from the date of manufacture, unless sampled and tested for re-approval by the Engineer. Material more than 18 months old from the date of manufacture shall not be used.

- b. **Asphalt pavement.** The curing material shall be an emulsified asphalt conforming to AASHTO M 140.

304-2.10 **Sand blotter.** Sand shall be applied, when required, to prevent tracking of the emulsion curing materials. The sand material shall be clean, dry, and non-plastic.

## COMPOSITION OF MIXTURE

304-3.1 **General.** The CTB material shall be composed of a mixture of aggregate, cementitious material, and water. Fly ash or slag cement may be used as a partial replacement for cement.

**304-3.2 Mix design.** The mix design shall use a cement content that produces a seven (7) day compressive strength between 300 pounds per square inch minimum and 600 pounds per square inch maximum. Avoid higher strengths due to potential to cause shrinkage and reflective cracks.

Wet-dry and/or freeze-thaw tests shall be performed in accordance with AASHTO T 135 and AASHTO T 136 respectively. The weight loss for each type of test shall not exceed 14% after 12 cycles.

The mix design shall include a complete list of materials, including type, brand, source, and amount of cement, fine aggregate, coarse aggregate, water, and cementitious additives.

Should a change be made in aggregate sources or type of cement, or if cementitious additives are added or deleted from the mix, production of the CTB mix shall be stopped and a new mix design shall be submitted.

**304-3.3 Submittals.** At least 30 days prior to the placement of the CTB, the Contractor shall submit certified test reports to the Resident Engineer for those materials proposed for use during construction, as well as the mix design information for the CTB material. Tests older than six (6) months shall not be used. The certificate of analysis (COA) shall show the ASTM or AASHTO specifications or tests for the material, the name of the company performing the tests, the date of the tests, the test results, and a statement that the material did or did not comply with the applicable specifications. The submittal package shall include the following:

- a. Source of materials, including aggregate, cement, cementitious additives, curing, and bond-breaking materials.
- b. Physical properties of the aggregates, cement, cementitious additives, curing, and bond-breaking materials.
- c. Mix design:
  - (1) Mix identification number
  - (2) Aggregate gradation
  - (3) Cement content
  - (4) Water content
  - (5) Cementitious materials content
  - (6) Compaction and strength results
  - (7) Laboratory compaction characteristics (maximum dry density and optimum moisture content)
  - (8) Compressive strength at seven (7) days
  - (9) Wet-dry and/or freeze-thaw weight loss

No CTB material shall be placed until the submittal is accepted in writing by the Engineer.

During production, the Contractor shall submit batch tickets for each delivered load.

## EQUIPMENT

**304-4.1 Mixing.** The mixer shall be a batch or continuous-flow type stationary mixer that produces a well-blended, uniform mixture of aggregate, cement, water, and pozzolan. The mixer shall be equipped with calibrated metering and feeding devices that introduce the aggregate, cement, water, and cementitious additives (if used) into the mixer in the specified quantities.

The Resident Engineer shall have free access to the plant at all times for inspection of the plant's equipment and operation and for sampling the CTB mixture.

- 304-4.2 Hauling.** The CTB material shall be transported from the plant to the job site in trucks or other hauling equipment having beds that are smooth, clean, and tight. Truck bed covers shall be provided and used to protect the CTB from weather. CTB material that becomes wet during transport shall be rejected.
- 304-4.3 Placing.** CTB material shall be placed with a mechanical spreader capable of receiving, spreading, and shaping the mixture without segregation into a uniform layer or lift. The equipment shall be equipped with a strike-off plate and end gates capable of being adjusted to the layer thickness and width.
- 304-4.4 Compaction.** The number, type, and weight of rollers and/or compactors shall be sufficient to compact the mixture to the required density.

### CONSTRUCTION METHODS

- 304-5.1 Control strip.** The first half-day of construction shall be considered the control strip. The Contractor shall demonstrate, in the presence of the Engineer, that the materials, equipment, and construction processes meet the requirements of the specification. Control strips that do not meet specification requirements shall be removed and replaced at the Contractor's expense. Full operations shall not continue until the control strip has been accepted by the Engineer. Upon acceptance of the control strip by the Engineer, the Contractor shall use the same equipment, materials, and construction methods for the remainder of construction, unless adjustments made by the Contractor are approved in advance by the Engineer.
- A control strip is not required on jobs less than 2,000 square yards.
- 304-5.2 Weather limitations.** The CTB shall not be placed on frozen surfaces or when weather conditions will detrimentally affect quality of the finished course. Apply cement when the ambient temperature is a minimum of 40°F and rising and aggregate are not frozen or contain frost. If ambient temperature falls below 40°F, protect completed CTB areas against freezing.
- The Contractor should stop operations prior to and during rain allowing time to cover and protect any freshly placed material. Areas damaged by rain shall be replaced at the Contractor's expense.
- 304-5.3 Maintenance.** Completed portions of the cement-stabilized area may be opened to local traffic provided the curing process is not impaired and to other traffic after the curing period has elapsed, provided that the cement-stabilized course has hardened sufficiently to prevent surface marring or distortion by equipment or traffic. Protect finished portions of cement stabilized base from traffic of equipment used in constructing adjoining sections in a manner to prevent marring or damaging completed work. The CTB shall be protected from freezing until covered. The maintenance cost shall be considered incidental to the contract and as a subsidiary obligation of the Contractor.
- 304-5.4 Preparation of underlying course.** The underlying course shall be checked by the Resident Engineer before placing and spreading operations are started. Prior to placing the material, the final grade should be firm, moist and free of frost. Use of chemicals to eliminate frost will not be permitted. The underlying course shall be wetted in advance of placing the CTB layer.
- 304-5.5 Grade control.** Grade control between the edges of the CTB shall be accomplished at intervals of 50 feet on the longitudinal grade and at 25 feet on the transverse grade.
- 304-5.6 Placing.** The CTB mixture shall be deposited on the moistened subgrade or subbase and spread into a uniform layer of specified width and thickness that, when compacted and trimmed, conforms to the required line, grade, and cross-section. The longitudinal joints shall be located so there is no offset for concrete surface layers and a two (2) foot minimum offset for asphalt surface layers from planned joints in any overlying layer. Placement of the material shall begin along the centerline of the pavement on a crowned section or on the highest elevation contour of a pavement with variable cross slope.

The Contractor shall install the CTB layer in single compacted layer no greater than six (6) inches thick.

- 304-5.7 Compaction.** All compaction operations shall be completed within two (2) hours from the start of mixing.

The Contractor shall provide a qualified nuclear gauge and operator for Quality Control (QC) testing for density.

- 304-5.8 Finishing.** After compaction, shape the surface of the CTB layer to the specified lines, grades, and cross-section. During the finishing process, the surface shall be kept moist by means of fog-type sprayers. Compaction and finishing shall produce a smooth, dense surface, free of ruts, cracks, ridges, and loose material.

- 304-5.9 Construction limitations.** All placement, compaction, and finishing operations shall be completed within two (2) hours from the start of mixing. Material not completed within the two (2) hour time limit shall be removed and replaced at the Contractor's expense.

At the end of each day's construction and/or when operations are interrupted for more than 30 minutes, a straight transverse construction joint shall be formed by a header or by cutting back into the compacted material to form a true vertical face.

Completed portions may be opened to light traffic, if approved by the Resident Engineer, and provided the curing is not impaired.

- 304-5.10 Curing.** The compacted and finished CTB shall be cured with the approved curing agents as soon as possible, but in no case later than two (2) hours after completion of the finishing operations. Curing material shall meet the requirements in paragraph 304-2.9 titled CURING MATERIALS. The layer shall be kept moist using a moisture-retaining cover or a light application of water until the curing material is applied.

For concrete pavement, the surface of the CTB layer shall be uniformly sprayed with a liquid membrane-forming curing compound at the rate of one (1) gallon to not more than 100 square feet to obtain a uniform cover over the surface. Hand spraying of odd widths or shapes and CTB surfaces exposed by the removal of forms is permitted.

For asphalt pavement, the entire surface of the CTB layer shall be uniformly sprayed with an asphalt emulsion at a rate of between 0.15 and 0.30 gallons per square yard; the exact temperature and rate of application being that required to achieve complete and uniform coverage without runoff. Apply sand at to treated surfaces requiring protection from traffic.

The curing seal shall be maintained and protected until the pavement is placed. If the surface of the finished CTB and/or the curing seal becomes damaged, additional curing material shall be applied at the time it is damaged or when the damage is first observed.

- 304-5.11 Surface tolerance.** In those areas on which a surface or base course is to be placed, the surface shall be tested for smoothness and accuracy of grade and crown. Any portion lacking the required smoothness or failing in accuracy of grade or crown shall be scarified to a depth of at least three (3) inches, reshaped and re-compacted to grade until the required smoothness and accuracy are obtained and approved by the Resident Engineer. The Contractor shall perform all final smoothness and grade checks in the presence of the Resident Engineer. Any deviation in surface tolerances shall be corrected by the Contractor at the Contractor's expense.

**a. Smoothness.** The finished surface shall not vary more than  $\pm$  three-eighths (3/8) inch when tested with a 12 or 16-foot straightedge applied parallel with and at right angles to the centerline, and moved continuously forward at half the length of the 12 or 16-foot straightedge for the full length of each line on a 50-foot grid.

**b. Grade.** The grade shall be measured on a 50-foot grid and shall be within  $\pm$ 0.05 feet of the specified grade.



- 304-5.12 Bond breaker.** Prior to placing the overlaying concrete pavement, a bond breaker shall be placed on the surface to prevent bonding. The surface of the CTB shall be coated with a de-bonding material applied in a quantity sufficient to prevent bonding of the concrete pavement to the base course. The Contractor shall be responsible for selecting the de-bonding material and application rate. The de-bonding material shall be approved by the Engineer.

#### MATERIAL ACCEPTANCE

- 304-6.1 Acceptance sampling and testing.** Cement treated aggregate base course shall be accepted for density and thickness on an area basis. Testing frequency shall be a minimum of one (1) compaction and thickness test per 1,500 square yards, but not less than four (4) tests per day of production. Random sampling locations will be determined by the Resident Engineer.
- a. Density testing.** The Resident Engineer shall perform all density tests. Each area shall be accepted for density when the field density is at least 98% of the maximum density as determined by AASHTO T 134. At the start of compaction, the moisture content shall be within  $\pm 2\%$  of the specified optimum moisture. The in-place field density shall be determined in accordance with AASHTO T 310 (Direct Transmission Density/Backscatter Moisture). The machine shall be calibrated in accordance with AASHTO 310 within 12 months prior to its use on this contract. Perform in-place density test immediately after completion of compaction to determine degree of compaction. If the material fails to meet the density requirements, compaction shall continue, or the material shall be removed and replaced at the Contractor's expense and two (2) additional random tests made. Maximum density refers to maximum dry density at optimum moisture content unless otherwise specified.
- b. Thickness.** Depth tests shall be made by test holes or cores at least three (3) inches in diameter that extend through the base. The thickness of the base course shall be within +0 and -1/2 inch of the specified thickness as determined by depth tests taken by the Contractor in the presence of the Resident Engineer for each subplot. The resulting core holes shall be filled by the Contractor with CTB or non-shrink grout.
- When the thickness measurement is deficient by more than one-half (1/2) inch, the material in the area represented by the tests shall be removed to full depth and replaced at the Contractor's expense.

#### METHOD OF MEASUREMENT

- 304-7.1** The quantity of cement-treated base course shall be measured for payment by the number of square yards as specified, completed, and accepted by the Resident Engineer

#### BASIS OF PAYMENT

- 304-8.1** Payment for accepted quantities of work performed by the Contractor and measured by the Resident Engineer shall be made at the contract unit price as specified in paragraph 304-7.1 of this section. Payment shall be full compensation for furnishing and placing all materials, including cement; for all preparation, manipulation, placing, and curing of these materials; and for all labor, equipment, tools, and incidentals necessary to complete the work as specified.

## REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

### ASTM International (ASTM)

ASTM C 309	Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
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### American Association of State Highway and Transportation Officials (AASHTO)

AASHTO M 85	Standard Specification for Portland Cement
AASHTO M 140	Standard Specification for Emulsified Asphalt
AASHTO M 295	Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
AASHTO M 302	Standard Specification for Slag Cement for Use in Concrete and Mortars
AASHTO T 26	Standard Method of Test for Quality of Water to Be Used in Concrete
AASHTO T 90	Standard Method of Test for Determining the Plastic Limit and Plasticity Index of Soils
AASHTO T 134	Standard Method of Test for Moisture–Density Relations of Soil–Cement Mixtures
AASHTO T 135	Standard Method of Test for Wetting-and-Drying Test of Compacted Soil-Cement Mixtures
AASHTO T 136	Standard Method of Test for Freezing-and-Thawing Tests of Compacted Soil-Cement Mixtures
AASHTO T 310	Standard Method of Test for In-Place Density and Moisture Content of Soil and Soil–Aggregate by Nuclear Methods (Shallow Depth)

### Illinois Department of Transportation, Bureau of Materials Illinois Laboratory Test Procedure (ITP)

#### *Manual of Test Procedures for Materials*

AASHTO T 11	Illinois Modified, Standard Method of Test for Materials Finer Than 75- $\mu$ m (No. 200) Sieve in Mineral Aggregates by Washing
ITP 19	Bulk Density (“Unit Weight”) and Voids in Coarse Aggregate

#### *Manual of Aggregate Quality Test Procedures*

AASHTO T 96	Illinois Modified, Standard Method of Test for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
AASHTO T 104	Illinois Modified, Standard Method of Test for Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate
AASHTO T 113	Illinois Modified, Standard Method of Test for Lightweight Pieces in Aggregate
ITP 203	Deleterious Particles in Coarse Aggregate

### Illinois Department of Transportation, Bureau of Materials Policy Memoranda (PM)

PM 11-08	Aggregate Gradation Control System (AGCS)
PM 12-08	Crushed Gravel Producer Self-Testing Program

**END OF ITEM 304**

**Item 306 Lean Concrete Base Course****DESCRIPTION**

- 306-1.1** This item shall consist of a lean concrete subbase material that is composed of aggregate and cement uniformly blended together and mixed with water. The mixture may also include approved cementitious additives, in the form of fly ash or slag, and chemical admixtures. The mixed material shall be spread, shaped, and as specified in the contract documents.

**MATERIALS**

- 306-2.1** **Aggregate.** The coarse aggregate fraction shall be gravel, crushed stone, crushed gravel, crushed slag, crushed concrete, or a combination thereof. The fine aggregate fraction may be part of the natural aggregate blend as obtained from the borrow source or it may be natural sand that is added at the time of mixing.

The natural and manufactured materials used as coarse aggregate are defined as follows.

- a. **Gravel.** Gravel shall be the coarse granular material resulting from the reduction of rock by the action of the elements and having subangular to rounded surfaces. It may be partially crushed.
- b. **Crushed stone.** Crushed stone shall be the angular fragments resulting from crushing undisturbed, consolidated deposits of rock by mechanical means. Crushed stone shall be divided into the following, when specified.
  - (1) **Carbonate crushed stone.** Carbonate crushed stone shall be either dolomite or limestone. Dolomite shall contain 11.0% or more magnesium oxide (MgO). Limestone shall contain less than 11.0% magnesium oxide (MgO).
  - (2) **Crystalline crushed stone.** Crystalline crushed stone shall be either metamorphic or igneous stone, including but is not limited to, quartzite, granite, rhyolite and diabase.
- c. **Crushed gravel.** Crushed gravel shall be the product resulting from crushing, by mechanical means, and shall consist entirely of particles obtained by crushing gravel. The acceptance and use of crushed gravel shall be according to the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 12-08 *Crushed Gravel Producer Self-Testing Program*.
- d. **Crushed slag.** Crushed slag shall be the graded product resulting from the processing of air-cooled blast furnace slag. Air-cooled blast furnace slag shall be the nonmetallic product, consisting essentially of silicates and aluminosilicates of lime and other bases, which is developed in a molten condition simultaneously with iron in a blast furnace. It shall be air-cooled and shall have a compact weight (ITP 19) of not less than 70 pounds per cubic foot. The acceptance and use of air-cooled blast furnace slag shall be according to the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 13-08, *Slag Producer Self-Testing Program*.
- e. **Crushed concrete.** Crushed concrete shall be the angular fragments resulting from crushing Portland cement concrete by mechanical means. The acceptance and use of crushed concrete shall be according to Item 219 titled RECYCLED CONCRETE AGGREGATE BASE COURSE.

**306-2.2 Quality.** The coarse aggregate shall be Class B Quality or better according to the quality standards listed in the following table.

### Coarse Aggregate Quality

Quality Test	Class
	B
Na <sub>2</sub> SO <sub>4</sub> Soundness 5 Cycle, Illinois Modified AASHTO T 104 <sup>1</sup> , % Loss max.	15
Los Angeles Abrasion, Illinois Modified AASHTO T 96, % Loss max.	40 <sup>2</sup>
Deleterious Materials <sup>3</sup>	
Shale, % max.	2.0
Clay Lumps, % max.	0.5
Coal & Lignite, % max.	---
Soft & Unsound Fragments, % max.	6.0
Other Deleterious, % max.	2.0
Total Deleterious, % max.	6.0

1. Does not apply to crushed concrete.
2. Does not apply to crushed slag or crushed steel slag.
3. Test shall be run according to ITP 203.

**306-2.3 Gradation requirements.** The gradation of the aggregate material shall meet the requirements of the gradation given in the following table when tested per the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 11-08, *Aggregate Gradation Control System (AGCS)*.

### Aggregate Gradation for Lean Concrete

Sieve Size	Gradation Percent Passing	
	CA 4	CA 6
2 inch	100	
1-1/2 inch	95±5	100
1 inch	85±10	95±5
1/2 inch	60±15	75±15
No. 4	40±10	43±13
No. 16	20±15	25±15
No. 200	8±4	8±4

The gradation represents the limits which shall determine suitability of aggregate for use from the sources of supply. The final gradation shall be well graded from coarse to fine within the limits designated in the table and shall not vary from the low limit on one (1) sieve to the high limit on adjacent sieves, or vice versa.

**306-2.4 Plasticity.** All material shall comply with the plasticity index requirements listed below. The plasticity index requirement for crushed gravel, crushed stone, and crushed slag may be waived if the ratio of the percent passing the No. 200 sieve to that passing the No. 40 sieve is 0.60 or less.

Use	Plasticity Index - Percent	
	Gravel	Crushed Gravel, Stone, & Slag
Aggregate Base Course	0 to 6	---

Plasticity Index shall be determined by the method given in AASHTO T 90. Where shale in any form exists in the producing ledges, crushed stone samples shall be soaked a minimum of 18 hours before processing for plasticity index or minus No. 40 material. When clay material is added to adjust the plasticity index, the clay material shall be in a minus No. 4 sieve size.

**306-2.5 Sampling and testing.**

a. **Aggregate base materials.** The Contractor shall take samples of the aggregate base stockpile in accordance with the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 11-08, *Aggregate Gradation Control System (AGCS)*, to verify initial aggregate base requirements and gradation. Material shall meet the requirements in paragraphs 306-2.1 through 306-2.4. This sampling and testing will be the basis for approval of the aggregate base quality requirements.

**306-2.6 Cement.** Cement shall conform to the requirements of AASHTO M 85, Type I.

**306-2.7 Cementitious additives.** Pozzolanic and slag cement may be added to the lean concrete mix. If used, each material must meet the following requirements:

- a. **Pozzolan.** Pozzolanic materials must meet the requirements of AASHTO M 295, Class C, or F with the exception of loss of ignition, where the maximum shall be less than 6%.
- b. **Slag cement (ground granulated blast furnace (GGBF) slag).** Slag shall conform to AASHTO M 302, Grade 100 or 120.

**306-2.8 Chemical admixtures.** The Contractor shall submit certificates indicating that the material to be furnished meets all the requirements listed below. In addition, the Engineer may require the Contractor to submit complete test data showing that the material to be furnished meets all the requirements of the cited specification.

- a. **Air-entraining admixtures.** Air-entraining admixtures shall meet the requirements of AASHTO M 154.
- b. **Water-reducing admixtures.** Water-reducing, set-controlling admixtures shall meet the requirements of AASHTO M 194, Type A. Water-reducing admixtures shall be added at the mixer separately from air-entraining admixtures in accordance with the manufacturer's printed instructions. The air entrainment agent and the water-reducing admixture shall be compatible.
- c. **Retarding admixtures.** Retarding admixtures shall meet the requirements of AASHTO M 194, Type B (retarding) or D (water reducing and retarding).
- d. **Accelerating admixtures.** Accelerating admixtures shall meet the requirements of AASHTO M 194, Type C.

**306-2.9 Water.** Water used in mixing or curing shall be from potable water sources. Other sources shall be tested in accordance with AASHTO T 26 and must be approved by the Engineer prior to use.

**306-2.10 Curing materials.** For curing lean concrete, use white-pigmented, liquid membrane-forming compound conforming to ASTM C309, Type 2, Class B, or clear or translucent Type 1-D, Class B with white fugitive dye.

Curing material shall be pre-approved by the Department. The Contractor shall provide the Resident Engineer with a certificate of analysis (COA) and/or LA-15, Supplier's Certification of Shipment of Approved Materials certifying that the materials have been inspected and are

approved by the Department. Each container shall be legibly marked with the name of the manufacturer, the type, date of manufacture, and the Test Identification, Lot, or Batch numbers.

Approved material shall not be used after nine (9) months from the date of manufacture, unless sampled and tested for re-approval by the Engineer. Material more than 18 months old from the date of manufacture shall not be used.

- 306-2.11 Bond breaker.** Liquid membrane forming compound shall be in accordance with paragraph 306-2.10 titled CURING MATERIALS.

### COMPOSITION OF MIXTURE

- 306-3.1 Mix design.** The lean concrete mix design shall be based on trial batch results conducted in the laboratory. The lean concrete shall be designed to meet the criteria in this section.

Compressive strength shall not be less than 500 pounds per square inch nor greater than 800 pounds per square inch at seven (7) days.

The percentage of air entrainment shall be  $6\% \pm 1/2\%$ . Air content shall be determined by testing in accordance with AASHTO T 152 for gravel and stone coarse aggregate and AASHTO T 196 for slag and other highly porous coarse aggregate.

If there is a change in aggregate sources, type of cement used, or pozzolanic materials, a new mix design must be submitted

- 306-3.2 Submittals.** At least 30 days prior to the placement of the lean concrete, the Contractor shall submit certified test reports to the Resident Engineer for those materials proposed for use during construction, as well as the mix design information for the lean concrete material. The certificate of analysis (COA) shall identify the specifications and test standard, the name of the testing laboratory, the date of the tests, and a statement that the materials comply with the applicable specifications. Tests older than six (6) months shall not be used. The submittal package shall include the following:

- a. Sources of materials, including aggregate, cement, admixtures, and curing and bond breaking materials.
- b. Physical properties of the aggregates, cement, admixtures, curing and bond breaking materials.
- c. Mix design:
  - (1) Mix identification number
  - (2) Weight of saturated surface-dry aggregates (fine and coarse)
  - (3) Combined aggregate gradation
  - (4) Cement factor
  - (5) Water content
  - (6) Water-cementitious material ratio (by weight)
  - (7) Volume of admixtures and yield for one (1) cubic yard of lean concrete
  - (8) Laboratory test results:
  - (9) Slump
  - (10) Unit weight
  - (11) Air content
  - (12) Compressive strength at three (3), seven (7), and 28 days (average values)

**(13)Wet-dry and/or Freeze-thaw weight loss**

Where applicable, the Contractor shall submit a jointing plan for transverse joints in the lean concrete layer for approval by the Resident Engineer.

During production, the Contractor shall submit batch tickets for each delivered load.

**EQUIPMENT**

- 306-4.1** All equipment necessary to mix, transport, place, compact, and finish the lean concrete material shall be furnished by the Contractor and is subject to inspection and approval by the Engineer. The Contractor shall provide a certificate of analysis (COA) that all equipment conforms to the requirements of AASHTO M 241.
- 306-4.2** **Forms.** Straight side forms shall be made of steel and shall be furnished in sections not less than ten (10) feet in length. Forms shall have a depth equal to the pavement thickness at the edge. Flexible or curved forms of proper radius shall be used for curves of 100 feet radius or less. Forms shall be provided with adequate devices for secure settings so that when in place they will withstand, without visible spring or settlement, the impact and vibration of the consolidating and finishing equipment. Forms with battered top surfaces and bent, twisted or broken forms shall not be used. Built-up forms shall not be used, except as approved by the Resident Engineer. The forms shall contain provisions for locking the ends of abutting sections together tightly for secure setting. Wood forms may be used under special conditions, when accepted by the Resident Engineer.
- 306-4.3** **Concrete pavers.** A fixed form or slip-form concrete paver may be used to place lean concrete. The paver shall be fully energized, self-propelled and capable of spreading, consolidating, and finishing the lean concrete material, true to grade, tolerances, and cross-sections. The paver shall be of sufficient weight and power to construct the maximum specified concrete paving lane width, at adequate forward speed, without transverse, longitudinal or vertical instability or without displacement. Slip-form pavers shall be equipped with electronic or hydraulic horizontal and vertical control devices. Bridge deck pavers are approved as paver-finishing machines for lean concrete, provided they are capable of handling the amount of lean concrete required for the full-lane width specified, and capable of spreading, consolidating, and finishing the lean concrete material, true to grade, tolerances, and cross-sections.
- 306-4.4** **Vibrators.** For fixed-form construction, vibrators may be either the surface pan type or internal type with either immersed tube or multiple spuds for the full width of the slab. They may be attached to the spreader, the finishing machine, or mounted on a separate carriage. They shall not come in contact with the subgrade or forms.
- For slip-form construction, the paver shall be accomplished by internal vibrators for the full width and depth of the pavement being placed. The number, spacing, frequency, and eccentric weights of vibrators shall be provided to achieve acceptable consolidation without segregation and finishing quality. Internal vibrators may be supplemented by vibrating screeds operating on the surface of the lean concrete. Vibrators and screeds shall automatically stop operation when forward motion ceases. An override switch shall be provided.
- Hand-held vibrators may be used in irregular areas.
- 306-4.5** **Joint saws.** The Contractor shall provide a sufficient number of saws with adequate power to cut contraction or construction joints to the required dimensions specified in the contract documents. The Contractor shall provide at least one (1) standby saw in good working order.

**CONSTRUCTION METHODS**

- 306-5.1** **Control strip.** The first half-day of construction shall be considered the control strip. The Contractor shall demonstrate, in the presence of the Engineer, that the materials, equipment,



and construction processes meet the requirements of the specification. Control strips that do not meet specification requirements shall be removed and replaced at the Contractor's expense. Full operations shall not continue until the control strip has been accepted by the Engineer. Upon acceptance of the control strip by the Engineer, the Contractor shall use the same equipment, materials, and construction methods for the remainder of construction, unless adjustments made by the Contractor are approved in advance by the Engineer.

A control strip is not required on jobs less than 3,000 square yards.

- 306-5.2 Weather limitations.** The Contractor shall follow the recommended practices in American Concrete Institute (ACI) 306R, Guide to Cold Weather Concreting. The temperature of the mixed lean concrete shall not be less than 50°F at the time of placement. The lean concrete shall not be placed when the ambient temperature is below 40°F or when conditions indicate that the temperature may fall below 35°F within 24 hours. The lean concrete shall not be placed on frozen underlying courses.

The Contractor shall follow the recommended practices in ACI 305R, Guide to Hot Weather Concreting. The lean concrete temperature from initial mixing through final cure shall not exceed 90°F. When the maximum daily air temperature exceeds 85°F, the forms and/or the underlying material shall be sprinkled with water before placing the lean concrete.

The Contractor should stop operations prior to and during rain allowing time to cover and protect any plastic lean concrete. Areas damaged by rain shall be refinished or replaced at the Contractor's expense.

- 306-5.3 Maintenance.** The Contractor shall protect the lean concrete from environmental or mechanical damage. Traffic shall not be allowed on the pavement until test specimens made per AASHTO T 23 have attained a compressive strength of 500 pounds per square inch when tested per AASHTO T 22. The Contractor shall maintain continuity of the applied curing method for the entire curing period. The maintenance cost shall be considered incidental to the contract and as a subsidiary obligation of the Contractor.

- 306-5.4 Form setting.** Form sections shall be tightly locked and shall be free from play or movement in any direction. The forms shall not deviate from true line by more than one-quarter (1/4) inch at any joint. The top face of the form shall not vary from a true plane more than one-eighth (1/8) inch in ten (10) feet, and the upstanding leg shall not vary more than one-quarter (1/4) inch. Forms shall be cleaned and oiled prior to the placing of lean concrete.

- 306-5.5 Preparation of underlying course.** The underlying course shall be checked and accepted by the Resident Engineer before placing operations begin. Prior to placing the material, the final grade should be firm, moist and free of frost. Use of chemicals to eliminate frost will not be permitted. The underlying course shall be wetted in advance of placing the lean concrete base course.

- 306-5.6 Grade control.** Grade control shall be as necessary to construct the layer to the profile and cross-sections as specified in the contract documents.

- 306-5.7 Mixing.** The batch plant site, layout, equipment, and provisions for transporting material shall assure a continuous supply of material to the work. Stockpiles shall be constructed in a manner that prevents segregation and intermixing of deleterious materials.

All lean concrete shall be mixed and delivered to the site per the requirements of AASHTO M 241. The mixing time should be adequate to produce lean concrete that is uniform in appearance, with all ingredients evenly distributed. Mixing time shall be measured from the time all materials are emptied into the drum (provided all the water is added before one-quarter (1/4) the preset mixing time has elapsed) and continues until the time the discharge chute is opened to deliver the lean concrete.

If mixing in a batch plant, the mixing time shall not be less than 50 or greater than 90 seconds. If mixing in a truck mixer, the mixing time shall not be less than 70 or more than 125 truck-drum

revolutions at a mixing speed of not less than six (6) or more than 18 truck-drum revolutions per minute.

The elapsed time from the addition of cementitious material to the mix until the lean concrete is deposited in place at the work site shall not exceed 45 minutes when the concrete is hauled in non-agitating trucks, or 90 minutes when it is hauled in truck mixers or truck agitators.

Re-tempering lean concrete will not be permitted, except when delivered in truck mixers. With truck mixers, additional water may be added to the batch materials if the addition of water is added within 45 minutes after the initial mixing operations and the water/cement ratio specified in the mix design is not exceeded.

**306-5.8 Placing.** The lean concrete material shall be placed continuously at a uniform rate on the underlying course minimizing segregation and handling of the mix. Rakes shall not be allowed for spreading the lean concrete.

**306-5.9 Finishing.** Shape the finished surface of the lean concrete base layer to the specified lines, grades, and cross-section. Hand finishing will not be permitted except in areas where the mechanical finisher cannot operate.

For concrete pavement, the surface of the lean concrete shall not be textured.

For asphalt pavement, the surface of the lean concrete shall have a coarse texture.

**306-5.10 Construction limitations.** All placement and finishing operations shall be completed within two (2) hours from the start of mixing. Material not completed within the two (2) hour time limit shall be removed and replaced at the Contractor's expense.

At the end of each day's construction and/or when operations are interrupted for more than 30 minutes, a straight transverse construction joint shall be formed by a header or by cutting back into the compacted material to form a true vertical face.

Completed portions may be opened to light traffic when it has achieved its seven (7) day strength and the curing is not damaged.

**306-5.11 Joints.** Locate all longitudinal and transverse construction joints as specified in the contract documents. Longitudinal joints shall be within six (6) inches of planned joints in the overlaying concrete pavement and transverse joints shall be within three (3) inches the planned joints of the overlying concrete surface. Joints shall be sawn as soon as the base can support the saws without damage to the lean concrete base. Joints shall be constructed by sawing the hardened lean concrete to a depth of at least one-third (1/3) the thickness of the lean concrete base, or one-fifth (1/5) the depth of the lean concrete base when constructed using early entry saws.

**306-5.12 Curing.** Immediately after the finishing operations are complete and within two (2) hours of placement of the lean concrete, the entire surface and edges of the newly placed lean concrete shall be sprayed uniformly with white pigmented, liquid membrane forming curing compound conforming to ASTM C309, Type 2, Class B or clear or translucent Type 1-D, Class B with white fugitive dye in accordance with paragraph 306-2.10 titled CURING MATERIALS. The layer should be kept moist using a moisture-retaining cover or a light application of water until the curing material is applied. The curing compound shall not be applied during rainfall.

The curing material shall be applied at a maximum coverage of 200 square feet per gallon using pressurized mechanical sprayers. The spraying equipment shall be a fully atomizing type equipped with a tank agitator. At the time of use, the curing compound in the tank shall be thoroughly and uniformly mixed with the pigment. During application, the curing compound shall be continuously stirred by mechanical means. Edges of the lean concrete layer shall be sprayed with curing compound immediately following placement with slip-form pavers or when side-forms are removed. Hand spraying of odd widths or shapes and lean concrete surfaces exposed by the removal of forms is permitted.

The lean concrete temperature during curing shall be in accordance with paragraph 306-5.2 titled WEATHER LIMITATIONS.

If the curing material becomes damaged from any cause, including sawing operations, within the required seven (7) day curing period or until the overlying course is constructed, the Contractor shall immediately repair the damaged areas by application of additional curing compound or other means approved by the Resident Engineer.

**306-5.13 Surface tolerance.** In those areas on which a surface or base course is to be placed, the surface shall be tested for smoothness and accuracy of grade and crown. Any portion lacking the required smoothness or failing in accuracy of grade or crown shall be corrected with a grinding machine or removed and replaced at the Contractor's expense as approved by the Resident Engineer. Any areas that have been ground shall have curing compound reapplied. The Contractor shall perform all final smoothness and grade checks in the presence of the Resident Engineer. Any deviation in surface tolerances shall be corrected by the Contractor at the Contractor's expense.

- a. **Smoothness.** The finished surface shall not vary more than  $\pm$  three-eighths (3/8)-inch when tested with a 12 or 16-foot straightedge applied parallel with and at right angles to the centerline, and moved continuously forward at half the length of the 12 or 16-foot straightedge for the full length of each line on a 50-foot grid.
- b. **Grade.** The grade shall be measured on a 50-foot grid and shall be within  $\pm 0.05$  feet of the specified grade.

**306-5.14 Bond-breaker.** Prior to placing the overlaying concrete pavement a bond breaker shall be placed on the surface to prevent bonding. Liquid membrane forming compound per paragraph 306-2.11 titled BOND BREAKER shall be placed on the surface of the lean concrete to prevent bonding. The liquid membrane forming compound when used as a bond breaker shall be applied at least eight (8) hours and not more than 24 hours before placement of the concrete pavement. The curing material shall be applied at a maximum coverage rate of 200 square feet per gallon using pressurized mechanical sprayers.

## MATERIAL ACCEPTANCE

**306-6.1 Acceptance sampling and testing.** Lean concrete base course shall be accepted for compressive strength and thickness on an area basis. Testing frequency shall be a minimum of one (1) compressive strength and thickness per 1,500 square yards. Random sampling locations will be determined by the Resident Engineer. The Contractor shall bear the cost of providing curing facilities for the strength specimens.

- a. **Compressive Strength.** The Resident Engineer shall perform all compressive strength tests.

Samples of freshly delivered lean concrete will be taken for compressive strength in accordance with ASTM C172 and air content tests in accordance with AASHTO T 152. Two (2) test cylinders will be made and cured from the sample per AASHTO T 23 and the seven (7) day compressive strength of each cylinder determined per AASHTO T 22. The compressive strength will be computed by averaging the two (2) seven (7) day compressive strengths.

The Contractor shall provide for the initial curing of cylinders in accordance with AASHTO T 23 during the 24 hours after molding.

If the material fails to meet the minimum compressive strength requirements, it shall be removed and replaced at the Contractor's expense.

- b. **Thickness.** Depth tests shall be made by test holes or cores at least three (3) inches in diameter that extend through the base. Thickness will be determined by measuring the depth of core holes and computed by averaging the thickness determination of the two (2) locations. The thickness of the base course shall be within  $\pm 0$  and  $-1/2$  inch of the specified

thickness as determined by depth tests taken by the Contractor in the presence of the Resident Engineer for each subplot.

Core holes shall be filled by the Contractor with lean concrete base or non-shrink grout. If the average thickness is not deficient by more than one-half (1/2) inch from the plan thickness, full payment shall be made. When such measurement is deficient by more than one-half (1/2) inch but less than one (1) inch from the plan thickness, the area represented by the test shall be removed and replaced at the Contractor's expense or shall be permitted to remain in-place at an adjusted payment of 75% of the contract unit price.

### METHOD OF MEASUREMENT

- 306-7.1** The quantity of lean concrete base course shall be measured for payment by the number of square yards as specified, completed, and accepted by the Resident Engineer.

### BASIS OF PAYMENT

- 306-8.1** Payment for accepted quantities of work performed by the Contractor and measured by the Resident Engineer shall be made at the contract unit price as specified in paragraph 306-7.1 of this section. Payment shall be full compensation for furnishing and placing all materials; for all preparation, manipulation, placing, and curing of these materials; and for all labor, equipment, tools, and incidentals necessary to complete the work as specified.

### REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

#### ASTM International (ASTM)

ASTM C 172	Standard Practice for Sampling Freshly Mixed Concrete
ASTM C 309	Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete

#### American Association of State Highway and Transportation Officials (AASHTO)

AASHTO M 85	Standard Specification for Portland Cement
AASHTO M 154	Standard Specification for Air-Entraining Admixtures for Concrete
AASHTO M 194	Standard Specification for Chemical Admixtures for Concrete
AASHTO M 241	Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing
AASHTO M 295	Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
AASHTO M 302	Standard Specification for Slag Cement for Use in Concrete and Mortars
AASHTO T 22	Standard Method of Test for Compressive Strength of Cylindrical Concrete Specimens
AASHTO T 23	Standard Method of Test for Making and Curing Concrete Test Specimens in the Field
AASHTO T 26	Standard Method of Test for Quality of Water to Be Used in Concrete
AASHTO T 90	Standard Method of Test for Determining the Plastic Limit and Plasticity Index of Soils

AASHTO T 152	Standard Method of Test for Air Content of Freshly Mixed Concrete by the Pressure Method
AASHTO T 196	Standard Method of Test for Air Content of Freshly Mixed Concrete by the Volumetric Method

**Illinois Department of Transportation, Bureau of Materials Illinois Laboratory Test Procedure (ITP)**

*Manual of Test Procedures for Materials*

AASHTO T 11	Illinois Modified, Standard Method of Test for Materials Finer Than 75- $\mu$ m (No. 200) Sieve in Mineral Aggregates by Washing
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ITP 19	Bulk Density ("Unit Weight") and Voids in Coarse Aggregate
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*Manual of Aggregate Quality Test Procedures*

AASHTO T 96	Illinois Modified, Standard Method of Test for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
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AASHTO T 104	Illinois Modified, Standard Method of Test for Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate
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AASHTO T 113	Illinois Modified, Standard Method of Test for Lightweight Pieces in Aggregate
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ITP 203	Deleterious Particles in Coarse Aggregate
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**Illinois Department of Transportation, Bureau of Materials Policy Memoranda (PM)**

PM 11-08	Aggregate Gradation Control System (AGCS)
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PM 12-08	Crushed Gravel Producer Self-Testing Program
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PM 13-08	Slag Producer Self-Testing Program
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**American Concrete Institute (ACI)**

ACI 305R	Guide to Hot Weather Concreting
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ACI 306R	Guide to Cold Weather Concreting
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**END OF ITEM 306**

**Item 307 Cement Treated Permeable Base Course (CTPB)****DESCRIPTION**

- 307-1.1** This item shall consist of an open-graded drainable base composed of mineral aggregate, cement and water mixed in a central mixing plant and placed on a prepare subgrade or subbase course as specified in the contract documents.

**MATERIALS**

- 307-2.1 Aggregate.** Coarse aggregate shall be crushed stone or crushed gravel.

The natural and manufactured materials used as coarse aggregate are defined as follows.

- a. Crushed stone.** Crushed stone shall be the angular fragments resulting from crushing undisturbed, consolidated deposits of rock by mechanical means. Crushed stone shall be divided into the following, when specified.
- (1) Carbonate crushed stone.** Carbonate crushed stone shall be either dolomite or limestone. Dolomite shall contain 11.0% or more magnesium oxide (MgO). Limestone shall contain less than 11.0% magnesium oxide (MgO).
  - (2) Crystalline crushed stone.** Crystalline crushed stone shall be either metamorphic or igneous stone, including but is not limited to, quartzite, granite, rhyolite and diabase.
- b. Crushed gravel.** Crushed gravel shall be the product resulting from crushing, by mechanical means, and shall consist entirely of particles obtained by crushing gravel. The acceptance and use of crushed gravel shall be according to the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 12-08 *Crushed Gravel Producer Self-Testing Program*.

- 307-2.2 Quality.** The coarse aggregate shall be Class B Quality or better according to the quality standards listed in the following table.

### Coarse Aggregate Quality

Quality Test	Class
	B
Na <sub>2</sub> SO <sub>4</sub> Soundness 5 Cycle, Illinois Modified AASHTO T 104 <sup>1</sup> , % Loss max.	15
Los Angeles Abrasion, Illinois Modified AASHTO T 96, % Loss max.	40 <sup>2</sup>
Deleterious Materials <sup>3</sup>	
Shale, % max.	2.0
Clay Lumps, % max.	0.5
Coal & Lignite, % max.	---
Soft & Unsound Fragments, % max.	6.0
Other Deleterious, % max.	2.0
Total Deleterious, % max.	6.0

1. Does not apply to crushed concrete.
2. Does not apply to crushed slag or crushed steel slag.
3. Test shall be run according to ITP 203.

**307-2.3 Gradation requirements.** The gradation of the aggregate material shall meet the requirements of the gradation given in the following table when tested per the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 11-08, Aggregate Gradation Control System (AGCS).

### Aggregate Gradation for CTPB Material

Sieve Size	Gradation Percent Passing	
	CA 7	CA 11
1-1/2 inch	100	
1 inch	95±5	100
3/4 inch		92±8
1/2 inch	45±15	45±15
No. 4	5±5	6±6
No. 16		3±3

The gradation represents the limits which shall determine suitability of aggregate for use from the sources of supply. The final gradation shall be well graded from coarse to fine within the limits designated in the table and shall not vary from the low limit on one (1) sieve to the high limit on adjacent sieves, or vice versa.

**307-2.4 Plasticity.** All material shall comply with the plasticity index requirements listed below. The plasticity index requirement for crushed gravel, crushed stone, and crushed slag may be waived if the ratio of the percent passing the No. 200 sieve to that passing the No. 40 sieve is 0.60 or less.

Use	Plasticity Index - Percent	
	Gravel	Crushed Gravel, Stone, & Slag
Aggregate Base Course	0 to 6	---

Plasticity Index shall be determined by the method given in AASHTO T 90. Where shale in any form exists in the producing ledges, crushed stone samples shall be soaked a minimum of 18 hours before processing for plasticity index or minus No. 40 material. When clay material is added to adjust the plasticity index, the clay material shall be in a minus No. 4 sieve size.

**307-2.5 Sampling and testing.**

**a. Aggregate base materials.** The Contractor shall take samples of the aggregate base stockpile in accordance with the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 11-08, Aggregate Gradation Control System (AGCS), to verify initial aggregate base requirements and gradation. Material shall meet the requirements in paragraph 307-2.1 through 307-2.4. This sampling and testing will be the basis for approval of the aggregate base quality requirements.

**307-2.6 Cement.** Cement shall conform to the requirements of AASHTO M 85, Type I.

The Contractor shall furnish vendor's certified test reports for cement shipped to the project.

**307-2.7 Water.** Water used in mixing or curing shall be from potable water sources. Other sources shall be tested in accordance with AASHTO T 26 and must be approved by the Engineer prior to use.

**307-2.8 Admixtures.** The use of any material to be added to the mixture shall be approved by the Engineer.

**307-2.9 Curing material.** Curing materials shall be a liquid membrane-forming compounds for curing concrete shall conform to the requirements of ASTM C309, Type 2, Class B.

Curing material shall be pre-approved by the Department. The Contractor shall provide the Resident Engineer with a certificate of analysis (COA) and/or LA-15, Supplier's Certification of Shipment of Approved Materials certifying that the materials have been inspected and are approved by the Department. Each container shall be legibly marked with the name of the manufacturer, the type, date of manufacture, and the Test Identification, Lot, or Batch numbers.

Approved material shall not be used after nine (9) months from the date of manufacture, unless sampled and tested for re-approval by the Engineer. Material more than 18 months old from the date of manufacture shall not be used.

**307-2.10 Bond breaker.** Fabric shall meet the requirements of AASHTO M 288 Class I woven fabric with elongation less than 50% at the specified strengths. A certificate of compliance (COC) shall be provided by the fabric manufacturer that the material may be used as a bond breaker.

**307-2.11 Geotextile fabric.** Geotextile fabric shall conform to the requirements of Item 152 titled EXCAVATION, SUBGRADE, AND EMBANKMENT.

### COMPOSITION OF MIXTURE

**307-3.1 Mix design.** The mix design shall be based on trial batch results conducted in the laboratory and shall be designed to meet the criteria in this section.

The water cement ratio shall be approximately 0.36 or of a cement content that produces a compressive strength not less than 500 pounds per square inch nor greater than 800 pounds per square inch at seven (7) days.

The coefficient of permeability shall not be less than 500 feet per day nor greater than 1,500 feet per day as determined by testing in accordance with AASHTO T 215.

The mix design shall include a complete list of materials, including type, brand, source, and amount of cement, fine aggregate, coarse aggregate, water, and cementitious additives, if used. It shall also contain the three (3), seven (7), and 14-day compressive strength test results and the results of the permeability tests. Data shall be provided to the Resident Engineer for seven (7) day breaks to serve as a basis for field testing requirements and comparison.



If the Contractor makes a change in aggregate sources or type of cement, or if cementitious additives are added or deleted from the mix, production of the drainable base course shall be stopped, and a new mix design shall be submitted to the Engineer for approval at the Contractor's expense.

**307-3.2 Submittals.** At least 30 days prior to the placement of the CTPB, the Contractor shall submit certified test reports to the Resident Engineer for those materials proposed for use during construction, as well as the mix design information for the material. The certificate of analysis (COA) shall show the specifications and tests for the material, the name of the testing laboratory, the date of the tests, and a statement that the materials comply with the applicable specifications. Tests shall be representative of the material to be used for the project. The submittal package shall include the following:

- a. Sources of materials, including aggregate, cement, cementitious additives, curing, and bond-breaking materials.
- b. Physical properties of the aggregates, cement, cementitious additives, curing, and bond-breaking materials.
- c. Mix design
  - (1) Mix identification number
  - (2) Aggregate gradation
  - (3) Cement content
  - (4) Water content
  - (5) Content of any additional cementitious materials or additives
  - (6) Compressive strength at three (3), seven (7), and 14 days.
  - (7) Coefficient of Permeability

No drainable base course material shall be placed until the submittal is accepted in writing by the Engineer.

During production, the Contractor shall submit batch tickets for each delivered load.

### CONSTRUCTION METHODS

**307-4.1 Control strip.** The first half-day of construction shall be considered the control strip. The Contractor shall demonstrate, in the presence of the Engineer, that the materials, equipment, and construction processes meet the requirements of the specification. Control strips that do not meet specification requirements shall be removed and replaced at the Contractor's expense. Full operations shall not continue until the control strip has been accepted by the Engineer. Upon acceptance of the control strip by the Engineer, the Contractor shall use the same equipment, materials, and construction methods for the remainder of construction, unless adjustments made by the Contractor are approved in advance by the Engineer.

When additional effort beyond that provided by the paver is required to seat the aggregate, additional compaction shall be initiated within 30 minutes following the placing and striking-off operations. The actual rolling pattern and sequence shall be established during placement of the control strip and approved by the Engineer. In areas inaccessible to the paver and roller, hand operated vibrator-plate compactors may be used to seat the aggregate.

The additional compaction, if required, shall be one (1) to three (3) passes of a self-propelled, steel-wheel static roller with weight between five (5) and 12 tons. The roller shall be in good condition and shall be capable of reversing without backlash and of compacting the CTPB without undue displacement or excessive crushing of the aggregate.

The control strip CTPB layer shall be considered acceptable when aggregate is completely coated with cement paste with no evidence of crushing; the surface is firm, unyielding and stable under construction traffic; and the layer meets the field permeability per paragraph 307-3.1 titled MIX DESIGN.

- 307-4.2 Weather limitations.** The CTPB material shall not be mixed or placed while the air temperature is below 40°F or when conditions indicate that the temperature may fall below 35°F within 24 hours. The CTPB shall not be placed on frozen underlying courses or mixed when aggregate is frozen. The CTPB may not be placed when rainfall is occurring or where rain is imminent. Any CTPB material that has become excessively wet by rain during transport and/or placement will be rejected.
- 307-4.3 Equipment.** All equipment necessary to mix, transport, place, compact, and finish the CTDB material shall be furnished by the Contractor and approved by the Engineer. The equipment will be inspected by the Resident Engineer prior to the start of construction operations.
- 307-4.4 Preparation of the underlying course.** The underlying course shall be checked and accepted by the Resident Engineer before placing operations begin. Prior to placing the material, the final grade should be firm, moist and free of frost. Use of chemicals to eliminate frost will not be permitted. The underlying course shall be wetted in advance of placing the lean concrete base course.
- 307-4.5 Mixing.** The batch plant site, layout, equipment, and provisions for transporting material shall assure a continuous supply of material to the work. Stockpiles shall be constructed in a manner that prevents segregation and intermixing of deleterious materials. Free access to the plant must be provided to the Resident Engineer at all times for inspection of the plant's equipment and operation and for sampling the CTPB mixture and its components.
- The mixers shall be examined daily by the Contractor and periodically by the Resident Engineer for changes in condition due to accumulation of hard concrete or mortar or wear of blades. The pick-up and throw-over blades shall be replaced as necessary to provide adequate mixing. Aggregate and cement may be proportioned either by weight or volume, and shall be mixed sufficiently to prevent the forming of cement balls when water is added. Batching weights shall be within a tolerance of 1% for cement and 2% for aggregates. The mixing time shall be that required to produce a uniform mixture of aggregate, cement, and water.
- 307-4.6 Hauling.** The CTPB mixture shall be transported from the plant to the job site in trucks or other hauling equipment having beds that are smooth and clean. Truck bed covers shall be provided to protect the CTPB during transport from rain. CTPB material that becomes wet during transport will be rejected.
- The elapsed time between the start of moist mixing and the time the CTPB is deposited in-place at the work site shall not exceed (a) 30 minutes when the CTPB is hauled in non-agitating trucks, or (b) 45 minutes when the CTPB is hauled in transit mixers. Re-tempering the CTPB material by adding water or by other means shall not be permitted.
- 307-4.7 Placing.** The CTPB material shall be placed using a mechanical spreader or an asphalt paver. The CTPB shall be installed in a single six (6) inch lift. The spreader shall be capable of placing a uniform, full-depth layer of material across the full width of the base in one (1) pass. When two (2) or more spreaders are required, they shall be operated so that spreading progresses along the full width of the base in a uniform manner, and the placement is no more than one (1) hour apart.
- 304-4.8 Finishing.** Shape the finished surface of the lean concrete base layer to the specified lines, grades, and cross-section.
- 307-4.9 Compaction.** Immediately upon completion of the spreading operations, the CTPB material shall be compacted using the approved compaction equipment and roller pattern/sequence, as determined in the approved control strip. Sufficient rollers shall be furnished to handle the output of the plant. If the rolling pattern/sequence results in undue displacement of the surface, or

causes crushing of the aggregate, work shall be stopped until the cause can be determined, and corrections are made.

A large asphalt paving machine with dual tamping bars may be used in lieu of rolling if approved during the control strip.

In all places not accessible to the rollers (or the alternative paving machine), the CTPB material shall be compacted with approved mechanical hand-operated tampers.

When additional effort beyond that provided by the paver is required to seat the aggregate, additional compaction shall be initiated within 30 minutes following the placing and striking-off operations.

The Contractor shall provide a qualified nuclear gauge and operator for Quality Control (QC) testing for density.

**307-4.10 Joints.** The formation of all joints shall be made in such a manner as to ensure a continuous bond between old and new sections of the course. All joints shall present the same texture and smoothness as other sections of the course.

All contact surfaces of previously constructed courses shall be cleaned of all dirt or other objectionable material and thoroughly moistened with water prior to placing new material.

**307-4.11 Curing.** The completed drainage layer shall be moist cured for a period of 12 hours followed by application of an impervious membrane curing compound in accordance with paragraph 307-2.9 titled CURING MATERIAL.

**307-4.12 Surface tolerance.** In those areas on which a surface or base course is to be placed, the surface shall be tested for smoothness and accuracy of grade and crown. Any portion lacking the required smoothness or failing in accuracy of grade or crown shall be corrected with a grinding machine or removed and replaced at the Contractor's expense as approved by the Resident Engineer. Any areas that have been ground shall have curing compound reapplied. The Contractor shall perform all final smoothness and grade checks in the presence of the Resident Engineer. Any deviation in tolerances shall be corrected by the Contractor at the Contractor's expense.

**a. Smoothness.** The finished surface shall not vary more than  $\pm$  three-eighths (3/8) inch when tested with a 12 or 16 foot straightedge applied parallel with and at right angles to the centerline, and moved continuously forward at half the length of the 12 or 16 foot straightedge for the full length of each line on a 50 foot grid.

**b. Grade.** The grade shall be measured on a 50-foot grid and shall be within  $\pm$ 0.05 feet of the specified grade.

**307-4.13 Field permeability.** One (1) test shall be performed by the Resident Engineer for 1,500 square yards. Random sampling locations will be determined by the Resident Engineer. The permeability of the base will be determined in accordance with ASTM C1701.

**307-4.14 Bond breaker.** Prior to placing the overlaying concrete pavement, a bond breaker shall be placed on the surface to prevent bonding. Fabric per paragraph 307-2.10 titled BOND BREAKER shall be placed on the surface of the lean concrete to prevent bonding. There shall be at least one (1) foot of overlay where adjoining sections of fabric come together.

**307-4.15 Maintenance.** The completed drainable base shall be maintained by the Contractor in a condition to meet all specification requirements until the pavement has been placed. Placement of the pavement shall be made within 30 calendar days after placement of the drainage layer. The CTPB shall not be opened to traffic until specimens made in accordance with AASHTO T 23 and tested in accordance with AASHTO T 22 show that a seven (7) day compressive strength of 500 pounds per square inch has been achieved. The maintenance cost shall be considered incidental to the contract and as a subsidiary obligation of the Contractor.

### MATERIAL ACCEPTANCE

**307-5.1 Acceptance sampling and testing.** Cement treated permeable base course shall be accepted for compressive strength and thickness on an area basis. Testing frequency shall be a minimum of one (1) compressive strength and thickness per 1,500 square yards. Random sampling locations will be determined by the Resident Engineer. The Contractor shall bear the cost of providing curing facilities for the strength specimens.

**a. Compressive strength.** The Resident Engineer shall perform all compressive strength tests.

Samples of CTPB will be taken for compressive strength in accordance with ASTM C172. Two (2) test cylinders will be made and cured from the sample per AASHTO T 23 and the 7-day compressive strength of each cylinder determined per AASHTO T 22. The compressive strength will be computed by averaging the two (2) seven (7) day compressive strengths.

The Contractor shall provide for the initial curing of cylinders in accordance with AASHTO T 23 during the 24 hours after molding.

If the material fails to meet the minimum compressive strength requirements, it shall be removed and replaced at the Contractor's expense.

**b. Thickness.** Depth tests shall be made by test holes or cores at least three (3) inches in diameter that extend through the base. Thickness will be determined by measuring the depth of core hole. The thickness of the base course shall be within +0 and -1/2 inch of the specified thickness as determined by depth tests taken by the Contractor in the presence of the Resident Engineer for each subplot. Core holes shall be filled by the Contractor with lean concrete base or non-shrink grout. When the thickness measurement is deficient by more than one-half (1/2) inch, the material in the area represented by the tests shall be removed to full depth and replaced at the Contractor's expense.

### METHOD OF MEASUREMENT

**307-6.1** The quantity of cement treated permeable base course shall be measured for payment by the number of square yards as specified, completed, and accepted by the Resident Engineer.

### BASIS OF PAYMENT

**307-7.1** Payment for accepted quantities of work performed by the Contractor and measured by the Resident Engineer shall be made at the contract unit price as specified in paragraph 307-6.1 of this section. Payment shall be full compensation for furnishing and placing all materials, for all preparation, mixing, placing, compacting curing and placement of overlaying bond breaker; and for all labor, equipment, tools, and incidentals necessary to complete the work as specified.

### REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

#### ASTM International (ASTM)

ASTM C 309	Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C 1701	Standard Test Method for Infiltration Rate of In Place Pervious Concrete

**American Association of State Highway and Transportation Officials (AASHTO)**

AASHTO M 85	Standard Specification for Portland Cement
AASHTO M 288	Standard Specification for Geosynthetic Specification for Highway Applications
AASHTO T 22	Standard Method of Test for Compressive Strength of Cylindrical Concrete Specimens
AASHTO T 23	Standard Method of Test for Making and Curing Concrete Test Specimens in the Field
AASHTO T 26	Standard Method of Test for Quality of Water to Be Used in Concrete
AASHTO T 90	Standard Method of Test for Determining the Plastic Limit and Plasticity Index of Soils
AASHTO T 215	Standard Method of Test for Permeability of Granular Soils (Constant Head)

**Illinois Department of Transportation, Bureau of Materials Illinois Laboratory Test Procedure (ITP)***Manual of Test Procedures for Materials*

AASHTO T 11	Illinois Modified, Standard Method of Test for Materials Finer Than 75- $\mu$ m (No. 200) Sieve in Mineral Aggregates by Washing
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*Manual of Aggregate Quality Test Procedures*

AASHTO T 96	Illinois Modified, Standard Method of Test for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
AASHTO T 104	Illinois Modified, Standard Method of Test for Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate
AASHTO T 113	Illinois Modified, Standard Method of Test for Lightweight Pieces in Aggregate
ITP 203	Deleterious Particles in Coarse Aggregate

**Illinois Department of Transportation, Bureau of Materials Policy Memoranda (PM)**

PM 11-08	Aggregate Gradation Control System (AGCS)
PM 12-08	Crushed Gravel Producer Self-Testing Program

**END ITEM 307**

## Part 6 – Flexible Pavements

### Item 401 Asphalt Mix Pavement Surface Course

#### DESCRIPTION

- 401-1.1** This item shall consist of pavement courses composed of mineral aggregate and asphalt binder mixed in a central mixing plant and placed on a prepared base or stabilized course as specified in the contract documents. Each course shall be constructed to the depth, typical section, and elevation required by the plans and shall be rolled, finished, and approved before the placement of the next course.

#### MATERIALS

- 401-2.1 Aggregate.** Aggregates shall consist of crushed stone, crushed gravel, crushed slag, screenings, natural sand, and mineral filler, as required. The aggregates should have no known history of detrimental pavement staining due to ferrous sulfides, such as pyrite. Coarse aggregate is the material retained on the No. 4 sieve. Fine aggregate is the material passing the No. 4 sieve.

- a. Coarse aggregate.** Coarse aggregate shall consist of crushed stone, crushed gravel, or crushed slag and shall be clean, sound, tough, durable particles, free from films of matter that would prevent thorough coating and bonding with the asphalt material and free from organic matter and other deleterious substances.

- (1) Description.** The natural and manufactured materials used as coarse aggregate are defined as follows.

- (a) Gravel.** Gravel shall be the coarse granular material resulting from the reduction of rock by the action of the elements and having subangular to rounded surfaces. It may be partially crushed.

- (b) Crushed gravel.** Crushed gravel shall be the product resulting from crushing, by mechanical means, and shall consist entirely of particles obtained by crushing gravel. The acceptance and use of crushed gravel shall be according to the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 12-08, *Crushed Gravel Producer Self-Testing Program*.

- (c) Crushed stone.** Crushed stone shall be the angular fragments resulting from crushing undisturbed, consolidated deposits of rock by mechanical means. Crushed stone shall be divided into the following, when specified.

- 1. Carbonate crushed stone.** Carbonate crushed stone shall be either dolomite or limestone. Dolomite shall contain 11.0% or more magnesium oxide (MgO). Limestone shall contain less than 11.0% magnesium oxide (MgO).

- 2. Crystalline crushed stone.** Crystalline crushed stone shall be either metamorphic or igneous stone, including but is not limited to, quartzite, granite, rhyolite and diabase.

- (d) Crushed slag.** Crushed slag shall be the graded product resulting from the processing of air-cooled blast furnace slag. Air-cooled blast furnace slag shall be the nonmetallic product, consisting essentially of silicates and alumino-silicates of lime and other bases, which is developed in a molten condition simultaneously with iron in a blast furnace. It shall be air-cooled and shall have a compact weight (ITP

19) of not less than 70 pounds per cubic foot. The acceptance and use of air-cooled blast furnace slag shall be according to the current Illinois Department of Transportation, Bureau of Materials Policy Memoranda (PM) 12-08, *Crushed Gravel Producer Self-Testing Program* and 13-08, *Slag Producer Self-Testing Program*.

- (e) **Crushed sandstone.** Crushed sandstone shall be the angular fragments resulting from crushing, by mechanical means, a cemented sand composed predominantly of quartz grains. Sandstone shall have an Insoluble Residue of 50.0% or higher.
- (f) **Crushed concrete.** Crushed concrete shall be the angular fragments resulting from crushing Portland cement concrete by mechanical means. The acceptance and use of crushed concrete shall be according to Item 219 titled RECYCLED CONCRETE AGGREGATE BASE COURSE.
- (g) **Crushed steel slag.** Crushed steel slag shall be the graded product resulting from the processing of steel slag. Steel slag shall be the nonmetallic product which is developed in a molten condition simultaneously with steel in an open hearth, basic oxygen, or electric furnace. The acceptance and use of crushed steel slag shall be according to the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 13-08, *Slag Producer Self-Testing Program*.
- (2) **Quality.** The coarse aggregate shall be Class A Quality according to the quality standards listed in the following table.

#### Coarse Aggregate Quality

Quality Test	Class
	A
Na <sub>2</sub> SO <sub>4</sub> Soundness 5 Cycle, Illinois Modified AASHTO T 104 <sup>1</sup> , % Loss max.	15
Los Angeles Abrasion, Illinois Modified AASHTO T 96, % Loss max.	40
Deleterious Materials <sup>3</sup>	
Shale, % max.	1.0
Clay Lumps, % max.	0.25
Coal & Lignite, % max.	0.25
Soft & Unsound Fragments, % max.	4.0
Other Deleterious, % max.	4.0 <sup>2</sup>
Total Deleterious, % max.	5.0

1. Does not apply to crushed concrete.
2. Includes deleterious chert. In gravel and crushed gravel aggregate, deleterious chert shall be the lightweight fraction separated in a 2.35 heavy media suspension. In crushed stone aggregate, deleterious chert shall be the lightweight fraction separated in a 2.55 heavy media separation. Tests shall be run according to Illinois Modified AASHTO TP 113.
3. Test shall be run according to ITP 203.

- b. **Fine aggregate.** Fine aggregate shall consist of sand, stone sand, chats, slag sand, or steel slag sand. For gradation FA 22, uncrushed material will not be permitted.

- (1) **Description.** The natural and manufactured materials used as fine aggregate are defined as follows.

- (a) **Sand.** Sand shall be the fine granular material resulting from the natural disintegration of rock. Sand produced from deposits simultaneously with, and by the same operations as, gravel coarse aggregate may contain crushed particles in the quantity resulting normally from the crushing and screening of oversize particles.
- (b) **Stone sand.** Stone sand shall be produced by washing, or processing by air separation, the fine material resulting from crushing rock quarried from undisturbed, consolidated deposits, or crushing gravel. The acceptance and use of crushed gravel stone sand shall be according to the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 12-08, *Crushed Gravel Producer Self-Testing Program*.
- (c) **Chats.** Chats shall be the tailings resulting from the separation of metals from rocks in which they occur.
- (d) **Slag sand.** Slag sand shall be the graded product resulting from the screening of air-cooled blast furnace slag. Air-cooled blast furnace slag shall be the nonmetallic product, consisting essentially of silicates and alumino-silicates of lime and other bases, which is developed in a molten condition simultaneously with iron in a blast furnace.
- The acceptance and use of air-cooled blast furnace slag sand shall be according to the current Illinois Department of Transportation, Bureau of Materials Policy Memoranda (PM) 12-08, *Crushed Gravel Producer Self-Testing Program* and 13-08, *Slag Producer Self-Testing Program*.
- (e) **Steel slag sand.** Steel slag sand shall be the graded product resulting from the screening of crushed steel slag. Crushed steel slag shall be the nonmetallic product which is developed in a molten condition simultaneously with steel in an open hearth, basic oxygen, or electric furnace. The acceptance and use of steel slag sand shall be according to the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 13-08, *Slag Producer Self-Testing Program*.
- (2) **Quality.** The fine aggregate shall be Class A Quality according to the quality standards listed in the following table.

### Fine Aggregate Quality

Quality Test	Class
	A
Na <sub>2</sub> SO <sub>4</sub> Soundness 5 Cycle, Illinois Modified AASHTO T 104, % Loss max.	10
Minus No. 200 Sieve Material, Illinois Modified AASHTO T 11, % max.	Footnote 1
Organic Impurities Check, Illinois Modified AASHTO T 21	Yes <sup>2</sup>
Deleterious Materials <sup>2, 3</sup>	
Shale, % max.	3.0
Clay Lumps, % max.	1.0
Coal & Lignite, & Shells, % max.	1.0
Conglomerate, % max.	3.0
Other Deleterious, % max.	3.0
Total Deleterious, % max.	3.0

1. Fine aggregate used for hot-mix asphalt (HMA) shall not contain more than three percent clay (2 micron or smaller) particles as determined by Illinois Modified AASHTO T 88.



2. Applies only to sand.
3. Tests shall be run according to ITP 204.

(3) **Gradation requirements.** The fine aggregate gradation shall be FA 1, FA 2, FA 20, FA 21, or FA 22.

### Gradation Requirements

Sieve Size	Gradation Percent Passing				
	FA 1	FA 2	FA 20	FA 21	FA 22
3/8 inch	100	100	100	100	100
No. 4	97±3	97±3	97±3	97±3	
No. 8			80±20	80±20	
No. 16	65±20	65±20	50±15	57±18	8±8
No. 50	16±13	20±10	19±11	30±10	
No. 100	5±5	5±5	10±7	20±10	
No. 200			4±4	9±9	2±2

c. **Sampling.** The current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 11-08, *Aggregate Gradation Control System (AGCS)*, shall be used in sampling coarse and fine aggregate.

**401-2.2 Mineral filler.** Mineral filler may be added in addition to material naturally present in the aggregate. Mineral filler shall consist of dry limestone dust, fly ash, cement kiln dust, or lime kiln dust and shall meet the following requirements.

a. **Gradation.** The gradation shall be according to the following.

### Gradation Requirements

Sieve Size	Percent Passing
No. 30	100
No. 100	92±8
No. 200	82±18

b. **Loss on ignition.** The loss on ignition for all products shall be a maximum of 5% when tested according to the ITP, *Loss on Ignition for Mineral Filler*.

c. **Additional requirements.**

### Mineral Filler Requirements

Material Test	Requirement	Standard
Plasticity Index	4 maximum	AASHTO T 90

**401-2.3 Asphalt binder.** Asphalt binder selection shall be based on the geographic location within the state, and the intended use of the pavement, as listed in the following table.

### Asphalt Binder Selection

Airport Location	Layer	PG Binder Grade	
		Runway & Taxiway	Apron
IDOT Districts 1-6	Surface and Top Binder	SBS PG 70-28	SBS PG 76-28
	Lower Binder	PG 64-22	PG 64-22
IDOT Districts 7-9	Surface and Top Binder	SBS PG 70-22	SBS PG 76-22
	Lower Binder	PG 64-22	PG 64-22

These materials shall be free from water and shall not foam when heated to any temperature below the actual flash point. When requested, producers shall provide the Engineer with viscosity/temperature relationships for the performance graded asphalt binders delivered and incorporated in the work.

Asphalt binder materials will be accepted according to the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 1-08, *Performance Graded Asphalt Binder Qualification Procedure* and/or be listed on the current Illinois Department of Transportation's published Qualified Producer List of *Certified Sources for Performance Graded Asphalt Binder*.

The Contractor shall provide a copy of the manufacturer's certificate of analysis (COA) for the asphalt binder. The test reports shall be provided to and approved by the Resident Engineer before the asphalt binder is applied. The furnishing of the vendor's certified test report for the asphalt material shall not be interpreted as a basis for final acceptance. The manufacturer's COA may be subject to verification by testing the material delivered for use on the project.

- a. **Performance graded (PG) asphalt binder.** The asphalt binder shall meet the requirements of AASHTO M 320, Table 1 "Standard Specification for Performance Graded Asphalt Binder" for the grade shown on the plans. Air blown asphalt will not be allowed.
- b. **Modified performance graded (PG) asphalt binder.** The asphalt binder shall meet the requirements of AASHTO M 320, Table 1 "Standard Specification for Performance Graded Asphalt Binder" for the grade shown on the plans. Elastomers shall be added to the base asphalt binder to achieve the specified performance grade and shall be either a styrene-butadiene (SB) diblock or styrene-butadiene-styrene (SBS) triblock copolymer without oil extension, or a styrene-butadiene rubber (SBR). Air blown asphalts, acid modification, and other modifiers will not be allowed. Asphalt modification at asphalt plants will not be allowed. The modified asphalt binder shall be smooth, homogeneous, and be according to the requirements shown in Table 1 or 2 for the grade shown on the plans.

**401-2.4 Anti-stripping agent.** If it is determined that an additive is required, the additive may be hydrated lime, slaked quicklime, or a liquid additive, at the Contractor's option.

Dry hydrated lime shall be added at a rate of 1.0% to 1.5% by weight of total dry aggregate. Slurry shall be added in such quantity as to provide the required amount of hydrated lime solids by weight of total dry aggregate.

### COMPOSITION

**401-3.1 Composition of mixture.** The asphalt mix shall be composed of a mixture of aggregates, filler and anti-strip agent if required, and asphalt binder. The aggregate fractions shall be sized, handled in separate size groups, and combined in such proportions that the resulting mixture meets the grading requirements of the job mix formula (JMF).

**401-3.2 Job mix formula (JMF) laboratory.** The Contractor shall provide a laboratory, at the plant, according to the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 6-08, *Minimum Private Laboratory Requirements for Construction Materials Testing or Mix Design*. The laboratory shall be of sufficient size and be furnished with the necessary equipment and supplies for adequately and safely performing the Contractor's QC testing.

The laboratory and equipment furnished by the Contractor shall be properly maintained. The Contractor shall maintain a record of calibration results at the laboratory. The Engineer may inspect measuring and testing devices at any time to confirm both calibration and condition. If the Engineer determines the equipment is not within the limits of dimensions or calibration described in the appropriate test method, the Engineer may stop production until corrective action is taken. If laboratory equipment becomes inoperable, the Contractor shall cease mix production.

**401-3.3 Job mix formula (JMF).** No asphalt mixture shall be placed until an acceptable mix design has been submitted to the Engineer for review and accepted in writing. The Engineer's review shall not relieve the Contractor of the responsibility to select and proportion the materials to comply with this section.

When the project requires asphalt mixtures of differing aggregate gradations and/or binders, a separate JMF shall be submitted for each mix. Add anti-stripping agent to meet tensile strength requirements.

The asphalt mixture shall be designed using procedures contained in Asphalt Institute MS-2 Mix Design Manual, 7th Edition. Samples shall be prepared and compacted using the gyratory compactor in accordance with AASHTO T 312.

Should a change in sources of materials be made, a new JMF must be submitted to the Engineer for review and accepted in writing before the new material is used. After the initial production JMF has been approved by the Engineer and a new or modified JMF is required for whatever reason, the subsequent cost of the new or modified JMF, including a new test strip when required by the Engineer, will be borne by the Contractor.

The Resident Engineer may request samples at any time for testing, prior to and during production, to verify the quality of the materials and to ensure conformance with the applicable specifications.

The JMF shall be submitted in writing by the Contractor at least 45 days prior to the start of paving operations. The JMF shall be developed within the same construction season using aggregates proposed for project use. The JMF shall include the following items as a minimum:

- a. Manufacturer's certificate of analysis (COA) for the asphalt binder used in the JMF. Asphalt binder shall be identified by the Illinois Department of Transportation material and producer code number and the producer name and location.
- b. Manufacturer's certificate of analysis (COA) for the anti-stripping agent if used in the JMF.
- c. Course and fine aggregate and mineral filler shall be identified by the Illinois Department of Transportation material and producer code number and the producer name and location.
- d. Percent passing each sieve size for individual gradation of each aggregate cold feed and/or hot bin; percent by weight of each cold feed and/or hot bin used; and the total combined gradation in the JMF.
- e. Specific Gravity and absorption of each coarse and fine aggregate.
- f. Percentage of each individual aggregate.
  - (1) Percent natural sand.
  - (2) Percent fractured faces.

- (3) Percent by weight of flat particles, elongated particles, and flat and elongated particles (and criteria).
- g. Summary of Superpave Design and Optimum Design Data.
  - (1) Asphalt Content (AC)
  - (2) Mixture Air Voids (AV)
  - (3) Mixture Bulk Specific Gravity ( $G_{mb}$ )
  - (4) Mixture Theoretical Maximum Specific Gravity ( $G_{mm}$ )
  - (5) Aggregate Bulk (Dry) Specific Gravity ( $G_{sb}$ )
  - (6) Aggregate Effective Specific Gravity ( $G_{se}$ )
  - (7) Effective Binder Content ( $P_{be}$ )
  - (8) Absorbed Binder ( $P_{ba}$ )
  - (9) Volume of Effective Asphalt ( $V_{be}$ )
  - (10) Voids Filled with Asphalt (VFA)
  - (11) Voids in Mineral Aggregate (VMA)
- h. Number of gyrations.
- i. Laboratory mixing and compaction temperatures.
- j. Supplier-recommended field mixing and compaction temperatures.
- k. Plot of the combined gradation on a 0.45 power gradation curve.
- l. Graphical plots of AV, VMA, and unit weight versus AC. To achieve minimum VMA during production, the mix design needs to account for material breakdown during production.
- m. Tensile Strength Ratio (TSR).
- n. Type and amount of anti-strip agent when used.
- o. Date the JMF was developed.

### Asphalt Design Criteria

Traffic Mix					
Design Parameter	Aircraft 60,000 Pounds Or More <sup>1</sup>		Aircraft Under 60,000 Pounds		Automobile <sup>5</sup>
	Runway/Taxiway	Apron	Runway/Taxiway	Apron	Roadways/Parking Lots
N <sub>ini</sub> <sup>2</sup>	7	7	5	5	5
N <sub>des</sub> <sup>3</sup>	50	50	30	30	30
N <sub>max</sub>	74	74	42	42	42
Air Voids (AV) <sup>4</sup>	2-4	2-4	2-4	2-4	2-4
VFA (min %)	75-90	75-90	75-90	75-90	75-90

1. Stone sand, gradation FA 20 or FA 21, shall be required as part of the fine aggregate portion of the JMF. The exact amount of stone sand will be determined by the Contractor. The percentage of stone sand will be verified as acceptable by the Department based upon the Contractor's final proposed JMF. The Department reserves the right to request a change in the amount of stone sand at any point in the mix design process, as well as during production, based upon performance of the mix during placement.
2. Number of gyrations on a Department approved Superpave gyratory compactor.
3. Value may be changed in order to obtain an acceptable mix design when approved by the Engineer
4. To be specified in plan documents. In general, target air voids are 2%-3% for lower traffic airports, and 3%-4% for higher traffic airports.
5. To be specified in plan documents. Highways N<sub>50</sub> mix may be substituted for above roadways/parking lot criteria.

The mineral aggregate shall be of such size that the percentage composition by weight, as determined by laboratory sieves, will conform to the gradation or gradations specified below when tested in accordance with the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 11-08, *Aggregate Gradation Control System (AGCS)*.

The gradation below represents the limits that shall determine the suitability of aggregate for use from the sources of supply; be well graded from coarse to fine and shall not vary from the low limit on one (1) sieve to the high limit on the adjacent sieve, or vice versa.

### Aggregate - Asphalt Pavements

Sieve Size	Percent by Weight Passing Sieve	
	1/2" Maximum	Ideal Target
1 inch	--	100
3/4 inch	--	100
1/2 inch	99-100	100
3/8 inch	91-97	94
No. 4	56-62	59
No. 8	36-42	39
No. 16	27-32	30
No. 30	19-25	22
No. 100	7-9	8
No. 200	5-7	6
Asphalt Content	5.0-7.0	6.0
Recommended Minimum Construction Lift Thickness	2 inch	2 inch

Locally available Department gradations may be blended to meet the JMF.

Before constructing the test strip, target values shall be determined by applying gradation correction factors to the JMF when applicable. After any JMF adjustment, the JMF shall become the Adjusted Job Mix Formula (AJMF). Upon completion of the first acceptable test strip, the JMF shall become the AJMF regardless of whether or not the JMF has been adjusted. If an adjustment/plant change is made, the Engineer may require a new test strip to be constructed. If the asphalt placed during the initial test strip is determined to be unacceptable to remain in place by the Engineer, it shall be removed and replaced.

The limitations between the JMF and AJMF are as follows.

#### JMF Tolerances

Sieve Size	Tolerance
No. 4	±7%
No. 8	±5%
No. 16	±5%
No. 30	±4%
No. 100	±2%
No. 200	±2%
Asphalt Content	±0.45%
Temperature	±20°F

Any adjustments outside the above limitations will require a new mix design.

**401-3.4 Reclaimed asphalt pavement (RAP).** RAP shall not be used.

**401-3.5 Test strip. (For Method II only; 2,000 tons/pay item and Over).** A test strip will be required at the beginning of production for each mixture with a quantity of 2,000 tons or more according to the current Illinois Department of Transportation, Bureau of Materials Manual of Test Procedures for Materials, *Hot-Mix Asphalt Test Strip Procedures, Appendix B.4*. Full production shall not begin until an acceptable test strip has been constructed and accepted in writing by the Engineer. The Contractor shall prepare and place a quantity of asphalt according to the approved JMF. The underlying grade or pavement structure upon which the test strip is to be constructed shall be the same as the remainder of the course represented by the test strip.

The Contractor will not be allowed to place the test strip until the Contractor quality control program (CQCP) has been accepted, in writing, by the Engineer.

The test strip will consist of at least 300 tons. The test strip shall be placed in two (2) lanes of the same width and depth to be used in production with a longitudinal cold joint. The cold joint must be cut back using the same procedure that will be used during production. The cold joint for the test strip will be an exposed construction joint at least four (4) hours old or when the mat has cooled to less than 160°F. The equipment used in construction of the test strip shall be the same type, configuration and weight to be used on the project.

The Contractor shall follow the following procedures for constructing a test strip.

**a. Contractor/Department test strip team.** A team of both Contractor and Department personnel shall construct a test strip and evaluate mix produced at the plant. The test strip team may consist of the following, as necessary:

- (1) Engineer
- (2) Resident Engineer
- (3) Contractor's QC Manager, required
- (4) Contractor's Density Tester

- b. Communications.** The Contractor shall advise the team members of the anticipated start time of production for the mix. The QC Manager shall direct the activities of the test strip team. A Department appointed representative from the test strip team will act as spokesperson for the Department.
- c. Acceptance criteria.**
- (1) Mix design and plant proportioning.** The mix design shall be approved by the Department prior to the test strip. Target values shall be provided by the Contractor and will be approved by the Department prior to constructing the test strip.
- (2) Evaluation of growth curves.** The completed test strip shall have a minimum density of 94.0 percent (6.0 percent air voids) of the maximum theoretical specific gravity of the mix. Individual test results (average of two cores) below 94.0% shall constitute a failing test section. The maximum density of individual test results (average of two cores) shall be 99.0% of the maximum theoretical specific gravity of the mix. Mixtures which exhibit density potential less than or greater than the density ranges specified shall be considered to have a potential density problem which is normally sufficient cause for mix adjustment.
- If an adjustment has been made, the Engineer may require an additional test strip be constructed and evaluated. This information shall then be compared to the AJMF and required design criteria for acceptance.
- (3) Evaluation of required plant tests.** If the results of the required plant tests exceed the JMF target value control limits, the Contractor shall make allowable mix adjustments/plant changes, resample, and retest. If the Engineer determines additional adjustments to the mix will not produce acceptable results, a new mix design may be required.
- d. Test strip method.** The Contractor shall produce 300 tons of mix for the test strip. The test strip will be included in the cost of the mix and will not be paid for separately since the Contractor may continue production, at their own risk, after the test strip has been completed.
- The procedures listed below shall be followed to construct a test strip.
- (1) Location of test strip.** The test strip shall be located on a relatively flat portion of the project. Descending/ascending grades should be avoided.
- (2) Constructing the test strip.** After the Contractor has produced and placed approximately 225 to 250 tons of mix, paving shall cease, and a growth curve shall be constructed. After completion of the first growth curve, paving shall resume for the remaining 50 to 75 tons, and the second growth curve shall be constructed within this area. The Contractor shall use normal rolling procedures for all portions of the test strip except for the growth curve areas which shall be compacted solely with a vibratory roller as directed by the QC Manager.
- (3) Required plant tests.** A set of mixture samples shall be taken at such a time as to represent the mixture in between the two (2) growth curve trucks.
- The mixture sampled to represent the test strip shall also include material sufficient for the Department to conduct an independent assurance Hamburg Wheel test according to AASHTO T 324.
- e. Compaction requirements.**
- (1) Compaction equipment.** The Contractor shall provide a vibratory roller meeting the following requirements.
- The vibratory roller shall be self-propelled and provide a smooth operation when starting, stopping or reversing directions. The vibrating drum amplitude and frequency shall be approximately the same in each direction and meet the following minimum

requirements: drum diameter 48 inches, length of drum 66 inches, vibrators 1,600 vibrations per minute, unit static force on vibrating drum 125 pounds per lineal inch, total applied force 325 pounds per lineal inch, adjustable eccentrics, and reversible eccentrics on nondriven drums. The total applied force for various combinations of vibrations per minute and eccentric positions shall be shown on decals on the vibrating roller or on a chart maintained with the roller. The vibratory roller shall be equipped with water tanks and sprinkling devices, or other approved methods, which shall be used to wet the wheels to prevent material pickup.

A vibrating reed tachometer (hand type) shall be furnished with each vibratory roller. The vibrating reed tachometer shall have a range of 1,000 to 4,000 vibrations per minute. The vibrating reed tachometer shall have two (2) rows of reeds, one (1) ranging from 1,000 to 2,000 vibrations per minute and the other from 2,000 to 4,000 vibrations per minute.

It shall be the responsibility of the test strip team to verify specification compliance before commencement of growth curve construction. An appropriate amplitude shall be selected on the basis of roller weight and mat thickness to achieve maximum density. The vibratory roller speed shall be balanced with frequency so as to provide compaction at a rate of not less than ten (10) impacts per one (1) foot.

- (2) **Compaction temperature.** In order to make an accurate analysis of the density potential of the mixture, the temperature of the mixture on the pavement at the beginning of the growth curve shall not be less than 280°F.
  - (3) **Compaction and testing.** The Contractor shall direct the roller speed and number of passes required to obtain a completed growth curve. The nuclear gauge shall be placed near the center of the hot mat and the position marked for future reference. With the bottom of the nuclear gauge and source rod clean, a one (1) minute nuclear reading (without mineral filler) shall be taken after each pass of the roller. Rolling shall continue until a growth curve can be plotted, the maximum density determined, and three (3) consecutive passes show no appreciable increase in density or evident destruction of the mat.
  - (4) **Final testing.** A core set (two cores, results averaged) shall be taken and will be secured by the Department from each growth curve to represent the density of the in-place mixture. Additional random core sets may be required as determined by the Engineer.
- f. **Nuclear/core correlation.** A correlation of core and nuclear gauge test results may be performed on-site as defined in the Illinois Department of Transportation, Bureau of Materials Manual of Test Procedures for Materials, *Standard Test Method for Correlating Nuclear Gauge Densities with Core Densities, Appendix B.3*. All correlation locations should be cooled with ice or dry ice so that cores can be taken as soon as possible. Three (3) locations should be selected. Two (2) sites should be located on the two (2) growth curves from the first acceptable test strip. The third location should be in an area corresponding to the second set of mixture samples taken at the plant. This correlation should be completed at the same time by the Contractor prior to the next day's production. Smoothness of the test strip shall be to the satisfaction of the Engineer.
- g. **Documentation.** All test strips, required plant tests, and rolling pattern information (including growth curves) will be tabulated by the Contractor with a copy provided to each team member and the original retained in the project files.

If the test strip is unacceptable, necessary adjustments to the JMF, plant operation, placing procedures, and/or rolling procedures shall be made and another test strip shall be placed. Unacceptable test strips shall be removed at the Contractor's expense.



## CONSTRUCTION METHODS

- 401-4.1 Weather limitations.** The asphalt surface course shall be placed only when the air temperature in the shade is at least 40°F and the forecast is for rising temperatures. The asphalt shall not be placed upon a wet surface or when the surface temperature of the underlying course is less than specified in the table below. The temperature requirements may be waived by the Engineer, if requested; however, all other requirements including compaction shall be met.

### Surface Temperature Limitations of Underlying Course

Mat Thickness	Base Temperature (Minimum)
	°F
3 inches or greater	40
Greater than 1 inch but less than 3 inches	45
Less than 1 inch	50

- 401-4.2 Equipment.** The Contractor is responsible for the proper operation and maintenance of all equipment necessary for handline materials and performing all parts of the work to meet this specification.

- a. Asphalt plant.** The asphalt plant shall be the batch-type or dryer drum plant. Plants used for the preparation of asphalt shall be evaluated for prequalification rating and conform to the requirements of the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 4-08, *Approval of Hot-Mix Asphalt Plants and Equipment*. The plants shall not be used to produce mixtures concurrently for more than one (1) project or for private work unless permission is granted in writing by the Engineer. The plant units shall be so designed, coordinated and operated that they will function properly and produce asphalt having uniform temperatures and compositions within the tolerances specified. The plant units shall meet the following requirements. The Engineer shall have access, at all times, to all areas of the plant for checking adequacy of equipment; inspecting operation of the plant: verifying weights, proportions, and material properties; and checking the temperatures maintained in the preparation of the mixtures.

- (1) General.** The plant shall be approved before production begins. All asphalt plants shall be capable of producing asphalt within the specification tolerances for gradation and asphalt binder content. The plant owner shall be responsible for demonstrating this capability through a production and testing program defined by the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 4-08, *Approval of Hot-Mix Asphalt Plants and Equipment*. If the plant fails to maintain this capability, the Department may require the demonstration to be repeated at any time. Failure to maintain the capability may result in loss of plant approval status. Accessibility to the top of truck beds shall be provided by dual platforms or other suitable device to enable the Resident Engineer to obtain samples and mixture temperature data.

For all types of plants, the ingredients shall be heated and combined in such a manner as to produce asphalt which when discharged from the plant will in general vary not more than 20°F from the temperature set by the Engineer. In all cases, the mix temperature shall not be more than 350°F or less than 250°F. Wide variations in the mixture temperature of successive loads may be cause for rejection of the asphalt.

During the drying process, the moisture content of the aggregate shall be reduced such that the moisture content of the asphalt at time of discharge from the mixer will not exceed 0.3%. For certain aggregates such as air-cooled blast furnace slag, and other

highly absorptive aggregates, special handling and treatment such as double drying may be required.

All hot bins shall be emptied and all aggregate in the dryer and collector conveyors shall be removed prior to starting production or resuming once production has been interrupted for the purpose of producing a different mixture.

- (a) **Storage facilities.** The plant used in the preparation of the asphalt shall be located where it will have adequate storage and transportation facilities. Sufficient space shall be provided for separate stockpiles of each gradation, source, and quality of aggregate required. If necessary, to prevent the intermixing of the different materials, or if stockpiles join together, suitable partitions shall be used between adjacent stockpiles. All aggregates shall be kept separated until they are fed in their proper proportions onto a belt conveyor or into the boot of the cold aggregate elevator. The aggregates shall be handled in such a manner as to prevent contamination, degradation and segregation.
- (b) **Aggregate bins and feeders.** The plant shall be provided with accurate mechanical means for uniformly feeding each aggregate and used in the proper proportions so that uniform production and uniform temperature will be obtained. A minimum of four (4) bins and feeders for aggregate will be required. The bins shall be designed to prevent overflow of material from one (1) bin to another. If any of the materials used in preparing the mixture become intermixed in a bin compartment, the compartment shall be emptied and the intermixed material shall not be used. Each bin shall be provided with a variable speed belt or apron feeder with adjustable gates which can be locked. Each bin shall have a cutoff system that shall automatically stop the asphalt production when any bin becomes empty. All feeders shall be calibrated to the desired volumes and/or weights for each material/mixture, to the satisfaction of the Engineer. This calibration may require plant modification. The controls of the total quantity of combined materials fed to the dryer shall be by a variable speed system. Other methods may be approved by the Engineer. When the proportioning gates of the feeders are once set for proper blending, they shall be locked or bolted securely and their positions shall not be changed unless directed by the Engineer.
- (c) **Dust collection.** The plant shall be equipped with a primary dust collector, approved by the Engineer, connected to a secondary dust collector (baghouse or wet-wash).
- (d) **Storage bins and Surge bins.** The asphalt mixture stored in storage and/or surge bins shall meet the same requirements as asphalt mixture loaded directly into trucks. Asphalt mixture shall not be stored in storage and/or surge bins for a period greater than twelve (12) hours. If the RE determines there is an excessive heat loss, segregation, or oxidation of the asphalt mixture due to temporary storage, temporary storage shall not be allowed. The Contractor may use an asphalt surge system in the manufacture of asphalt provided the bins meet the following requirements and are operated to the satisfaction of the Engineer. The complete surge system shall be designed and operated to prevent segregation and loss of temperature of the mix. Maximum retention time shall be eight (8) hours unless longer retention time is authorized in writing by the Engineer. When requested, longer retention time will be evaluated according to the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 4-08, *Approval of Hot-Mix Asphalt Plants and Equipment*. The bins shall be insulated and/or heated, and of an enclosed weatherproof type. A combination low level indicator and cutoff system shall be provided that will automatically stop the discharge of mix from the surge bins when the mix falls below the top of the discharge cone. The conveying system used to transport the mix from the mixer to the bins shall be enclosed, heated and/or insulated for effective control of mix temperature.

No surge system will be approved by itself but shall be considered as part of a complete operating asphalt plant. The mix as discharged from the bins shall meet all specification requirements for the mix being produced. Approval for the use of a surge system may be withdrawn at any time, by the Engineer, for unsatisfactory operation.

- (e) **Storage tanks for asphalt binders.** Tanks for the storage of asphalt binder shall be equipped to heat and hold the material at the required temperatures. The heating shall be accomplished by steam coils, hot oil coils, electricity or other approved means so that no flame shall be in contact with the tank. All asphalt binder lines and fittings shall be steam, electric or hot oil jacketed. Provisions shall be made for sampling the asphalt binder from the line leading to the weigh bucket or metering device. If more than one (1) grade of asphalt binder is required for concurrent operations, adequate storage and separate piping to the weigh bucket or metering device for each grade, or other methods approved by the Engineer that prevent intermingling of the asphalt binders, shall be provided. An armored thermometer or pyrometer which will accurately show temperatures between 200°F and 400°F shall be suitably located in the asphalt binder line or within the tank. The instrument shall be located so as to indicate to the plant personnel, the temperature of the asphalt binder.
- (f) **Equipment for weighing asphalt.** The asphalt shall be weighed on an approved scale furnished by the Contractor meeting the requirements of *225 ILCS 470/Weights and Measures Act* of the State of Illinois. Each time the scale is moved, the accuracy shall be retested and certified. For dryer drum plants the load-out scale used to weigh asphalt shall be equipped with an automatic printer. Batch plants shall have an automatic printer to record the weight of all ingredient materials. The automatic printer shall be an integral part of the scale equipment or the scale and printer shall be directly connected in a manner that will prohibit the manual entry of weights, except as provided in paragraph (a), below.
1. If the platform scale equipment measures gross weight, the printer shall record the gross weight as a minimum. Tare and net weights shall be shown on weigh tickets and may be printed automatically or entered manually.
  2. If scale equipment on a platform scale zeros out the truck tare automatically, the printer shall record the net weight as a minimum.
  3. If the scale equipment on a surge bin weigh hopper zeros automatically after discharging each batch, the printer shall record the net weight as a minimum.
  4. If the scale equipment on surge bins automatically shuts down the feed system weighing and weighs the amount in the silo before and after discharge, the printer shall record the net weight as a minimum.

The automatic printer shall produce a weight ticket in triplicate. Weights shall be shown in tons to the nearest 0.01 ton.

- (g) **Equipment for anti-strip additives.** When an anti-stripping additive is required and a liquid additive is used, it shall be added to the asphalt binder by means of an approved in-line blending system located between the asphalt binder supply tank and distribution onto the heated aggregate. The in-line blending system shall be installed in such a location that the liquid additive cannot recirculate and contaminate the asphalt binder supply tank. The in-line blending system shall be capable of delivering a consistent and controllable stream of material to the asphalt binder under all operating weather conditions and shall be capable of controlling the introduction of additive into the asphalt binder within  $\pm 10\%$  of the amount specified or required. The Contractor shall use methods and procedures for handling and storage of the additive which meet the manufacturer's safety recommendations.

When hydrated lime is used as the anti-strip additive, a separate bin or tank and feeder system shall be provided to store and accurately proportion the lime onto the aggregate either as a slurry, as dry lime applied to damp aggregates, or as dry lime injected onto the hot aggregates prior to adding the liquid asphalt cement. If the hydrated lime is added either as a slurry or as dry lime on damp aggregates, the lime and aggregates shall be mixed by a power driven pugmill to provide a uniform coating of the lime prior to entering the dryer. If dry hydrated lime is added to the hot dry aggregates in a dryer-drum plant, the lime shall be added in such a manner that the lime will not become entrained into the air stream of the dryer-drum and that thorough dry mixing shall occur prior to the injection point of the liquid asphalt. When a batch plant is used, the hydrated lime shall be added to the mixture in the weigh hopper or as approved by the Engineer. The feeder system shall be controlled by a proportioning device which shall provide accuracy to within  $\pm 10\%$  of the specified amount of hydrated lime solids. The proportioning device shall have a convenient and accurate means of calibration and shall be interlocked with the aggregate feed or weight system so as to maintain the required proportion. A flow indicator or sensor shall be provided and interlocked with the plant controls such that the production of the mixture will be interrupted if there is a stoppage of the hydrated lime feed. The stockpiling of hydrated lime treated aggregate will not be permitted. The methods of introducing and mixing the anti-stripping additive and aggregate shall be subject to approval by the Engineer prior to beginning production.

- (h) **Stabilizing additive.** When a stabilizing additive such as a cellulose or mineral fiber is required to prevent asphalt binder drain down, adequate dry storage shall be provided for the stabilizing fiber additive. A separate feed system shall be provided to proportion the fiber into the mixture uniformly and in desired quantities. The feed system shall be interlocked with the aggregate feed or weigh system to maintain the correct proportions for all rates of production and batch sizes. The proportion of fibers shall be controlled at all times within  $\pm 10\%$  of the amount of fibers required. The fiber system shall provide in-process monitoring consisting of either a digital display of output or a printout of the feed-rate, in pounds per minute. Flow indicators or sensing devices for the fiber system shall be provided and interlocked with plant controls so mix production shall be interrupted if fiber introduction fails, or if the output rate is not within the specified tolerances.
1. **Batch plant.** Stabilizing additive shall be pneumatically added through a separate inlet directly into the weigh hopper above the pugmill. The addition of fibers shall be timed to occur during the hot aggregate charging of the hopper. Adequate mixing time will be required to ensure proper blending of the aggregate and fiber additive. Both the wet and dry mixing times shall each be increased a minimum of five (5) seconds beyond the standard mixing time. The actual mixing time increase shall be determined by the Engineer based on individual plant characteristics. If concentrations of mastic (fiber, asphalt binder, and fines) are visible behind the paver, the batch size shall be reduced in 10% increments until the problem is alleviated.
  2. **Drum mix plant.** Stabilizing additive shall be introduced using specialized equipment to mix the asphalt binder with loose fibers at the time of introduction into the drum mixer. This equipment shall be approved by the Engineer. Care shall be taken to ensure the loose fibers do not become entrained in the exhaust system of the plant.
- (2) **Batching plants.** Batch plants shall be according to the following.
- (a) **Dryers.** The plant shall be equipped with a revolving cylindrical dryer or dryers capable of heating and drying all of the fine and coarse aggregates to a temperature of 250°F to 350°F.

- (b) **Equipment for weighing or measuring aggregate.** The equipment shall include a means for accurately weighing each size of aggregate in a weigh hopper suspended on scales and of ample size to hold a full batch without hand raking or running over. The gate shall close tightly so that no material is allowed to leak into the pugmill mixer while a batch is being weighed.

The scale shall be the springless dial type, shall be designed as an integral unit of the batching equipment, and shall be constructed to withstand the usage for which they are intended. Load cells with digital readouts may be used if approved by the Engineer. The scale shall have a capacity of not more than twice the weight of the approved capacity of the mixer.

Except for permanently located plants, springless dial scales shall be provided with suitable markers inside the glass cover and in front of the dial which may be set to show the position of the dial indicator for the required load or the various accumulative loads when more than one (1) aggregate is weighed in the same hopper. Markers shall have distinctive colors for the various materials to be weighed. Dials shall be placed so that they can be viewed without parallax by the operator.

The value of the minimum graduation interval of any scale used for weighing materials shall be not more than 0.2% of the batch weight and not more than 0.1% of the capacity of the scale, except that graduation intervals less than five (5) pounds when weighing aggregates and less than two (2) pounds when weighing cement and finely divided minerals will not be required. In the case of beam scales, the same requirement shall also apply to the graduation of each individual beam with respect to the weight of material normally weighed on it. The value of the minimum graduation interval of any scale used for weighing mixing water shall be not less than two (2) pounds. All scales shall be designed and built to a maximum tolerance of 0.4% of the net load in the hopper.

Scales shall be housed or otherwise protected against the effect of wind in a manner meeting the approval of the Engineer.

The scales shall be calibrated by an independent company. The independent company shall have scale testing equipment and standard weights meeting the requirements of NIST. The scale calibration will be observed by the Engineer. Scales shall be calibrated at the beginning of each construction season or each 12 month period, and each time the scales are moved, or when scale components are repaired or replaced.

Once a scale is calibrated, the settings shall not be altered. The concrete producer shall submit for approval by the Engineer, a method to verify the settings have not been altered. If at any time the Engineer determines the settings have been altered, a new calibration will be required.

Means of access for inspection purposes shall be safe and shall meet the approval of the Engineer. In the case of permanently located plants, the means of access shall be an inclined stairway with the handrail located so that its upward flight will end on the scale operator's platform. It shall be firmly attached to the supporting members of the bin. The weigh platform shall have an approved floor of metal grid or two (2) inch plank.

- (c) **Dust collection.** Material collected from the primary collector shall be discharged into a hopper which is equipped with the means of either wasting stored dust or metering and conveying its contents into the boot of the hot elevator. Metering of dust from the hopper shall be accomplished by either an adjustable variable speed vane or auger feeder. Feed shall be actuated by a control located in the discharge chute between the dryer and the hot elevator and shall only occur when aggregate

is being discharged from the dryer. In all cases, the hopper used for storing the primary material shall be equipped with a low-bin indicator.

Material collected in the secondary collector (baghouse) shall not be stored internally but shall be discharged directly into a silo. Feed of the material from the silo to the mix shall be accomplished only by weight. In no case shall the collected secondary material be returned to the hot elevator. To meet job mix formula criteria, it may be necessary to waste some or all of the collected secondary material.

- (d) **Mineral filler system.** The mineral filler shall be weighed in the aggregate weigh hopper. It shall be conveyed to the weigh hopper by approved means. The feeding method shall operate in such manner as will enable small fractions of the material to be weighed. The chute used to introduce the mineral filler into the weigh hopper shall be so constructed that none of the material is retained in it after the required amount has been deposited in the weigh hopper.
- (e) **Equipment for weighing or measuring asphalt binder.** The equipment used for weighing or measuring the asphalt binder shall consist either of an approved weigh bucket or metering device. If a weigh bucket is used, it shall be a non-tilting type and shall be completely suspended from a springless dial scale. Load cells with digital readouts may be used if approved by the Engineer. The weigh bucket, its discharge valve or valves and spray bar shall be adequately heated and shall have a capacity of at least 15% in excess of the weight of asphalt binder required in any batch. Adequately heated, quick-acting, non-drip valves shall be used in charging the bucket.

If a metering device is used, it shall be of an approved design and have a capacity of at least 15% in excess of the quantity of asphalt binder used in a batch. The controls shall be constructed so that they may be locked at any dial setting and will automatically reset to that reading after the addition of asphalt binder to the mix. The dial shall be in full view of the mixer operator. The flow of asphalt binder shall be automatically controlled so that it will begin when the dry mixing period is over. The section of the asphalt line between the charging valve and the spray bar shall be provided with a valve and outlet for calibrating-verifying the meter.

Either the weigh bucket or the meter device shall discharge all the asphalt binder required for one (1) batch in not more than 15 seconds after the flow has started. The size and spacing of the spray bar openings shall provide a uniform application of asphalt binder the full length of the mixer.

- (f) **Accuracy of scales.** The scales shall meet the requirements of *225 ILCS 470/Weights and Measures Act* of the State of Illinois. The scales shall be calibrated at the beginning of each construction season and as often as the Engineer may deem necessary to assure their continued accuracy. Ten (10) standard 50-pound weights meeting the requirements of NIST shall be available at the asphalt plant for use in calibrating and testing the weighing equipment. The scales shall be inspected frequently for sensitivity, sluggishness or damage. They shall be checked for accuracy at intervals of not more than one (1) week by obtaining the net weight, on truck scales, of a truck load of asphalt.
- (g) **Pugmill mixer.** The batch mixer shall have a rating plate attached showing the manufacturer's rated capacity and shall be an approved type capable of producing a uniform mixture within the job tolerances. If not enclosed, the mixer box shall be equipped with a dust hood to prevent loss of dust. The clearance of the blades from all fixed and moving parts shall not exceed three-quarters (3/4) inch.

The capacity of the pugmill mixer will be determined by the Engineer based on 115% of the calculated net volume of the mixer below the center of the mixer shafts and 100 pounds per cubic foot material. If the mixer will not operate efficiently at the approved capacity, or if its production does not coordinate with other plant units, the

right is reserved to reduce the size of the batch until the desired efficiency is obtained. The Engineer's decision as to the permissible capacity of the pugmill mixer will be final.

The mixer shall be heated by an approved method and shall have a capacity of not less than 2,000 pounds for any composition required under these specifications. The amount of material which the Contractor will be permitted to mix per batch shall be determined by the Engineer. The mixer shall be of the twin-shaft type.

- (h) **Time lock.** The mixer shall be equipped with an accurate time lock to control the operations of a complete mixing cycle. It shall lock the weigh hopper gate after the charging of the mixer until the closing of the mixer gate at the completion of the cycle. It shall lock the asphalt binder bucket or meter throughout the dry mixing period and shall lock the mixer gate throughout the dry and wet mixing periods. The dry mixing period is defined as the interval of time between the opening of the weigh hopper gate and the start of introduction of asphalt binder. The wet mixing period is the interval of time between the start of introduction of asphalt binder and the opening of the mixer gate.

The heated aggregates, and mineral filler shall be mixed in the pugmill mixer for a period of not less than ten (10) seconds. The asphalt binder shall then be added and the mixing continued. The time required to add the asphalt binder shall be not more than 15 seconds. The total time required for adding the asphalt binder and completing the wet mixing period shall be not less than 35 seconds, or longer if necessary, to produce a homogeneous mixture in which all particles of aggregate are coated uniformly. If a question as to the degree of coating should arise, AASHTO T 195 shall be used. The total mixing time shall be a minimum of 45 seconds consisting of dry and wet mixing. The times of dry and wet mixing shall be set by the Engineer. The same size batch weights shall be used in the production of asphalt, unless permission to change is granted in writing by the Engineer.

The control of the timing shall be flexible and capable of being set at intervals of five (5) seconds or less throughout a total cycle. The setting of time intervals shall be at the direction of the Engineer.

- (i) **Batch counter.** An approved mechanical batch and/or tonnage counter shall be installed as part of the time lock device. It shall register only upon the actuation of the asphalt weigh bucket or valve release. It shall not register any dry batches, or any material released during the operation of pulling the bins.
- (j) **Screens.** The screens used in separating the aggregates shall be of the vibrating types, and when operated at normal speeds shall separate the aggregates satisfactorily. The screening system shall be equipped with a scalping screen having openings not more than one-half (1/2) inch larger than the largest size aggregate used in preparing the asphalt. The screening system shall have a tailing pipe for the removal of oversized aggregate. The discharge point of the tailing pipe shall be located so that it will not create a hazard or nuisance. The screens shall produce aggregate in the proper bins, as required.

Efficiency of separation based on laboratory sieves, shall be such that no more than 20% of the material in the bin is smaller than neither the nominal size nor more than 10% over size for that bin.

- (k) **Hot aggregate bin.** The plant shall be equipped with a minimum of four (4) aggregate storage bins of sufficient capacity to supply the mixer when it is operating at full capacity. Bins shall be arranged to assure separate and adequate storage of appropriate fractions of the mineral aggregates. Separate dry storage shall be provided for mineral filler, and the plant shall be equipped to feed the material into the aggregate weigh hopper. Each bin shall be provided with overflow pipes, of such size and at such locations as to prevent backing up of material into other

compartments or bins. Material from the overflow pipe shall not be returned to the hot elevator. Each compartment shall be provided with its individual outlet gate, constructed so that when the gate is closed, there shall be no leakage. Gates shall cut off quickly and completely. Bins shall be so constructed that samples can be readily obtained. A sampling device having the same width as the hot aggregate bin outlet gates shall be provided for this purpose. Hot aggregate bins shall not be modified in any manner nor shall divider plates be removed.

- (l) **Temperature recording instrument.** The plant shall be equipped with either a recording pyrometer or a recording thermometer having at least two (2) terminals when a single dryer is used, and at least three (3) terminals when a dual dryer is used. The type and accuracy of the recording instrument shall be approved by the Engineer. Unless otherwise approved, one (1) terminal shall be installed at a suitable location at the discharge of each dryer and the others near the discharge gate in each bin compartment used for fine aggregate. The temperature recording instrument shall be capable of making accurate charts of the temperatures during the day's run. The recording instrument shall be installed at a point free from the dust and vibration of the plant. If this instrument is not located as to indicate clearly to the plant operator the temperature of the mineral aggregates at the discharge of each dryer, a non-recording pyrometer shall also be installed in view of the plant operator. At the end of each days run, the record sheet of the recording instrument shall be submitted to the Engineer.
- (3) **Dryer drum plants.** Dryer drum plants shall be according to the following.
- (a) **General.** General requirements shall be according to paragraph 401-4.2 a. (1) titled GENERAL, except a surge bin meeting the requirements of paragraph 401-4.2 a.(1)(d) titled STORAGE BINS AND SURGE BINS shall be utilized.
- The heated aggregates, mineral filler, asphalt binder, shall be proportioned by electronic proportioning equipment and mixed to produce a homogenous mixture in which all particles of aggregate are coated uniformly. If a question as to the degree of coating should arise, AASHTO T 195 shall be used. If the Engineer ascertains that proper mixing is not being obtained, adjustments shall be made in the plant operation (production rate, dryer drum slope, etc.) to assure that these conditions are met.
- (b) **Vibrating scalping screen.** The combined aggregates, shall pass over a vibrating scalper that will remove all material and aggregate greater than the nominal top size gradation permitted by the specification for the mixture being produced, or as set by the Engineer, prior to the aggregates being placed on the weigh belt. The scalper shall be independent of other proportioning or weighing equipment.
- (c) **Aggregate weighing equipment.** The combined aggregates shall be weighed on continuous belt weighing devices meeting the requirements of the NIST Handbook #44. The weigh belts shall be self-aligning with a gravity belt takeup and rigid wind guards at the weighing section. Sun screens may be required by the Engineer at the weighing section. Means shall be provided to divert the aggregate into a truck, after passing over the weigh belt scales.
- (d) **Mineral filler system.** Mineral filler shall be proportioned to the mixing zone of the asphalt plant by a variable speed vane feeder and storage system or other systems approved by the Engineer. Means must be provided to divert material from the proportioning unit for purposes of calibration. The feeder shall be provided with an automatic cutoff system in the event the feeder is blocked or is devoid of material.
- (e) **Asphalt binder system.** The asphalt binder system shall consist of a temperature compensating meter and pump. Other asphalt binder systems may be used if approved by the Engineer. The pump and meter shall be installed as close to the asphalt binder storage tanks as possible using rigid pipe with a minimum of piping



length and bends. The diameter of the pipe shall be consistent throughout the system. Means shall be provided to automatically stop the plant in the event asphalt binder ceases to flow through the meter.

- (f) **Dryer drum mixer.** Dryer drum mixer components shall have a minimum capacity of 60 tons per hour of asphalt. The units shall have a recording pyrometer or thermometer that records the discharge temperature of the mixture.
1. **Single unit dryer drum mixers.** The single unit dryer drum mixer shall be a revolving cylindrical drum capable of heating, drying, and mixing the combined aggregates, mineral filler when required, and asphalt binder to produce a uniformly coated, homogenous asphalt meeting all applicable specifications. The dryer burner shall be equipped with automatic controls.
  2. **Dual unit dryer drum mixers.** The dryer portion of the dual unit dryer drum mixer shall be a revolving cylindrical drum capable of heating and drying the combined aggregates to the required specifications. The mixer portion of the dual unit dryer drum mixer shall be either a revolving cylindrical drum or a continuous twin shaft pugmill with a compatible mixing capacity to the dryer production rating. The unit shall be capable of mixing the heated and dried combined aggregates, mineral filler when required, and asphalt binder to produce a uniformly coated, homogenous asphalt meeting all applicable specifications.
- (g) **Secondary dust collector.** The collected baghouse dust shall be returned to the dryer at a uniform rate at a point where the asphalt binder is added to the mixing zone of the asphalt plant.

If positive dust control equipment (PDCE) is required, it shall consist of a system that is an integral part of the production process. The system shall accurately weigh all of the secondary dust collected in the baghouse, transfer the material to a storage silo, accurately weigh the required amount of fines to be returned from the storage silo, and transfer them back to the mixture. The PDCE weighing devices shall have an accuracy of 0.5% of the actual weight of the material. The system shall be capable of automatically monitoring the dust collection process and adjusting the amount of asphalt binder added to the mixture. The entire system shall be interlocked with the plant controls to respond to production rate changes, start up, and shut down situations. The weighing process shall be displayed and recorded in 0.1 units. The PDCE shall be capable of accurately wasting dust without having any adverse effects on the mixture.

- (h) **Proportioning control systems.**
1. **Aggregate feed control.** Each feeder shall have an adjustable feed control, which can be locked, with a master control that will automatically increase or decrease the production rate of each feeder proportionately when the total rate of production is changed. The revolutions per minute, tons per hour, etc. of all feeders shall be measured at the tail shaft of the feeder. The aggregate feeders shall have an accuracy of  $\pm 1.0\%$  of the actual quantity of material incorporated.
  2. **Aggregate weighing.** The main proportioning weigh belt shall be electronically interfaced with the asphalt binder, and mineral filler system to proportion the required amount of each material simultaneously to the mixer. The aggregate weighing systems shall have an accuracy of  $\pm 0.5\%$  of the actual material weighed by the belts. The weighing system shall also have a high-low adjustable tolerance indicator that will signal the operator audibly when the actual production rate differs from the preset rate by more than 3.0%.
  3. **Mineral filler control.** Mineral filler shall be added to the mixer by a variable speed proportioning system interfaced with the aggregate weigh belt that will indicate total dry aggregate combined (aggregates + mineral filler) weight to the

asphalt proportioning system. The mineral filler system shall have an accuracy of  $\pm 0.5\%$  if the mineral filler is measured by weight, or  $\pm 8.0\%$  if the mineral filler is measured solely by volume of the actual material measured by the system. The mineral filler shall be added in the mixer at the same point the asphalt binder is added such that no mineral filler is lost as fugitive dust. Other systems will be permitted if approved by the Engineer.

4. **Asphalt binder control.** The required quantity of asphalt binder shall be proportioned to the mixer via a temperature compensating meter that will correct the quantity of asphalt binder to 60°F, or a system approved by the Engineer. This system shall be electronically interfaced with the combined dry aggregates and mineral filler. The meter shall have an accuracy of  $\pm 0.4\%$  of the actual material metered.
  5. **Aggregate moisture compensators.** The moisture compensation devices shall be capable of electronically converting the wet aggregate weight to dry aggregate weight. Other systems will be permitted if approved by the Engineer.
- (i) **Control console.** The following items shall be part of the operator's control console.
1. **Aggregate feed controls.** The variable speed controls, both total and proportional for each feeder and combined aggregates, shall be indexed in units with a minimum unit of 0.1. The rate in revolutions per minute, tons per hour, etc. shall be displayed by a digital readout for each feeder with a minimum unit of 0.1 revolutions per minute or one (1) ton per hour, etc.
  2. **Aggregate weight indicator.** The accumulated wet weight of material in tons that passes over each weigh belt shall be available at the control console with a minimum unit of 0.1 ton. The dry weight of material, in tons per hour, passing over each weigh belt shall be displayed by digital readouts with a minimum unit of one (1) ton per hour.
  3. **Mineral filler control.** Mineral filler shall be controlled by a variable speed control with a minimum unit of 0.1 and shall be displayed in revolutions per minute, tons per hour, etc. with a minimum unit of 0.1 revolutions per minute or 0.1 tons per hour, etc.
  4. **Asphalt binder control.** The asphalt binder control shall be capable of presetting the actual asphalt binder content directly as a percent of the total weight of mixture with a minimum unit of 0.1%. The asphalt binder rate shall be displayed to a minimum unit of 0.1. A control shall be provided to set the specific gravity or weight per gallon of the asphalt binder. The temperature of the asphalt binder shall be recorded by a recording pyrometer or thermometer at the console.
  5. **Aggregate moisture compensators.** The compensators shall be part of the operator's console and shall have a minimum unit of 0.1%. The control shall be lockable if the moisture setting is not printed as part of the record.
  6. **Asphalt temperature.** The temperature of the mixture shall be recorded in degrees Fahrenheit by a recording pyrometer or thermometer at the console.
- (j) **Recording of proportions.** The plant shall be equipped with a digital printer that will automatically print the following data at six (6) minute intervals during production time and on demand. All readings shall show the date, month and year, and time to the nearest minute for each print.
1. Accumulated dry aggregate in tons to the nearest 0.1 ton.
  2. Accumulated mineral filler in revolutions, tons, etc., to the nearest 0.1 unit.
  3. Accumulated asphalt binder in gallons, tons, etc., to the nearest 0.1 unit.

4. Aggregate moisture compensators in percent as set at the panel. Required when accumulated dry aggregate is printed in wet aggregate weight.

Another system approved by the Engineer, such as a fully computerized system, that will provide the control and documentation of the above equipment, will be permitted.

- b. **Hauling equipment.** Trucks used for hauling asphalt shall have tight, clean, and smooth metal beds. To prevent the asphalt from sticking to the truck beds, the truck beds shall be lightly coated with a minimum amount of paraffin oil, lime solution, or other material approved by the Engineer. Petroleum products shall not be used for coating truck beds. Each truck shall have a suitable cover to protect the mixture from adverse weather. When necessary, to ensure that the mixture will be delivered to the site at the specified temperature, truck beds shall be insulated or heated, and covers shall be securely fastened.
- c. **Material transfer vehicle (MTV).** Material transfer vehicles used to transfer the material from the hauling equipment to the paver shall be self-propelled with a swing conveyor that can deliver material to the paver without making contact with the paver. The MTV shall be able to move back and forth between the hauling equipment and the paver providing material transfer to the paver, while allowing the paver to operate at a constant speed. The MTV will have remixing and storage capability to prevent physical and thermal segregation.

An MTV is required for runway and taxiway construction on pavements designed for aircraft weighing 100,000 pounds or more. The MTV is recommended for all pavements where the weight of the MTV will not damage the pavement structure.

- d. **Asphalt pavers.** Asphalt pavers shall be self-contained, power-propelled units equipped with augers, activated screed or a strike off assembly and be capable of being heated. The augers, activated screed or strike off assembly shall be adjustable either automatically or by adding additional sections so the paver will place, compact or strike off the asphalt to the full width being placed. All width extensions shall have the same placement features and equipment functions as provided on the main body of the paver. Pavers with extendible type screeds shall have a minimum ten (10) foot basic screed, except on projects with 7,500 square yards or less of asphalt. For these smaller projects, a minimum eight (8) foot basic screed will be permitted. Augers shall be extended as additional sections of screed are bolted on or automatically adjustable screeds are extended. The augers need not be extended when the screed extensions on each side of the machine are one (1) foot or less if the finished surface of the mat is uniform. Pavers used for shoulders and similar construction shall be capable of spreading and finishing asphalt in widths shown on the plans. The use of any machine obsolete in design or in poor mechanical condition will not be permitted.

The asphalt paver shall be equipped with a control system capable of automatically maintaining the specified screed grade and elevation. The device shall be effective in leveling depressions in the surface of the existing pavement, the leveling course and the binder course.

The automatic electronic grade control device shall be capable of controlling the elevation of the screed relative to either a pre-set grade control stringline or a grade reference device traveling on the adjacent pavement surface. The traveling grade reference device shall be not less than 30 feet in length.

The paver shall be equipped with a receiving hopper having sufficient capacity for a uniform spreading operation. The hopper shall be equipped with a distribution system to uniformly place a non-segregated mixture in front of the screed. The distribution system shall have chain curtains, deflector plates, and/or other devices designed and built by the paver manufacturer to prevent segregation during distribution of the mixture from the hopper to the paver screed. The Contractor shall submit a written certification that the devices recommended by the paver manufacturer to prevent segregation have been installed and are operational. Prior to paving, the Contractor, in the presence of the Engineer, shall

visually inspect paver parts specifically identified by the manufacturer's check list for excessive wear and the need for replacement. The Contractor shall supply the completed check list to the Engineer noting the condition of the parts. Worn parts shall be replaced. The Engineer may require an additional inspection prior to placement of the surface course or at other times throughout the work.

The screed or strike off assembly shall effectively produce a finished surface of the required smoothness and texture without tearing, shoving or gouging the mixture. If the spreading and finishing equipment in use leaves tracks or indented areas or produces other blemishes in the pavement that are not satisfactorily corrected by the scheduled operations, the use of such equipment shall be discontinued.

The paver shall be capable of paving to a minimum width specified in the contract documents.

The paver shall be capable of being operated at forward speeds consistent with satisfactory placement of the mixture.

A straightedge at least four (4) feet in length and equipped with a carpenter's level shall be available at the spreading and finishing machine to check the surface of the asphalt for transverse slope and longitudinal surface variations.

- e. **Rollers.** The number, type, and weight of rollers shall be sufficient to compact the asphalt to the required density while it is still in a workable condition without crushing of the aggregate, depressions or other damage to the pavement surface. Rollers shall be in good condition, clean, capable of reversing without backlash, and of operating at slow speeds to avoid displacement of the asphalt. All rollers shall be specifically designed and suitable for compacting asphalt concrete and shall be properly used. Rollers that impair the stability of any layer of a pavement structure or underlying soils shall not be used.

No roller shall be used that has in any way been thrown out of its original balance by the application of attachments not approved by the Engineer. All bearings shall be tight.

- (1) **Self-propelled pneumatic-tired roller.** The roller shall be of the oscillating wheel type consisting of not less than seven (7) pneumatic-tired wheels revolving on two (2) axles, and capable of being ballasted to the weight required. The tires on the front and rear wheels shall be staggered so that the tire sidewalls will have a minimum overlap of one-half (1/2) inch. The roller shall provide for a smooth operation when starting, stopping or reversing direction.

The tires shall withstand inflation pressures between 60 and 120 pounds per square inch. The roller shall be equipped with an adequate scraping or cleaning device on each tire to prevent the accumulation of material on the tires. The roller shall be equipped with a water system which will keep all tires uniformly wet to prevent material pickup.

The Contractor shall provide means for determining the weight of the roller as distributed on each wheel. Ballast shall be included in determining the weight.

- (2) **Steel wheel rollers.** The roller shall be self-propelled and provide a smooth operation when starting, stopping, or reversing directions. The steering mechanism shall provide for positive control of the roller. Roller wheels shall be smooth and free from openings or projections which will mar the surface on which the roller is operated. Motor rollers shall be equipped with drip pans to contain oil, grease, or gasoline drips generated by the roller operation. The roller shall be provided with adjustable scrapers which shall be used when necessary to keep the surface of the wheels clean.

When used on a hot-mix asphalt surface, the roller shall be equipped with water tanks and sprinkling devices which shall be used to wet the wheels and prevent material pickup.

- (a) **Tandem rollers.** The Contractor shall provide means for determining the weight of the roller as distributed on each axle. Ballast shall be included in determining the weight.

The rear wheel may be crowned at the rate of not more than 3/16 inch in 4-1/2 feet. The front wheel shall be divided into at least two (2) sections and shall show no noticeable crown. The weight of the roller shall meet requirements of the specific item of work being constructed.

- (b) **Three-wheel rollers.** The rear wheels of three-wheel rollers may be crowned at the rate of not more than 1/16 inch in 20 inches and shall be propelled with a differential gear. The front wheel shall be divided into at least two (2) sections, shall show no noticeable crown, and shall overlap the compression area of each rear wheel by not less than 1-1/2 inch. The weight of the roller shall meet requirements of the specific item of work being constructed.

- (3) **Vibratory roller.** The vibratory roller shall be self-propelled and provide a smooth operation when starting, stopping or reversing directions. The vibrating drums amplitude and frequency shall be approximately the same in each direction and meet the following minimum requirements: drum diameter 48 inches, length of drum 66 inches, vibrators 1,600 vibrations per minute, unit static force on vibrating drums 125 pounds per inch, total applied force 325 pounds per inch, adjustable eccentrics, and reversible eccentrics on nondriven drums. The total applied force for various combinations of vibrations per minute and eccentric positions shall be shown on decals on the vibrating roller or on a chart maintained with the roller. The vibratory roller shall be equipped with water tanks and sprinkling devices, or other approved methods, which shall be used to wet the wheels to prevent material pickup.

A vibrating reed tachometer (hand type) shall be furnished with each vibratory roller. The vibrating reed tachometer shall have a range of 1,000 to 4,000 vibrations per minute. The vibrating reed tachometer shall have two (2) rows of reeds, one (1) ranging from 1,000 to 2,000 vibrations per minute and the other from 2,000 to 4,000 vibrations per minute.

- (4) **Oscillatory roller.** The oscillatory roller shall be self-propelled and provide a smooth operation when starting, stopping, or reversing directions. The oscillatory roller shall be able to operate in a mode that will provide tangential impact force with or without vertical impact force by using at least one drum. The oscillatory roller shall be equipped with water tanks and sprinkling devices, or other approved methods, which shall be used to wet the drums to prevent material pickup. The drum(s) amplitude and frequency of the tangential and vertical impact force shall be approximately the same in each direction and meet the following requirements:

- (a) The minimum diameter of the drum(s) shall be 48 inches;
- (b) The minimum length of the drum(s) shall be 66 inches;
- (c) The minimum unit static force on the drum(s) shall be 125 lb/in;
- (d) The minimum force on the oscillatory drum shall be 18,000 lb; and
- (e) Self-adjusting eccentrics, and reversible eccentrics on non-driven drum(s).

- f. **Density device.** The Contractor shall have on site a density gauge during all paving operations in order to assist in the determination of the optimum rolling pattern, type of roller and frequencies, as well as to monitor the effect of the rolling operations during production paving. The Contractor shall supply a qualified technician during all paving operations to calibrate the gauge and obtain accurate density readings for all new asphalt. These densities shall be supplied to the Resident Engineer upon request at any time during construction. No separate payment will be made for supplying the density gauge and technician.

**g. Pavement surface test equipment.** Required surface testing and analysis equipment and their jobsite transportation shall be provided by the Contractor.

**(1) Straightedge.** The 16-foot or 12-foot straightedge shall consist of a metal I-beam mounted between two (2) wheels spaced 16 feet or 12 feet between the axles. Scratcher bolts, which can be easily and accurately adjusted, shall be set at the 1/4, 1/2, and 3/4 points between the axles. A handle suitable for pushing and guiding shall be attached to the straightedge.

**h. Profile testing device.** The profile testing device shall have a decal displayed to indicate it has been tested through the Profile Equipment Verification (PEV) Program administered by the Department.

**(a) California profilograph.** The California Profilograph shall be either computerized or manual and have a frame 25 feet in length supported upon multiple wheels at either end. The profile shall be recorded from the vertical movement of a wheel attached to the frame at midpoint.

The California Profilograph shall be calibrated according to the manufacturer's recommendations and California Test 526. All calibration traces and calculations shall be submitted to the Engineer for the project file.

**(b) Inertial profiler.** The inertial profiler shall be either an independent device or a system that can be attached to another vehicle using one (1) or two (2) non-contact sensors to measure the pavement profile. The inertial profiler shall be capable of performing a simulation of the California Profilograph to provide results in the Profile Index format.

The inertial profiler shall be calibrated according to the manufacturer's recommendations. All calibration traces and calculations shall be submitted to the Engineer for the project file.

**(c) Trace analysis.** The Contractor shall reduce/evaluate these traces using a 0.00-inch blanking band and determine a Profile Index in inches per mile for each section of finished pavement surface. Traces produced using a computerized profile testing device will be evaluated without further reduction. When using a manual profile testing device, the Contractor shall provide an electronic scanner, a computer, and software to reduce the trace. All analysis equipment (electronic scanner, computerized recorder, etc.) shall be able to accept 0.00 inches for the blanking band.

All traces from pavement sections tested with the profile testing device shall be recorded on paper with scales of 300-to-1 longitudinally and 1-to-1 vertically. Equipment and software settings of the profile testing device and analysis equipment shall be set to those values approved through the PEV Program.

The Engineer may retest the pavement at any time to verify the accuracy of the equipment.

**401-4.3 Aggregate stockpile management.** Aggregate stockpiles shall be constructed in a manner that prevents segregation and intermixing of deleterious materials. Aggregates from different sources shall be stockpiled, weighed and batched separately at the asphalt batch plant. Aggregates that have become segregated or mixed with earth or foreign material shall not be used.

A continuous supply of materials shall be provided to the work to ensure continuous placement.

**401-4.4 Preparation of asphalt binder.** The asphalt binder shall be heated in a manner that will avoid local overheating and provide a continuous supply of the asphalt binder to the mixer at a uniform temperature. The temperature of unmodified asphalt binder delivered to the mixer shall be sufficient to provide a suitable viscosity for adequate coating of the aggregate particles, but shall

not exceed 325°F when added to the aggregate. The temperature of modified asphalt binder shall be no more than 350°F when added to the aggregate.

**401-4.5 Preparation of mineral aggregate.** The aggregate for the asphalt shall be heated and dried. The maximum temperature and rate of heating shall be such that no damage occurs to the aggregates. The temperature of the aggregate and mineral filler shall not exceed 350°F when the asphalt binder is added. Particular care shall be taken that aggregates high in calcium or magnesium content are not damaged by overheating. The temperature shall not be lower than is required to obtain complete coating and uniform distribution on the aggregate particles and to provide a mixture of satisfactory workability.

**401-4.6 Preparation of asphalt mixture.** The aggregates and the asphalt binder shall be weighed or metered and mixed in the amount specified by the JMF. The combined materials shall be mixed until the aggregate obtains a uniform coating of asphalt binder and is thoroughly distributed throughout the mixture. Wet mixing time shall be the shortest time that will produce a satisfactory mixture, but not less than 25 seconds for batch plants. The wet mixing time for all plants shall be established by the Contractor, based on the procedure for determining the percentage of coated particles described in AASHTO T 195, for each individual plant and for each type of aggregate used. The wet mixing time will be set to achieve 95% of coated particles. For continuous mix plants, the minimum mixing time shall be determined by dividing the weight of its contents at operating level by the weight of the mixture delivered per second by the mixer. The moisture content of all asphalt upon discharge shall not exceed 0.5%.

For batch plants, wet mixing time begins with the introduction of asphalt binder into the mixer and ends with the opening of the mixer discharge gate. Mixing time should be the shortest time required to obtain uniform distribution of aggregate sizes and thorough coating of aggregate particles with asphalt binder.

**401-4.7 Application of prime and tack coat.** Immediately before placing the asphalt mixture, the underlying course shall be cleaned of all dust and debris.

A prime coat in accordance with Item 602 titled EMULSIFIED ASPHALT PRIME COAT shall be applied to aggregate base prior to placing the asphalt mixture.

A tack coat shall be applied in accordance with Item 603 titled EMULSIFIED ASPHALT TACK COAT to all vertical and horizontal asphalt and concrete surfaces prior to placement of the first and each subsequent lift of asphalt mixture.

**401-4.8 Laydown plan, transporting, placing, and finishing.** Prior to the placement of the asphalt, the Contractor shall prepare a laydown plan with the sequence of paving lanes and width to minimize the number of cold joints; the location of any temporary ramps; laydown temperature; and estimated time of completion for each portion of the work (milling, paving, rolling, cooling, etc.). The laydown plan and any modifications shall be approved by the Engineer.

Deliveries shall be scheduled so that placing and compacting of asphalt is uniform with minimum stopping and starting of the paver. Hauling over freshly placed material shall not be permitted until the material has been compacted, as specified, and allowed to cool to approximately ambient temperature. The Contractor, at their expense, shall be responsible for repair of any damage to the pavement caused by hauling operations.

The Contractor shall survey each lift of asphalt surface course and certify to the Resident Engineer that every lot of each lift meets the grade tolerances specified in the contract documents before the next lift can be placed.

Edges of existing asphalt pavement abutting the new work shall be saw cut and the cut off material and laitance removed. Apply a tack coat in accordance with Item 603 titled EMULSIFIED ASPHALT TACK COAT before new asphalt material is placed against it.

The speed of the paver shall be regulated to eliminate pulling and tearing of the asphalt mat. The paver speed shall be mated with the required roller speed and shall not exceed that which coincides with the average rate of delivery of asphalt to the paver to provide, as nearly as

possible, continuous operation of the paver. In no case shall the speed of the paver exceed 50 feet per minute

Placement of the asphalt mix shall begin along the centerline of a crowned section or on the high side of areas with a one-way slope unless shown otherwise on the laydown plan as accepted by the Engineer. The asphalt mix shall be placed in consecutive adjacent lanes having a minimum width as specified in the contract documents. Additional screed sections attached to widen the paver to meet the minimum lane width requirements must include additional auger sections to move the asphalt mixture uniformly along the screed extension.

The longitudinal joint in one (1) course shall offset the longitudinal joint in the course immediately below by at least one (1) foot; however, the joint in the surface top course shall be at the centerline of crowned pavements. Transverse joints in one (1) course shall be offset by at least ten (10) feet from transverse joints in the previous course. Transverse joints in adjacent lanes shall be offset a minimum of ten (10) feet. On areas where irregularities or unavoidable obstacles make the use of mechanical spreading and finishing equipment impractical, the asphalt may be spread and luted by hand tools.

The Resident Engineer may at any time, reject any batch of asphalt, on the truck or placed in the mat, which is rendered unfit for use due to contamination, segregation, incomplete coating of aggregate, or overheated asphalt mixture. Such rejection may be based on only visual inspection or temperature measurements. In the event of such rejection, the Contractor may take a representative sample of the rejected material in the presence of the Resident Engineer, and if it can be demonstrated in the laboratory, in the presence of the Resident Engineer, that such material was erroneously rejected, payment will be made for the material at the contract unit price.

Paving operations shall be conducted in a manner to prevent medium or high segregation. Plant operations, hauling of the mix, paver operations, and the compacted mat shall be continually monitored for segregation. Areas of segregation in the surface course, as determined by the Resident Engineer, shall be removed and replaced at the Contractor's expense. The area shall be removed by saw cutting and milling a minimum of the construction lift thickness as specified for the approved mix design. The area to be removed and replaced shall be a minimum width of the paver and a minimum of ten (10) feet long.

**401-4.9 Compaction of asphalt mixture.** Immediately after each lift of asphalt course mixture is placed, each lift shall be compacted with equipment meeting the following requirements.

- a. **Breakdown roller.** The break down roller shall be a vibratory roller, pneumatic-tired roller, oscillatory roller, steel-wheeled tandem roller or steel wheeled three-wheel roller.
- b. **Intermediate roller.** The intermediate roller shall be a pneumatic-tired roller or oscillatory roller. A vibratory roller may be used on mixtures containing polymer modified asphalt binder.
- c. **Final roller.** The final roller shall be a vibratory roller operated in static mode, an oscillatory roller operated in tangential impact mode only, or steel-wheeled tandem roller.

Rolling of the first lane of asphalt shall start longitudinally at the edge having the lower elevation and progress to the other edge, overlapping on successive trips to obtain uniform coverage. The roller shall not pass over an unprotected edge of the freshly laid asphalt, unless directed by the Resident Engineer. When directed by the Resident Engineer, the edge shall be rolled with a pneumatic-tired roller.

When laying the asphalt adjacent to a previously placed lane, the first pass of the roller shall be along the longitudinal joint on the fresh mixture with the compression wheel not more than six (6) inches from the joint. The second pass of the roller shall overlap the longitudinal joint not more than 12 inches on the previously placed lane, after which the rolling shall proceed from the low side of the transverse slope to the high side, overlapping uniformly. Each stop shall be regulated to prevent trapping of water on the rolled surface. The steel-wheeled rollers shall be operated with the compression wheels toward the direction of paving.



The speed of the roller at all times shall be slow enough to avoid displacement of the asphalt. If displacement occurs, it shall be corrected at once by raking and applying fresh asphalt where required. To prevent adhesion of the asphalt to the roller, the wheels shall be kept properly moistened without an excess of water.

Rolling of the asphalt shall be continued until all roller marks are eliminated and the asphalt is satisfactorily compacted. When required by the Resident Engineer, the surface course shall be rolled diagonally in two (2) directions with a tandem roller, the second rolling crossing the lines of the first, and, if the width of the pavement permits, it shall also be rolled at right angles to the centerline.

In all places inaccessible to the rollers, such as locations adjacent to curbs, gutters, headers, manholes, and similar structures, the required compaction shall be secured with tampers.

Any asphalt that becomes loose and broken, mixed with dirt, contains check-cracking, or in any way defective shall be removed and replaced with fresh hot mixture and immediately compacted to conform to the surrounding area. This work shall be done at the Contractor's expense. Skin patching shall not be allowed.

**401-4.10 Joints.** The formation of all joints shall be made to ensure a continuous bond between the courses and obtain the required density. All joints shall have the same texture as other sections of the course and meet the requirements for smoothness and grade.

The roller shall not pass over the unprotected end of the freshly laid asphalt except when necessary to form a transverse joint. When necessary to form a transverse joint, it shall be made by means of placing a bulkhead or by tapering the course. The tapered edge shall be cut back to its full depth and width on a straight line to expose a vertical face prior to placing the adjacent lane. In both methods, all contact surfaces shall be coated with an asphalt tack coat before placing any fresh asphalt against the joint.

Longitudinal joints which have been left exposed for more than four (4) hours; the surface temperature has cooled to less than 175°F; or are irregular, damaged, uncompacted or otherwise defective shall be cut back with a cutting wheel or pavement saw a maximum of three (3) inches to expose a clean, sound, uniform vertical surface for the full depth of the course. All cutback material and any laitance produced from cutting joints shall be removed from the project. Asphalt tack coat in accordance with Item 603 titled EMULSIFIED ASPHALT TACK COAT shall be applied to the clean, dry joint prior to placing any additional fresh asphalt against the joint. The cost of this work shall be considered incidental to the cost of the asphalt.

The Contractor may provide additional joint density QC by use of joint heaters at the Contractor's expense. Electrically powered infrared heating equipment should consist of one (1) or more low-level radiant energy heaters to uniformly heat and soften the pavement joints. The heaters should be configured to uniformly heat an area up to 18 inches in width and three (3) inches in depth. Infrared equipment shall be thermostatically controlled to provide a uniform, consistent temperature increase throughout the layer being heated up to a maximum temperature range of 200°F to 300°F.

Propane powered infrared heating equipment shall be attached to the paving machine and the output of infrared energy shall be in the one (1) to six (6) micron range. Converters shall be arranged end to end directly over the joint to be heated in sufficient numbers to continuously produce, when in operation, a minimum of 240,000 BTU per hour. The joint heater shall be positioned not more than one (1) inch above the pavement to be heated and in front of the paver screed and shall be fully adjustable. Heaters will be required to be in operation at all times.

The heaters shall be operated so they do not produce excessive heat when the units pass over new or previously paved material.

**401-4.11 Saw-cut grooving.** Saw-cut grooves shall be provided as specified in Item 621 titled SAW-CUT GROOVES.

**401-4.12 Diamond grinding.** Diamond grinding shall be completed prior to pavement grooving. Diamond grinding shall be accomplished by sawing with saw blades impregnated with industrial diamond abrasive.

Diamond grinding shall be performed with a machine designed specifically for diamond grinding capable of cutting a path at least three (3) feet wide. The saw blades shall be one-eighth (1/8) inch wide with a sufficient number of blades to create grooves between 0.090 and 0.130 inches wide; and peaks and ridges approximately 1/32 inch higher than the bottom of the grinding cut. The actual number of blades will be determined by the Contractor and depend on the hardness of the aggregate. Equipment or grinding procedures that cause raveling, aggregate fractures, spalls or disturbance to the pavement will not be permitted. The Contractor shall demonstrate to the Engineer that the grinding equipment will produce satisfactory results prior to making corrections to surfaces. Grinding will be tapered in all directions to provide smooth transitions to areas not requiring grinding. The slurry resulting from the grinding operation shall be continuously removed and the pavement left in a clean condition. The Contractor shall apply a surface treatment per Item 608 titled EMULSIFIED ASPHALT SEAL COAT to all areas that have been subject to grinding.

**401-4.13 Nighttime paving requirements.** The Contractor shall provide adequate lighting during any nighttime construction. A lighting plan shall be submitted by the Contractor and approved by the Engineer prior to the start of any nighttime work. All work shall be in accordance with the approved construction safety and phasing plan and lighting plan.

**401-4.14 Protection of pavement.** After final rolling, no vehicular traffic of any kind shall be permitted on the pavement until it has cured at least 12 hours or unless otherwise authorized by the Engineer. Newly constructed pavement areas shall not be opened to aircraft traffic until 24 hours after completion or unless otherwise authorized by the Engineer.

#### CONTRACTOR QUALITY CONTROL (QC)

**401-5.1 General.** The Contractor shall develop a Contractor Quality Control Program (CQCP) in accordance with Item 100 titled CONTRACTOR QUALITY CONTROL PROGRAM (CQCP). No partial payment will be made for materials without an approved CQCP.

**401-5.2 Contractor quality control (QC) facilities.** The Contractor shall provide or contract for testing facilities in accordance with Item 100 titled CONTRACTOR QUALITY CONTROL PROGRAM (CQCP). The Engineer shall be permitted unrestricted access to inspect the Contractor's QC facilities and witness QC activities. The Engineer will advise the Contractor in writing of any noted deficiencies concerning the QC facility, equipment, supplies, or testing personnel and procedures. When the deficiencies are serious enough to be adversely affecting the test results, the incorporation of the materials into the work shall be suspended immediately and will not be permitted to resume until the deficiencies are satisfactorily corrected.

**401-5.3 Contractor QC testing.** The Contractor shall perform all QC tests necessary to control the production and construction processes applicable to these specifications and as set forth in the approved CQCP. The testing program shall include, but not necessarily be limited to, tests for the control of asphalt content, aggregate gradation, temperatures, aggregate moisture, field compaction, and surface smoothness. A QC Testing Plan shall be developed as part of the CQCP.

**a. Asphalt content.** A minimum of two (2) tests shall be performed per day in accordance with AASHTO T 308 or AASHTO T 164 for determination of asphalt content. When using AASHTO T 308, the correction factor shall be determined as part of the first test performed at the beginning of plant production; and as part of every tenth test performed thereafter. The asphalt content for the day will be determined by averaging the test results.

**b. Gradation.** Aggregate gradations shall be determined a minimum of twice per day from mechanical analysis of extracted aggregate in accordance with the current Illinois

Department of Transportation, Bureau of Materials Policy Memorandum (PM) 11-08, *Aggregate Gradation Control System (AGCS)*.

- c. **Moisture content of aggregate.** The moisture content of aggregate used for production shall be determined a minimum of once per day in accordance with AASHTO T 255.
- d. **Moisture content of asphalt.** The moisture content shall be determined once per day in accordance with AASHTO T 329.
- e. **Temperatures.** Temperatures shall be checked, at least four (4) times per day, at necessary locations to determine the temperatures of the dryer, the asphalt binder in the storage tank, the asphalt at the plant, and the asphalt at the job site.
- f. **In-place density monitoring.** The Contractor shall conduct any necessary testing to ensure that the specified density is being achieved. A nuclear gauge may be used to monitor the pavement density in accordance with ASTM D2950.
- g. **Smoothness for contractor quality control.**

The Contractor shall perform smoothness testing in transverse and longitudinal directions daily to verify that the construction processes are producing pavement with variances less than one-quarter (1/4) inch in 16 feet, identifying areas that may pond water which could lead to hydroplaning of aircraft. If the smoothness criterion is not met, appropriate changes and corrections to the construction process shall be made by the Contractor before construction continues

The Contractor may use a 12 or 16-foot straightedge or a profile testing device approved by the Engineer. Straight-edge testing shall start with one-half (1/2) the length of the straightedge at the edge of pavement section being tested and then moved ahead one-half (1/2) the length of the straightedge for each successive measurement. Testing shall be continuous across all joints. The surface irregularity shall be determined by placing the freestanding (unleveled) straightedge on the pavement surface and allowing it to rest upon the two (2) highest spots covered by its length, and measuring the maximum gap between the straightedge and the pavement surface in the area between the two (2) high points. If an external reference device is used, the data may be evaluated using the FAA profile program, ProFAA, or FHWA ProVal, using the 12-foot straightedge simulation function.

Smoothness readings shall not be made across grade changes or cross slope transitions. The transition between new and existing pavement shall be evaluated separately for conformance with the contract documents.

- (1) **Transverse measurements.** Transverse measurements shall be taken for each day's production placed. Transverse measurements shall be taken perpendicular to the pavement centerline each 50 feet or more often as determined by the Resident Engineer. The joint between lanes shall be tested separately to facilitate smoothness between lanes.
- (2) **Longitudinal measurements.** Longitudinal measurements shall be taken for each day's production placed. Longitudinal tests shall be parallel to the centerline of paving; at the center of paving lanes when widths of paving lanes are less than 20 feet; and at the third points of paving lanes when widths of paving lanes are 20 feet or greater.

Deviations on the final surface course in either the transverse or longitudinal direction that will trap water greater than one-quarter (1/4) inch shall be corrected with diamond grinding or by removing and replacing the surface course to full depth. Grinding shall be tapered in all directions to provide smooth transitions to areas not requiring grinding. All areas in which diamond grinding has been performed shall be subject to the final pavement thickness tolerances specified herein. Areas that have been ground shall be sealed with a surface treatment in accordance with Item 608 titled EMULSIFIED ASPHALT SEAL COAT. To avoid the surface treatment creating any conflict with runway or taxiway markings, it may be necessary to seal a larger area.

Control charts shall be kept to show area of each day's placement and the percentage of corrective grinding required. Corrections to production and placement shall be initiated when corrective grinding is required. If the Contractor's machines and/or methods produce significant areas that need corrective actions in excess of 10% of a day's production, production shall be stopped until corrective measures are implemented by the Contractor.

- h. Grade.** Grade shall be evaluated daily to allow adjustments to paving operations when grade measurements do not meet specifications. As a minimum, grade shall be evaluated prior to and after the placement of the first lift and after placement of the surface lift.

Measurements will be taken at appropriate grade lines (as a minimum at center and edges of paving lane) and longitudinal spacing as shown on cross-sections and plans. The final surface of the pavement will not vary from the grade line elevations and cross-sections specified in the contract documents by more than 0.05 feet vertically and 0.1 feet laterally. The documentation will be provided by the Contractor to the Resident Engineer by the end of the following working day.

Areas with humps or depressions that exceed grade or smoothness criteria and that retain water on the surface must be ground off provided the course thickness after grinding is not more than one-half (1/2) inch less than the thickness specified in the contract documents.

The Contractor shall repair low areas or areas that cannot be corrected by grinding by removal of deficient areas to the depth of the final course plus one-half (1/2) inch and replacing with new material. Skin patching is not allowed.

- 401-5.4 Sampling.** When directed by the Resident Engineer, the Contractor shall sample and test any material that appears inconsistent with similar material being sampled, unless such material is voluntarily removed and replaced, or deficiencies corrected by the Contractor. All sampling shall be in accordance with standard procedures specified.

- 401-5.5 Control charts.** The Contractor shall maintain linear control charts for both individual measurements and moving average of the last four (4) tests for aggregate gradation, asphalt content, and voids.

Control charts shall be posted in a location satisfactory to the Resident Engineer and kept current. As a minimum, the control charts shall identify the project number, the contract item number, the test number, each test parameter, the limits applicable to each test parameter, and the Contractor's test results. The Contractor shall use the control charts as part of a process control system for identifying potential problems and assignable causes before they occur. If the Contractor's projected data during production indicates a problem and the Contractor is not taking satisfactory corrective action, the Engineer may halt production or acceptance of the material.

- a. Individual measurements and moving average.** Control charts for individual measurements and moving average of the last four (4) tests shall be established to maintain process control within tolerance for aggregate gradation, asphalt content, and voids. The control charts shall use the job mix formula target values as indicators of central tendency for the following test parameters with associated limits.

### Control Chart Limits

Sieve	Individual Test	Moving Average of 4
1/2 inch	±6%	±4%
No. 4	±6%	±4%
No. 8	±5%	±3%
No. 30	±3%	±2.5%
No. 200	±2%	±1%
Asphalt Content	±0.45%	±0.2%
Voids	±1.2%	±1%

- b. Corrective action.** The CQCP shall indicate that appropriate action shall be taken when the process is believed to be out of tolerance. The plan shall contain rules to gauge when a process is out of control and detail what action will be taken to bring the process into control. As a minimum, a process shall be deemed out of control and production stopped and corrective action taken, if:

**(1) Corrective action for required plant tests.**

- (a) Individual test results.** When an individual test result exceeds its control limit, the Contractor shall immediately resample and retest. If at the end of the day no material remains from which to resample, the first sample taken the following day shall serve as the resample as well as the first sample of the day. This result shall be recorded as a retest. If the retest passes, the Contractor may continue the required plant test frequency. Additional check samples should be taken to verify mix compliance.

- 1. Voids and asphalt binder content.** If the retest for voids, , or asphalt binder content exceeds control limits, asphalt production shall cease and immediate corrective action shall be instituted by the Contractor. After corrective action, asphalt production shall be restarted, the asphalt production shall be stabilized, and the Contractor shall immediately resample and retest. asphalt production may continue when approved by the Engineer. The corrective action shall be documented.
- 2. Gradation.** For gradation retest failures, immediate corrective action shall be instituted by the Contractor. After corrective action, the Contractor shall immediately resample and retest. The corrective action shall be documented.

- (b) Moving average.** When the moving average values trend toward the moving average control limits, the Contractor shall take corrective action and increase the sampling and testing frequency. The corrective action shall be documented.

The Contractor shall notify the Engineer whenever the moving average values exceed the moving average control limits. If two (2) consecutive moving average values fall outside the moving average control limits, the Contractor shall cease operations. Corrective action shall be immediately instituted by the Contractor. Operations shall not be reinstated without the approval of the Engineer. Failure to cease operations shall subject all subsequently produced material to be considered unacceptable.

- (c) Asphalt production control.** If the Contractor is not controlling the production process and is making no effort to take corrective action, the operation shall stop.

- (2) Corrective action for required field tests (density).** When an individual density test exceeds the control limits, the Contractor shall immediately retest in a location that is

halfway between the failed test site and the finish roller. If the retest passes, the Contractor shall continue the normal density test frequency. An additional density check test should be performed to verify the mix compaction.

If the retest fails, the Contractor shall immediately conduct one (1) of the following procedures.

**(a) Low density.** If the failing density retest indicates low densities, the Contractor shall immediately increase the compaction effort, review all mixture test results representing the asphalt being produced, and make corrective action as needed. The Contractor shall immediately perform a second density retest within the area representing the increased compaction effort and mixture adjustments.

**(b) High density.** If the failing density retest indicates high densities, the Contractor shall cease production and placement until all mixture test results are reviewed and corrective action is taken. If the high-density failure is a result of a change in the mixture, any existing material in the surge bin may be subject to rejection by the Engineer. After restart of asphalt production, a second density retest shall then be performed in the area representing the mixture adjustments.

If the second retest from either procedure passes, production and placement of the asphalt may continue. The increased compaction effort for low density failures shall not be reduced to that originally being used unless it is determined by investigation that the cause of the low density was unrelated to compaction effort, the cause was corrected, and tests show the corrective action has increased the density within the required limits.

If the second retest fails, production and placement of the asphalt shall cease until the Contractor has completed an investigation and the problem causing the failing densities has been determined. If the Contractor's corrective action is approved by the Engineer, production and placement of the asphalt may then be resumed. The Contractor shall increase the frequency of density testing to show, to the satisfaction of the Engineer, that the corrective action taken has corrected the density problem.

If the Contractor is not controlling the compaction process and is making no effort to take corrective action, the operation, as directed by the Engineer, shall stop.

**401-5.6 Quality control (QC) reports.** The Contractor shall maintain records and shall submit reports of QC activities daily in accordance with Item 100 titled CONTRACTOR QUALITY CONTROL PROGRAM (CQCP).

## MATERIAL ACCEPTANCE

**401-6.1 Acceptance sampling and testing.** Unless otherwise specified, all acceptance sampling and testing necessary to determine conformance with the requirements specified in this section will be performed by the Resident Engineer at no cost to the Contractor except that coring as required in this section shall be completed and paid for by the Contractor. Refer to Illinois Department of Transportation, Aeronautics Policy Memorandum (PM) 96-3, *Requirements for Quality Assurance on Projects With Bituminous Concrete Paving*.

**(For Method I only: Under 2,000 tons/pay item)** After the completion of compaction, the pavement will be tested for acceptance by the Resident Engineer and accepted on the basis of percent air voids in the final compacted mat. The HMA surface course shall be compacted to a minimum density of 93 percent (7 percent air voids) and a maximum of 99 percent (1 percent air voids) of the Theoretical Maximum Specific Gravity (AASHTO T 209). If during construction, the density test fails below 93 percent, additional approved rollers shall be required. Failure to achieve density within these limits shall be cause for rejection of the material, as determined by the Department.

Two random nuclear density tests shall be taken for each 500 tons of mix placed, in accordance with ASTM D2950. Each nuclear density test shall be the average of five (5) nuclear tests taken

as a cross-section of the pavement. The Resident Engineer shall have a nuclear gauge and qualified operator on the project when constructing this item. One random mix sample shall be taken from each 1,000 tons of mix laid, for Extraction, Maximum Specific Gravity, and Air Void tests.

A minimum of one core set (2 cores, results averaged) shall be collected from a location centered on a longitudinal construction joint. The minimum density of the joint shall be 90 percent of the Maximum Theoretical Specific Gravity. When a longitudinal joint sealant is applied, longitudinal joint density testing will not be required on the joint(s) sealed.

Joint density results below an average of 90% shall result in an immediate suspension of paving operations until sufficient investigation and solution to the density problem is agreed to by the Engineer. The result of this deficiency will be a 5% penalty on all production done on the day the core represents.

**(For Method II only: 2,000 tons/pay item and Over).** After the completion of compaction, the pavement will be tested and accepted on the basis of Percentage of material Within specification Limits (PWL).

The HMA surface course shall be compacted to a minimum density of 93 percent (7 percent air voids) and a maximum of 99 percent (1 percent air voids) of the Theoretical Maximum Specific Gravity (AASHTO T 209) and accepted by the following statistical procedure. When more than one surface course mix design is used on the same project, each mix will be evaluated separately under the statistical acceptance procedure specified herein.

- a. **Quality assurance (QA) testing laboratory.** The QA testing laboratory performing these acceptance tests will be accredited in accordance with the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 6-08, *Minimum Private Laboratory Requirements for Construction Materials Testing or Mix Design*.
- b. **Lot size.** A standard lot will consist of one (1) day's production not to exceed 2,000 tons. Each lot will be divided into approximately equal sublots with individual sublots equivalent to 500 tons of asphalt. When only one (1) or two (2) sublots are produced in a day's production, the sublots will be combined with the production lot from the previous or next day. A lot shall consist of the average of four (4) sublot samples, but shall not exceed six (6) sublots. The minimum number of sublots per lot shall be three (3). Where three (3) sublots are produced, they will constitute a lot. Where one (1) or two (2) sublots are produced, they will be incorporated into the previous or next lot. Where more than one (1) plant is simultaneously producing asphalt for the job, the lot sizes will apply separately for each plant.
- c. **Partial lots.** When operational conditions cause a lot to be terminated before the specified number of tests have been made for the lot or for overages or minor placements to be considered as partial lots, the following procedure will be used to adjust the lot size and the number of tests for the lot.

Where three (3) sublots have been produced, they will constitute a lot. The final lot may thus contain up to six (6) sublots. Where one (1) or two (2) sublots have been produced, they will be incorporated into the next lot or the previous lot and the total number of sublots will be used in the acceptance criteria calculation, that is,  $n=5$  or  $n=6$ .

- d. **Asphalt air voids.** Plant-produced asphalt will be tested for air voids on a sublot basis.
  - (1) **Sampling.** Random sampling locations will be determined by the Resident Engineer. Samples shall be taken from material deposited into trucks at the plant or at the job site in accordance with ASTM D979. The sample of asphalt may be put in a covered metal tin and placed in an oven for not less than 30 minutes nor more than 60 minutes to maintain the material at or above the compaction temperature as specified in the JMF.

- (2) **Testing.** Air voids will be determined for each subplot in accordance with AASHTO T 269 for a set of compacted specimens prepared in accordance with AASHTO T 312.
- e. **In-place asphalt mat and joint density.** Each subplot will be tested for in-place mat and joint density as a percentage of the theoretical maximum density (TMD).
- (1) **Sampling.** The Contractor will cut minimum five (5) inch diameter samples in accordance with AASHTO R 67. The Contractor shall furnish all tools, labor, and materials for cleaning, and filling the cored pavement. Laitance produced by the coring operation shall be removed immediately after coring, and core holes shall be filled within one (1) day after sampling in a manner acceptable to the Resident Engineer.
- (2) **Bond.** Each lift of asphalt shall be bonded to the underlying layer. If cores reveal that the surface is not bonded, additional cores shall be taken as directed by the Resident Engineer to determine the extent of unbonded areas. Unbonded areas shall be removed by milling and replaced at the Contractor's expense as directed by the Engineer.
- (3) **Thickness.** Thickness of each lift of surface course will be evaluated by the Resident Engineer for compliance to the requirements specified in the contract documents after any necessary corrections for grade. Measurements of thickness will be made using the cores extracted for each subplot for density measurement. The maximum allowable deficiency at any point will not be more than one-quarter (1/4) inch less than the thickness indicated for the lift. Average thickness of lift, or combined lifts, will not be less than the indicated thickness. Where the thickness tolerances are not met, the lot or subplot shall be corrected by the Contractor at his expense by removing the deficient area and replacing with new pavement. The Contractor, at his expense, may take additional cores as approved by the Engineer to circumscribe the deficient area.
- (4) **Mat density.** One (1) core shall be taken from each subplot. Random sampling locations will be determined by the Resident Engineer. Cores for mat density shall not be taken closer than one (1) foot from a transverse or longitudinal joint. The bulk specific gravity of each core sample will be determined in accordance with AASHTO T 166. The percent compaction (density) of each sample will be determined by dividing the bulk specific gravity of each subplot sample by the TMD for that subplot.
- (5) **Joint density.** One (1) core centered over the longitudinal joint shall be taken for each subplot that has a longitudinal joint. Random sampling locations will be determined by the Resident Engineer. The bulk specific gravity of each core sample will be determined in accordance with AASHTO T 166. The percent compaction (density) of each sample will be determined by dividing the bulk specific gravity of each joint density sample by the average TMD for the lot. The TMD used to determine the joint density at joints formed between lots will be the lower of the average TMD values from the adjacent lots. The minimum joint density shall be 90% of the TMD.

When a longitudinal joint sealant is applied, longitudinal joint density testing will not be required on the joint(s) sealed.

#### 401-6.2 Acceptance criteria.

- a. **General.** Acceptance will be based on the implementation of the Contractor Quality Control Program (CQCP) and the following characteristics of the completed pavements:
- (1) Air voids
  - (2) Mat density
  - (3) Joint density
  - (4) Grade
  - (5) Profilograph smoothness



- (a) Profilograph smoothness and acceptance only apply when the overall project is a new or reconstructed runway or taxiway greater than 500 feet in length. Profilograph roughness is not applicable to aprons and should be used with caution on projects to rehabilitate runways and/or taxiways unless the project includes provisions to correct existing deficiencies.
- b. **Air voids and mat density.** Acceptance of each lot of plant produced material for air voids, and mat density will be based on the percentage of material within specification limits (PWL). If the PWL of the lot equals or exceeds 90%, the lot will be acceptable.
- c. **Joint density.** Acceptance of each lot of plant produced asphalt for joint density will be based on the PWL. If the PWL of the lot is equal to or exceeds 90%, the lot will be considered acceptable. If the PWL is less than 90%, the Contractor shall evaluate the reason and act accordingly. If the PWL is less than 80%, the Contractor shall cease operations. Production may resume once the reason for poor compaction has been determined and appropriate measures have been taken to ensure proper compaction. If the PWL is less than 71%, the pay factor for the lot used to complete the joint will be reduced by 5%.
- d. **Grade.** The final finished surface of the pavement of the completed project shall be surveyed to verify that the grade elevations and cross-sections specified in the contract documents do not deviate more than 0.05 feet vertically or 0.1 feet laterally.

Cross-sections of the pavement shall be taken at a minimum 50 foot longitudinal spacing and at all longitudinal grade breaks. Minimum cross-section grade points shall include grade at centerline,  $\pm 10$  feet of centerline, and edge of pavement.

The survey and documentation shall be stamped and signed by a professional licensed surveyor. Payment for sublots that do not meet grade for over 25% of the subplot shall be reduced by 5% and not be more than 95%.

- e. **Profilograph smoothness for QA acceptance.** The final profilograph shall be the full length of the project to facilitate testing of roughness between lots. The Contractor, in the presence of the Resident Engineer shall perform a profilograph smoothness test on the completed project with a profilograph as specified in paragraph 401-4.2 titled EQUIPMENT. Data and results shall be provided within 48 hours of profilograph smoothness tests.

The pavement shall have an average profile index less than 15 inches per mile per one-tenth (1/10) mile. The equipment shall utilize electronic recording and automatic computerized reduction of data to indicate "must grind" bumps and the Profile Index for the pavement using a 0.2-inch blanking band. The bump template must span one (1) inch with an offset of 0.4 inches. The profilograph must be calibrated prior to use and certified through the Profile Equipment Verification (PEV) Program administered by the Department. Profilograms shall be recorded on a longitudinal scale of one (1) inch equals 25 feet and a vertical scale of one (1) inch equals one (1) inch. Profilograph shall be performed one (1) foot right and left of project centerline and 15 feet right and left of project centerline. Any areas that indicate "must grind" shall be corrected with diamond grinding or by removing and replacing full depth of surface course, as directed by the Engineer. Where corrections are necessary, a second profilograph run shall be performed to verify that the corrections produced an average profile index of 15 inches per mile per one-tenth (1/10) mile or less.

- 401-6.3 Percentage of material within specification limits (PWL).** The PWL will be determined in accordance with procedures specified in Item 110 titled METHOD OF ESTIMATING PERCENTAGE OF MATERIAL WITHIN SPECIFICATION LIMITS (PWL). The specification tolerance limits (L) for lower and (U) for upper are contained in the table below.

### Acceptance Limits for Air Voids, and Density

Test Property	Pavement Specification Tolerance Limits	
	L	U
Air Voids (%)	Design Voids – 1.35	Design Voids + 1.35
Mat Density (%)	93.0 <sup>1</sup>	
Joint Density (%)	90.0	--

1. Applies to all asphalt mixes other than Leveling Course placed less than 1.25 inches thick.

- a. **Outliers.** All individual tests for mat density and air voids will be checked for outliers (test criterion) in accordance with ASTM E178, at a significance level of 5%. Outliers will be discarded, and the PWL will be determined using the remaining test values.

#### 401-6.4 Resampling pavement for mat density.

- a. **General.** Resampling of a lot of pavement will only be allowed for mat density, and then, only if the Contractor requests same, in writing, within 48 hours after receiving the written test results from the Resident Engineer. Only one (1) resampling per lot will be permitted. Results of the resampling and retesting shall be final.

(1) A redefined PWL will be calculated for the resampled lot. The number of tests used to calculate the redefined PWL will include the initial tests made for that lot plus the retests.

(2) The cost for resampling and retesting shall be borne by the Contractor.

- b. **Payment for resampled lots.** The redefined PWL for a resampled lot will be used to calculate the payment for that lot.
- c. **Outliers.** Check for outliers in accordance with ASTM E178, at a significance level of 5%. Outliers will be discarded, and density determined using the remaining test values.

### METHOD OF MEASUREMENT

- 401-7.1 The quantity of asphalt shall be measured for payment by the number of tons of asphalt used for pavement as specified, completed and accepted by the Resident Engineer.

Recorded batch weights or truck scale weights will be used to determine the basis for the tonnage.

### BASIS OF PAYMENT

- 401-8.1 **(For Method I only: Under 2,000 tons/pay item).** Payment for accepted quantities of work performed by the Contractor and measured by the Resident Engineer shall be made at the contract unit price as specified in paragraph 401-7.1 of this section. Acceptance shall be based upon the test results for density. Acceptance test results that do not meet the limits set forth in paragraph 401-6.1 QUALITY ASSURANCE ACCEPTANCE SAMPLING AND TESTING, Method I, shall be cause for a payment adjustment, or removal and replacement, of the material placed in the failed subplot(s), as determined by the Department.

The total project payment for asphalt shall not exceed 103% of the product of the contract plan quantity of asphalt used in the accepted work.

**(For Method II only: 2,000 tons/pay item and Over).** Payment for accepted quantities of work performed by the Contractor and measured by the Resident Engineer shall be made at the contract unit price as specified in paragraph 401-7.1 of this section adjusted based on results of tests for air voids, mat density, joint density, and smoothness. Payment shall be compensation for furnishing all materials, for all preparation, mixing, and placing of these materials, and for all labor, equipment, tools, and incidentals necessary to complete the item as specified.

The total project payment for asphalt shall not exceed 103% of the product of the contract plan quantity of asphalt used in the accepted work.

- a. Adjusted payment.** The pay factor for each individual lot shall be calculated in accordance with the Pay Adjustment Schedule table below. A pay factor shall be calculated for both mat density and air voids. The lot pay factor shall be the higher of the two values when calculations for both mat density and air voids are 100% or higher. The lot pay factor shall be the product of the two values when only one of the calculations for either mat density or air voids is 100% or higher. The lot pay factor shall be the lower of the two values when calculations for both mat density and air voids are less than 100%. If PWL for joint density is less than 71% then the lot pay factor shall be reduced by 5% but be no higher than 95%.

For each lot accepted, the adjusted contract unit price shall be the product of the lot pay factor for the lot and the contract unit price. Payment shall be subject to the total project limitations specified in paragraph 401-8.1. Payment in excess of 100% for accepted lots of asphalt shall be used to offset payment for accepted lots of asphalt pavement that achieve a lot pay factor less than 100%.

Payment for sublots which do not meet grade in accordance with paragraph 401-6.2d after correction for over 25% of the subplot shall be reduced by 5%.

**Pay Adjustment Schedule<sup>1</sup>**

<b>Percentage of Material Within Specification Limits (PWL)</b>	<b>Lot Pay Factor (percent of contract unit price)</b>
96 – 100	106
90 – 95	PWL + 10
75 – 89	0.5 PWL + 55
55 – 74	1.4 PWL - 12
Below 55	Reject

Although it is theoretically possible to achieve a pay factor of 106% for each lot, actual payment above 100% shall be subject to the total project limitation specified in paragraph 401-8.1.

- b. Profilograph smoothness.** The Contractor will receive full payment when the profilograph average profile index is in accordance with the contract documents. When the final average profile index for the entire length of pavement does not exceed 15 inches per mile per one-tenth (1/10) mile, payment will be made at the contract unit price for the completed pavement.

## REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

### ASTM International (ASTM)

ASTM D 979	Standard Practice for Sampling Asphalt Paving Mixtures
ASTM D 2041	Standard Test Method for Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures
ASTM D 2950	Standard Test Method for Density of Bituminous Concrete in Place by Nuclear Methods
ASTM E 178	Standard Practice for Dealing with Outlying Observations

### American Association of State Highway and Transportation Officials (AASHTO)

AASHTO M 320	Standard Specification for Performance-Graded Asphalt Binder
AASHTO R 67	Standard Practice for Sampling Asphalt Mixtures after Compaction (Obtaining Cores)
AASHTO T 88	Standard Method of Test for Particle Size Analysis of Soils
AASHTO T 90	Standard Method of Test for Determining the Plastic Limit and Plasticity Index of Soils
AASHTO T 164	Standard Method of Test for Quantitative Extraction of Asphalt Binder from Hot-Mix Asphalt (HMA)
AASHTO T 166	Standard Method of Test for Bulk Specific Gravity ( $G_{mb}$ ) of Compacted Hot Mix Asphalt (HMA) Using Saturated Surface-Dry Specimens
AASHTO T 195	Standard Method of Test for Determining Degree of Particle Coating of Bituminous-Aggregate Mixtures
AASHTO T 209	Standard Method of Test for Theoretical Maximum Specific Gravity ( $G_{mm}$ ) and Density of Hot-Mix Asphalt (HMA)
AASHTO T 255	Standard Method of Test for Total Evaporable Moisture Content of Aggregate by Drying
AASHTO T 269	Standard Method of Test for Percent Air Voids in Compacted Dense and Open Asphalt Mixtures
AASHTO T 308	Standard Method of Test for Determining the Asphalt Binder Content of Hot Mix Asphalt (HMA) by the Ignition Method
AASHTO T 312	Standard Method of Test for Preparing and Determining the Density of Asphalt Mixture Specimens by Means of the Superpave Gyratory Compactor
AASHTO T 329	Standard Method of Test for Moisture Content of Hot Mix Asphalt (HMA) by Oven Method
AASHTO T 324	Standard Method of Test for Hamburg Wheel-Track Testing of Compacted Asphalt Mixtures

### Asphalt Institute (AI)

Asphalt Institute MS-2 Mix Design Manual, 7th Edition

### Federal Aviation Administration Advisory Circulars (AC)

AC 150/5320-6 Airport Pavement Design and Evaluation

**Illinois Department of Transportation, Bureau of Materials Illinois Laboratory Test Procedure (ITP)***Manual of Test Procedures for Materials*

AASHTO T 11 Illinois Modified, Standard Method of Test for Materials Finer Than 75- $\mu$ m (No. 200) Sieve in Mineral Aggregates by Washing

ITP 19 Bulk Density ("Unit Weight") and Voids in Aggregate

*Manual of Aggregate Quality Test Procedures*

AASHTO T 21 Illinois Modified, Standard Method of Test for Organic Impurities in Fine Aggregates for Concrete

ITP 71 Effect of Organic Impurities in Fine Aggregate on Strength of Mortar

AASHTO T 96 Illinois Modified, Standard Method of Test for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine

AASHTO T 104 Illinois Modified, Standard Method of Test for Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate

AASHTO T 113 Illinois Modified, Standard Method of Test for Lightweight Pieces in Aggregate

ITP 203 Deleterious Particles in Coarse Aggregate

ITP 204 Deleterious Particles in Fine Aggregate

**Illinois Department of Transportation, Bureau of Materials Policy Memoranda (PM)**

PM 1-08 Performance Graded Asphalt Binder Acceptance Procedure

PM 4-08 Approval of Hot-Mix Asphalt Plants and Equipment

PM 6-08 Minimum Private Laboratory Requirement for Construction Materials Testing or Mix Design

PM 11-08 Aggregate Gradation Control System (AGCS)

PM 12-08 Crushed Gravel Producer Self-Testing Program

PM 13-08 Slag Producer Self-Testing Program

**Illinois Department of Transportation, Bureau of Materials Qualified Product List**

Certified Sources for Performance Graded Asphalt Binder

**Illinois Department of Transportation, Aeronautics Policy Memoranda (PM)**

PM 96-3 Requirements for Quality Assurance on Projects With Bituminous Concrete Paving

PM 2003-1 Requirements for Laboratory, Testing, Quality Control, and Paving of Superpave HMA Concrete Mixtures for Airports

PM HMA Comparison Samples

**END OF ITEM 401**

## Item 402 Porous Friction Course

### DESCRIPTION

- 402-1.1** This item shall consist of a plant mixed, open-graded pavement course, composed of mineral aggregate and asphalt binder mixed in a central mixing plant and placed on a prepared base or stabilized course as specified in the contract documents. The porous friction course (PFC) shall be constructed in one (1) layer to the depth, typical section, and elevation required by the plans and shall be rolled, finished, and approved as specified in the contract documents.

The PFC shall be designed as a free draining crack relief layer of uniform thickness. The PFC shall not be used as a surface course. The PFC must be placed on a prepared surface, which drains freely and does not allow ponding. The PFC shall not be applied over an existing PFC. Any existing PFC shall be removed, and the entire surface leveled prior to placement of a new PFC.

### MATERIALS

- 402-2.1 Aggregate.** The aggregate shall consist of crushed stone, crushed gravel, or crushed slag screenings, natural sand, and mineral filler, as required. The aggregates should have no known history of detrimental pavement staining due to ferrous sulfides, such as pyrite. Coarse aggregate is the material retained on the No. 4 sieve. Fine aggregate is the material passing the No. 4 sieve.

- a. Coarse aggregate.** Coarse aggregate shall consist of crushed stone, crushed gravel, or crushed slag and shall be clean, sound, tough, durable particles, free from films of matter that would prevent thorough coating and bonding with the asphalt materials and free from organic matter, and other deleterious substances.

- (1) Description.** The natural and manufactured materials used as coarse aggregate are defined as follows.

- (a) Gravel.** Gravel shall be the coarse granular material resulting from the reduction of rock by the action of the elements and having subangular to rounded surfaces. It may be partially crushed.

- (b) Crushed gravel.** Crushed gravel shall be the product resulting from crushing, by mechanical means, and shall consist entirely of particles obtained by crushing gravel. The acceptance and use of crushed gravel shall be according to the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 12-08, *Crushed Gravel Producer Self-Testing Program*.

- (c) Crushed stone.** Crushed stone shall be the angular fragments resulting from crushing undisturbed, consolidated deposits of rock by mechanical means. Crushed stone shall be divided into the following, when specified.

- 1. Carbonate crushed stone.** Carbonate crushed stone shall be either dolomite or limestone. Dolomite shall contain 11.0% or more magnesium oxide (MgO). Limestone shall contain less than 11.0% magnesium oxide (MgO).
- 2. Crystalline crushed stone.** Crystalline crushed stone shall be either metamorphic or igneous stone, including but is not limited to, quartzite, granite, rhyolite and diabase.

- (d) **Crushed slag.** Crushed slag shall be the graded product resulting from the processing of air-cooled blast furnace slag. Air-cooled blast furnace slag shall be the nonmetallic product, consisting essentially of silicates and aluminosilicates of lime and other bases, which is developed in a molten condition simultaneously with iron in a blast furnace. It shall be air-cooled and shall have a compact weight (ITP 19) of not less than 70 pounds per cubic foot. The acceptance and use of air-cooled blast furnace slag shall be according to the current Illinois Department of Transportation, Bureau of Materials Policy Memoranda (PM) 12-08, *Crushed Gravel Producer Self-Testing Program* and 13-08, *Slag Producer Self-Testing Program*.
- (e) **Crushed sandstone.** Crushed sandstone shall be the angular fragments resulting from crushing, by mechanical means, a cemented sand composed predominantly of quartz grains. Sandstone shall have an Insoluble Residue of 50.0% or higher.
- (f) **Crushed concrete.** Crushed concrete shall be the angular fragments resulting from crushing Portland cement concrete by mechanical means. The acceptance and use of crushed concrete shall be according to Item 219 titled RECYCLED CONCRETE AGGREGATE BASE COURSE.
- (g) **Crushed steel slag.** Crushed steel slag shall be the graded product resulting from the processing of steel slag. Steel slag shall be the nonmetallic product which is developed in a molten condition simultaneously with steel in an open hearth, basic oxygen, or electric furnace. The acceptance and use of crushed steel slag shall be according to the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 13-08, *Slag Producer Self-Testing Program*.
- (2) **Quality.** The coarse aggregate shall be Class B Quality or better according to the quality standards listed in the following table.

### Coarse Aggregate Quality

Quality Test	Class
	B
Na <sub>2</sub> SO <sub>4</sub> Soundness 5 Cycle, Illinois Modified AASHTO T 104 <sup>1</sup> , % Loss max.	15
Los Angeles Abrasion, Illinois Modified AASHTO T 96, % Loss max.	40 <sup>2</sup>
Deleterious Materials <sup>3</sup>	
Shale, % max.	2.0
Clay Lumps, % max.	0.5
Coal & Lignite, % max.	---
Soft & Unsound Fragments, % max.	6.0
Other Deleterious, % max.	2.0
Total Deleterious, % max.	6.0

1. Does not apply to crushed concrete.
2. Does not apply to crushed slag or crushed steel slag.
3. Test shall be run according to ITP 203.

- b. **Fine aggregate.** Fine aggregate shall consist of sand, stone sand, chats, slag sand, or steel slag sand. For gradation FA 22, uncrushed material will not be permitted.
- (1) **Description.** The natural and manufactured materials used as fine aggregate are defined as follows.
- (a) **Sand.** Sand shall be the fine granular material resulting from the natural disintegration of rock. Sand produced from deposits simultaneously with, and by the

same operations as, gravel coarse aggregate may contain crushed particles in the quantity resulting normally from the crushing and screening of oversize particles.

- (b) **Stone sand.** Stone sand shall be produced by washing, or processing by air separation, the fine material resulting from crushing rock quarried from undisturbed, consolidated deposits, or crushing gravel. The acceptance and use of crushed gravel stone sand shall be according to the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 12-08, *Crushed Gravel Producer Self-Testing Program*.
- (c) **Chats.** Chats shall be the tailings resulting from the separation of metals from rocks in which they occur.
- (d) **Slag sand.** Slag sand shall be the graded product resulting from the screening of air-cooled blast furnace slag. Air-cooled blast furnace slag shall be the nonmetallic product, consisting essentially of silicates and alumino-silicates of lime and other bases, which is developed in a molten condition simultaneously with iron in a blast furnace.

The acceptance and use of air-cooled blast furnace slag sand shall be according to the current Illinois Department of Transportation, Bureau of Materials Policy Memoranda (PM) 12-08, *Crushed Gravel Producer Self-Testing Program* and 13-08, *Slag Producer Self-Testing Program*.

- (e) **Steel slag sand.** Steel slag sand shall be the graded product resulting from the screening of crushed steel slag. Crushed steel slag shall be the nonmetallic product which is developed in a molten condition simultaneously with steel in an open hearth, basic oxygen, or electric furnace. The acceptance and use of steel slag sand shall be according to the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 13-08, *Slag Producer Self-Testing Program*.
- (2) **Quality.** The fine aggregate shall be Class B Quality or better according to the quality standards listed in the following table.

### Fine Aggregate Quality

Quality Test	Class
	B
Na <sub>2</sub> SO <sub>4</sub> Soundness 5 Cycle, Illinois Modified AASHTO T 104, % Loss max.	15
Minus No. 200 Sieve Material, Illinois Modified AASHTO 11, % max. <sup>1</sup>	6 <sup>4</sup>
Deleterious Materials <sup>2, 3</sup>	
Shale, % max.	3.0
Clay Lumps, % max.	3.0
Coal & Lignite, & Shells, % max.	3.0
Conglomerate, % max.	3.0
Other Deleterious, % max.	3.0
Total Deleterious, % max.	5.0

1. Fine aggregate used for hot-mix asphalt (HMA) shall not contain more than three percent clay (2 micron or smaller) particles as determined by Illinois Modified AASHTO T 88.
2. Applies only to sand.
3. Tests shall be run according to ITP 204.
4. Does not apply to Gradations FA 20 or FA 21.



- c. **Sampling.** The current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 11-08, *Aggregate Gradation Control System (AGCS)*, shall be used in sampling coarse and fine aggregate.

**402-2.2 Mineral filler.** Mineral filler shall consist of dry limestone dust, fly ash, cement kiln dust, or lime kiln dust and shall meet the following requirements.

- a. **Gradation.** The gradation shall be according to the following.

#### Gradation Requirements

Sieve Size	Percent Passing
No. 30	100
No. 100	92±8
No. 200	82±18

- b. **Loss on ignition.** The loss on ignition for all products shall be a maximum of 5% when tested according to the ITP, *Loss on Ignition for Mineral Filler*.
- c. **Additional requirements.**

#### Mineral Filler Requirements

Material Test	Requirement	Standard
Plasticity Index	4 maximum	AASHTO T 90

**402-2.3 Asphalt binder.** Asphalt binder shall be polymer modified and conform to Performance Grade (PG) 70-28 when the project is located north of U.S. Route 36 and either PG 70-22 or PG 70-28 when the project is located south of U.S. Route 36.

These materials shall be free from water and shall not foam when heated to any temperature below the actual flash point. When requested, producers shall provide the Engineer with viscosity/temperature relationships for the performance graded asphalt binders delivered and incorporated in the work.

- a. **Modified performance graded (PG) asphalt binder.** The asphalt binder shall meet the requirements of AASHTO M 320, Table 1 “Standard Specification for Performance Graded Asphalt Binder” for the grade shown on the plans. Elastomers shall be added to the base asphalt binder to achieve the specified performance grade and shall be either a styrene-butadiene diblock or triblock copolymer without oil extension, or a styrene-butadiene rubber. Air blown asphalts, acid modification, and other modifiers will not be allowed. Asphalt modification at asphalt plants will not be allowed. The modified asphalt binder shall be smooth, homogeneous, and be according to the requirements shown in Table 1 or 2 for the grade shown on the plans.

Asphalt binder materials will be accepted according to the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 1-08, *Performance Graded Asphalt Binder Acceptance Procedure* and/or be listed on the current Illinois Department of Transportation’s published Qualified Producer List of *Certified Sources for Performance Graded Asphalt Binder*.

The Contractor shall provide a copy of the manufacturer’s certificate of analysis (COA) for the asphalt binder. The test reports shall be provided to and approved by the Resident Engineer before the asphalt binder is applied. The furnishing of the vendor’s certified test report for the

asphalt material shall not be interpreted as a basis for final acceptance. The manufacturer's COA may be subject to verification by testing the material delivered for use on the project.

**402-2.4 Anti-stripping agent.** If it is determined that an additive is required, the additive may be hydrated lime, slaked quicklime, or a liquid additive, at the Contractor's option.

Dry hydrated lime shall be added at a rate of 1.0% to 1.5% by weight of total dry aggregate. Slurry shall be added in such quantity as to provide the required amount of hydrated lime solids by weight of total dry aggregate.

### COMPOSITION

**402-3.1 Composition of mixture.** The porous friction course shall be composed of a mixture of aggregates, filler and anti-strip agent if required, and asphalt binder. The aggregate fractions shall be sized, handled in separate size groups, and combined in such proportions that the resulting mixture meets the grading requirements of the job mix formula (JMF).

**402-3.2 Job mix formula (JMF) laboratory.** The Contractor shall provide a laboratory, at the plant, according to the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 6-08, *Minimum Private Laboratory Requirements for Construction Materials Testing or Mix Design*. The laboratory shall be of sufficient size and be furnished with the necessary equipment and supplies for adequately and safely performing the Contractor's QC testing.

The laboratory and equipment furnished by the Contractor shall be properly maintained. The Contractor shall maintain a record of calibration results at the laboratory. The Engineer may inspect measuring and testing devices at any time to confirm both calibration and condition. If the Engineer determines the equipment is not within the limits of dimensions or calibration described in the appropriate test method, the Engineer may stop production until corrective action is taken. If laboratory equipment becomes inoperable, the Contractor shall cease mix production.

**402-3.3 Job mix formula.** No asphalt mixture shall be placed until an acceptable mix design has been submitted to the Engineer for review and has been accepted in writing. The Engineer's review shall not relieve the Contractor of the responsibility to select and proportion the materials to comply with this section.

Should a change in sources of materials be made, a new JMF must be submitted to the Engineer for review and accepted in writing before the new material is used. After the initial production JMF has been approved by the Engineer and a new or modified JMF is required for whatever reason, the subsequent cost of the new or modified JMF, including a new test strip when required by the Engineer, will be borne by the Contractor.

The Resident Engineer may request samples at any time for testing, prior to and during production, to verify the quality of the materials and to ensure conformance with the applicable specifications.

The JMF shall be submitted in writing by the Contractor at least 45 days prior to the start of paving operations. The JMF shall be developed within the same construction season using aggregates proposed for project use. The JMF shall include the following items as a minimum:

- a. Manufacturer's certificate of analysis (COA) for the asphalt binder used in the JMF. Asphalt binder shall be identified by the Illinois Department of Transportation material and producer code number and the producer name and location.
- b. Manufacturer's certificate of analysis (COA) for the anti-stripping agent if used in the JMF.
- c. Course and fine aggregate and mineral filler shall be identified by the Illinois Department of Transportation material and producer code number and the producer name and location.

- d. Percent passing each sieve size for individual gradation of each aggregate cold feed and/or hot bin; percent by weight of each cold feed and/or hot bin used; and the total combined gradation in the JMF.
- e. Specific Gravity and absorption of each coarse and fine aggregate.
- f. Percentage of each individual aggregate.
  - (1) Percent natural sand.
  - (2) Percent fractured faces.
  - (3) Percent by weight of flat particles, elongated particles, and flat and elongated particles (and criteria).
- g. Laboratory mixing and compaction temperatures.
- h. Asphalt viscosity.
- i. Temperature viscosity relationship of the asphalt cement.
- j. Type and amount of anti-strip agent when used.
- k. Date the JMF was developed.

The mineral aggregate shall be of such size that the percentage composition by weight, as determined by laboratory sieves, will conform to the gradation or gradations specified below when tested in accordance with the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 11-08, *Aggregate Gradation Control System (AGCS)*.

The gradations below represent the limits that shall determine the suitability of aggregate for use from the source of supply; be well graded from coarse to fine and shall not vary from the low limit on one (1) sieve to the high limit on the adjacent sieve, or vice versa.

### Aggregate - Porous Friction Course

Sieve Size	Percent by Weight Passing Sieves	
	3/4" Maximum	1/2" Maximum
3/4 inch	100	---
1/2 inch	70-100	100
3/8 inch	45-75	80-100
No. 4	20-40	20-40
No. 8	12-20	12-20
No. 30	8-14	8-14
No. 200	3-5	3-5
Asphalt Content	5.0-7.0	5.0-7.0
Compacted Thickness	1 inch	3/4 inch

The minimum thickness of the layer of the course being constructed shall be one (1) inch when the 3/4-inch maximum size aggregate is to be used and five-eighths (5/8) inch when the one-half (1/2) inch maximum size aggregate is to be used. During construction the Resident Engineer shall check the minimum thickness on a daily basis.

Locally available Department gradations may be blended to meet the JMF.

Before constructing the test strip, target values shall be determined by applying gradation correction factors to the JMF when applicable. After any JMF adjustment, the JMF shall become the Adjusted Job Mix Formula (AJMF). Upon completion of the first acceptable test strip, the JMF shall become the AJMF regardless of whether or not the JMF has been adjusted. If an

adjustment/plant change is made, the Engineer may require a new test strip to be constructed. If the asphalt placed during the initial test strip is determined to be unacceptable to remain in place by the Engineer, it shall be removed and replaced.

The limitations between the JMF and AJMF are as follows.

#### JMF Tolerances

Sieve Size	Tolerance
No. 4	±5% 5
No. 8	±2% 2
No. 30	±2% 2
No. 200	±2%
Asphalt Content	±0.20%
Temperature	±20°F

Any adjustments outside the above limitations will require a new mix design.

**402-3.4 Recycled asphalt mix pavement.** No reclaimed asphalt pavement (RAP) or recycled asphalt shingles (RAS) shall be permitted in this mix.

**402-3.5 Test strip.** A test strip will be required at the beginning of production for each mixture. Full production shall not begin until an acceptable test strip has been constructed and accepted in writing by the Engineer. The Contractor shall prepare and place a quantity of asphalt according to the approved JMF. The underlying grade or pavement structure upon which the test strip is to be constructed shall be the same as the remainder of the course represented by the test strip.

The Contractor will not be allowed to place the test strip until the Contractor quality control program (CQCP) has been accepted, in writing, by the Engineer.

The test strip will consist of at least 300 tons. The test strip shall be placed in two (2) lanes of the same width and depth to be used in production with a longitudinal cold joint. The cold joint must be cut back using the same procedure that will be used during production. The cold joint for the test strip will be an exposed construction joint at least four (4) hours old or when the mat has cooled to less than 160°F. The equipment used in construction of the test strip shall be the same type, configuration and weight to be used on the project.

If the test strip unacceptable, necessary adjustments to the JMF, plant operation, placing procedures, and/or rolling procedures shall be made and another test strip shall be placed. Unacceptable test strips shall be removed at the Contractor's expense.

#### CONSTRUCTION METHODS

**402-4.1 Weather limitations.** The porous friction course shall be placed only on a dry surface and when the air temperature is 60°F and rising two (2) days before and the air temperature in the shade is 60°F and rising on the day of placement. The temperature requirements may be waived by the Engineer, if requested; however, all other requirements including compaction shall be met.

**402-4.2 Equipment.** The Contractor is responsible for the proper operation and maintenance of all equipment necessary for handline materials and performing all parts of the work to meet this specification.

**a. Asphalt plant.** The asphalt plant used for the preparation of asphalt shall be evaluated for prequalification rating and conform to the requirements of ASTM D995 with the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 4-08, *Approval of Hot-Mix Asphalt Plants and Equipment*. The plants shall not be used to produce mixtures concurrently for more than one (1) project or for private work unless permission is

granted in writing by the Engineer. The plant units shall be so designed, coordinated and operated that they will function properly and produce asphalt having uniform temperatures and compositions within the tolerances specified. The plant units shall meet the following requirements. Inspection of plant. The Engineer shall have access, at all times, to all areas of the plant for checking adequacy of equipment; inspecting operation of the plant; verifying weights, proportions, and material properties; and checking the temperatures maintained in the preparation of the mixtures.

- (1) **General.** The plant shall be approved before production begins. All asphalt plants shall be capable of producing asphalt within the specification tolerances for gradation and asphalt binder content. The plant owner shall be responsible for demonstrating this capability through a production and testing program defined by the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 4-08, *Approval of Hot-Mix Asphalt Plants and Equipment*. If the plant fails to maintain this capability, the Department may require the demonstration to be repeated at any time. Failure to maintain the capability may result in loss of plant approval status. Accessibility to the top of truck beds shall be provided by dual platforms or other suitable device to enable the Resident Engineer to obtain samples and mixture temperature data.

For all types of plants, the ingredients shall be heated and combined in such a manner as to produce asphalt which when discharged from the plant will in general vary not more than 20°F from the temperature set by the Engineer. In all cases, the mix temperature shall not be more than 350°F or less than 250°F. Wide variations in the mixture temperature of successive loads may be cause for rejection of the asphalt.

During the drying process, the moisture content of the aggregate shall be reduced such that the moisture content of the asphalt at time of discharge from the mixer will not exceed 0.3%. For certain aggregates such as air-cooled blast furnace slag, and other highly absorptive aggregates, special handling and treatment such as double drying may be required.

All hot bins shall be emptied and all aggregate in the dryer and collector conveyors shall be removed prior to starting production or resuming once production has been interrupted for the purpose of producing a different mixture.

- (a) **Storage facilities.** The plant used in the preparation of the asphalt shall be located where it will have adequate storage and transportation facilities. Sufficient space shall be provided for separate stockpiles of each gradation, source, and quality of aggregate required. If necessary, to prevent the intermixing of the different materials, or if stockpiles join together, suitable partitions shall be used between adjacent stockpiles. All aggregates shall be kept separated until they are fed in their proper proportions onto a belt conveyor or into the boot of the cold aggregate elevator. The aggregates shall be handled in such a manner as to prevent contamination, degradation and segregation.
- (b) **Aggregate bins and feeders.** The plant shall be provided with accurate mechanical means for uniformly feeding each aggregate used in the proper proportions so that uniform production and uniform temperature will be obtained. A minimum of four (4) bins and feeders for aggregate will be required. The bins shall be designed to prevent overflow of material from one (1) bin to another. If any of the materials used in preparing the mixture become intermixed in a bin compartment, the compartment shall be emptied, and the intermixed material shall not be used. Each bin shall be provided with a variable speed belt or apron feeder with adjustable gates which can be locked. Each bin shall have a cutoff system that shall automatically stop the asphalt production when any bin becomes empty. All feeders shall be calibrated to the desired volumes and/or weights for each material/mixture, to the satisfaction of the Engineer. This calibration may require plant modification. The controls of the total quantity of combined materials fed to the dryer shall be by

a variable speed system. Other methods may be approved by the Engineer. When the proportioning gates of the feeders are once set for proper blending, they shall be locked or bolted securely, and their positions shall not be changed unless directed by the Engineer.

- (c) **Dust collection.** The plant shall be equipped with a primary dust collector, approved by the Engineer, connected to a secondary dust collector (baghouse or wet-wash).
- (d) **Surge bins.** The Contractor may use an asphalt surge system in the manufacture of asphalt provided the bins meet the following requirements and are operated to the satisfaction of the Engineer. The complete surge system shall be designed and operated to prevent segregation and loss of temperature of the mix. Maximum retention time shall be eight (8) hours unless longer retention time is authorized in writing by the Engineer. When requested, longer retention time will be evaluated according to the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 4-08, *Approval of Hot-Mix Asphalt Plants and Equipment*. The bins shall be insulated and/or heated, and of an enclosed weatherproof type. A combination low level indicator and cutoff system shall be provided that will automatically stop the discharge of mix from the surge bins when the mix falls below the top of the discharge cone. The conveying system used to transport the mix from the mixer to the bins shall be enclosed, heated and/or insulated for effective control of mix temperature.

No surge system will be approved by itself but shall be considered as part of a complete operating asphalt plant. The mix as discharged from the bins shall meet all specification requirements for the mix being produced. Approval for the use of a surge system may be withdrawn at any time, by the Engineer, for unsatisfactory operation.

- (e) **Storage tanks for asphalt binders.** Tanks for the storage of asphalt binder shall be equipped to heat and hold the material at the required temperatures. The heating shall be accomplished by steam coils, hot oil coils, electricity or other approved means so that no flame shall be in contact with the tank. All asphalt binder lines and fittings shall be steam, electric or hot oil jacketed. Provisions shall be made for sampling the asphalt binder from the line leading to the weigh bucket or metering device. If more than one (1) grade of asphalt binder is required for concurrent operations, adequate storage and separate piping to the weigh bucket or metering device for each grade, or other methods approved by the Engineer that prevent intermingling of the asphalt binders, shall be provided. An armored thermometer or pyrometer which will accurately show temperatures between 200°F and 400°F shall be suitably located in the asphalt binder line or within the tank. The instrument shall be located so as to indicate to the plant personnel, the temperature of the asphalt binder.
- (f) **Equipment for weighing asphalt.** The asphalt shall be weighed on an approved scale furnished by the Contractor meeting the requirements of *225 ILCS 470/Weights and Measures Act* of the State of Illinois. Each time the scale is moved, the accuracy shall be retested and certified. For dryer drum plants the load-out scale used to weigh asphalt shall be equipped with an automatic printer. Batch plants shall have an automatic printer to record the weight of all ingredient materials. The automatic printer shall be an integral part of the scale equipment or the scale and printer shall be directly connected in a manner that will prohibit the manual entry of weights, except as provided in paragraph (a), below.
1. If the platform scale equipment measures gross weight, the printer shall record the gross weight as a minimum. Tare and net weights shall be shown on weigh tickets and may be printed automatically or entered manually.

2. If scale equipment on a platform scale zeros out the truck tare automatically, the printer shall record the net weight as a minimum.
3. If the scale equipment on a surge bin weigh hopper zeros automatically after discharging each batch, the printer shall record the net weight as a minimum.
4. If the scale equipment on surge bins automatically shuts down the feed system weighing and weighs the amount in the silo before and after discharge, the printer shall record the net weight as a minimum.

The automatic printer shall produce a weight ticket in triplicate. Weights shall be shown in tons to the nearest 0.01 ton.

- (g) Equipment for anti-strip additives.** When an anti-stripping additive is required and a liquid additive is used, it shall be added to the asphalt binder by means of an approved in-line blending system located between the asphalt binder supply tank and distribution onto the heated aggregate. The in-line blending system shall be installed in such a location that the liquid additive cannot recirculate and contaminate the asphalt binder supply tank. The in-line blending system shall be capable of delivering a consistent and controllable stream of material to the asphalt binder under all operating weather conditions and shall be capable of controlling the introduction of additive into the asphalt binder within  $\pm 10\%$  of the amount specified or required. The Contractor shall use methods and procedures for handling and storage of the additive which meet the manufacturer's safety recommendations.

When hydrated lime is used as the anti-strip additive, a separate bin or tank and feeder system shall be provided to store and accurately proportion the lime onto the aggregate either as a slurry, as dry lime applied to damp aggregates, or as dry lime injected onto the hot aggregates prior to adding the liquid asphalt cement. If the hydrated lime is added either as a slurry or as dry lime on damp aggregates, the lime and aggregates shall be mixed by a power driven pugmill to provide a uniform coating of the lime prior to entering the dryer. If dry hydrated lime is added to the hot dry aggregates in a dryer-drum plant, the lime shall be added in such a manner that the lime will not become entrained into the air stream of the dryer-drum and that thorough dry mixing shall occur prior to the injection point of the liquid asphalt. When a batch plant is used, the hydrated lime shall be added to the mixture in the weigh hopper or as approved by the Engineer. The feeder system shall be controlled by a proportioning device which shall provide accuracy to within  $\pm 10\%$  of the specified amount of hydrated lime solids. The proportioning device shall have a convenient and accurate means of calibration and shall be interlocked with the aggregate feed or weight system so as to maintain the required proportion. A flow indicator or sensor shall be provided and interlocked with the plant controls such that the production of the mixture will be interrupted if there is a stoppage of the hydrated lime feed. The stockpiling of hydrated lime treated aggregate will not be permitted. The methods of introducing and mixing the anti-stripping additive and aggregate shall be subject to approval by the Engineer prior to beginning production.

- (h) Stabilizing additive.** When a stabilizing additive such as a cellulose or mineral fiber is required to prevent asphalt binder drain down, adequate dry storage shall be provided for the stabilizing fiber additive. A separate feed system shall be provided to proportion the fiber into the mixture uniformly and in desired quantities. The feed system shall be interlocked with the aggregate feed or weigh system to maintain the correct proportions for all rates of production and batch sizes. The proportion of fibers shall be controlled at all times within  $\pm 10\%$  of the amount of fibers required. The fiber system shall provide in-process monitoring consisting of either a digital display of output or a printout of the feed-rate, in pounds per minute. Flow indicators or sensing devices for the fiber system shall be provided and interlocked with plant

controls so mix production shall be interrupted if fiber introduction fails, or if the output rate is not within the specified tolerances.

1. **Batch plant.** Stabilizing additive shall be pneumatically added through a separate inlet directly into the weigh hopper above the pugmill. The addition of fibers shall be timed to occur during the hot aggregate charging of the hopper. Adequate mixing time will be required to ensure proper blending of the aggregate and fiber additive. Both the wet and dry mixing times shall each be increased a minimum of five (5) seconds beyond the standard mixing time. The actual mixing time increase shall be determined by the Engineer based on individual plant characteristics. If concentrations of mastic (fiber, asphalt binder, and fines) are visible behind the paver, the batch size shall be reduced in 10% increments until the problem is alleviated.
2. **Drum mix plant.** Stabilizing additive shall be introduced using specialized equipment to mix the asphalt binder with loose fibers at the time of introduction into the drum mixer. This equipment shall be approved by the Engineer. Care shall be taken to ensure the loose fibers do not become entrained in the exhaust system of the plant.

(2) **Batching plants.** Batch plants shall be according to the following.

- (a) **Dryers.** The plant shall be equipped with a revolving cylindrical dryer or dryers capable of heating and drying all of the fine and coarse aggregates to a temperature of 250°F to 350°F.
- (b) **Equipment for weighing or measuring aggregate.** The equipment shall include a means for accurately weighing each size of aggregate in a weigh hopper suspended on scales and of ample size to hold a full batch without hand raking or running over. The gate shall close tightly so that no material is allowed to leak into the pugmill mixer while a batch is being weighed.

The scale shall be the springless dial type, shall be designed as an integral unit of the batching equipment, and shall be constructed to withstand the usage for which they are intended. Load cells with digital readouts may be used if approved by the Engineer. The scale shall have a capacity of not more than twice the weight of the approved capacity of the mixer.

Except for permanently located plants, springless dial scales shall be provided with suitable markers inside the glass cover and in front of the dial which may be set to show the position of the dial indicator for the required load or the various accumulative loads when more than one (1) aggregate is weighed in the same hopper. Markers shall have distinctive colors for the various materials to be weighed. Dials shall be placed so that they can be viewed without parallax by the operator.

The value of the minimum graduation interval of any scale used for weighing materials shall be not more than 0.2% of the batch weight and not more than 0.1% of the capacity of the scale, except that graduation intervals less than five (5) pounds when weighing aggregates and less than two (2) pounds when weighing cement and finely divided minerals will not be required. In the case of beam scales, the same requirement shall also apply to the graduation of each individual beam with respect to the weight of material normally weighed on it. The value of the minimum graduation interval of any scale used for weighing mixing water shall be not less than two (2) pounds. All scales shall be designed and built to a maximum tolerance of 0.4% of the net load in the hopper.

Scales shall be housed or otherwise protected against the effect of wind in a manner meeting the approval of the Engineer.



The scales shall be calibrated by an independent company. The independent company shall have scale testing equipment and standard weights meeting the requirements of NIST. The scale calibration will be observed by the Engineer. Scales shall be calibrated at the beginning of each construction season or each 12 month period, and each time the scales are moved, or when scale components are repaired or replaced.

Once a scale is calibrated, the settings shall not be altered. The concrete producer shall submit for approval by the Engineer, a method to verify the settings have not been altered. If at any time the Engineer determines the settings have been altered, a new calibration will be required.

Means of access for inspection purposes shall be safe and shall meet the approval of the Engineer. In the case of permanently located plants, the means of access shall be an inclined stairway with the handrail located so that its upward flight will end on the scale operator's platform. It shall be firmly attached to the supporting members of the bin. The weigh platform shall have an approved floor of metal grid or two (2) inch plank.

- (c) **Dust collection.** Material collected from the primary collector shall be discharged into a hopper which is equipped with the means of either wasting stored dust or metering and conveying its contents into the boot of the hot elevator. Metering of dust from the hopper shall be accomplished by either an adjustable variable speed vane or auger feeder. Feed shall be actuated by a control located in the discharge chute between the dryer and the hot elevator and shall only occur when aggregate is being discharged from the dryer. In all cases, the hopper used for storing the primary material shall be equipped with a low-bin indicator.

Material collected in the secondary collector (baghouse) shall not be stored internally but shall be discharged directly into a silo. Feed of the material from the silo to the mix shall be accomplished only by weight. In no case shall the collected secondary material be returned to the hot elevator. To meet job mix formula criteria, it may be necessary to waste some or all of the collected secondary material.

- (d) **Mineral filler system.** The mineral filler shall be weighed in the aggregate weigh hopper. It shall be conveyed to the weigh hopper by approved means. The feeding method shall operate in such manner as will enable small fractions of the material to be weighed. The chute used to introduce the mineral filler into the weigh hopper shall be so constructed that none of the material is retained in it after the required amount has been deposited in the weigh hopper.
- (e) **Equipment for weighing or measuring asphalt binder.** The equipment used for weighing or measuring the asphalt binder shall consist either of an approved weigh bucket or metering device. If a weigh bucket is used, it shall be a non-tilting type and shall be completely suspended from a springless dial scale. Load cells with digital readouts may be used if approved by the Engineer. The weigh bucket, its discharge valve or valves and spray bar shall be adequately heated and shall have a capacity of at least 15% in excess of the weight of asphalt binder required in any batch. Adequately heated, quick-acting, non-drip valves shall be used in charging the bucket.

If a metering device is used, it shall be of an approved design and have a capacity of at least 15% in excess of the quantity of asphalt binder used in a batch. The controls shall be constructed so that they may be locked at any dial setting and will automatically reset to that reading after the addition of asphalt binder to the mix. The dial shall be in full view of the mixer operator. The flow of asphalt binder shall be automatically controlled so that it will begin when the dry mixing period is over. The section of the asphalt line between the charging valve and the spray bar shall be provided with a valve and outlet for calibrating-verifying the meter.

Either the weigh bucket or the meter device shall discharge all the asphalt binder required for one (1) batch in not more than 15 seconds after the flow has started. The size and spacing of the spray bar openings shall provide a uniform application of asphalt binder the full length of the mixer.

- (f) **Accuracy of scales.** The scales shall meet the requirements of *225 ILCS 470/Weights and Measures Act* of the State of Illinois. The scales shall be calibrated at the beginning of each construction season and as often as the Engineer may deem necessary to assure their continued accuracy. Ten (10) standard 50-pound weights meeting the requirements of NIST shall be available at the asphalt plant for use in calibrating and testing the weighing equipment. The scales shall be inspected frequently for sensitivity, sluggishness or damage. They shall be checked for accuracy at intervals of not more than one (1) week by obtaining the net weight, on truck scales, of a truck load of asphalt.
- (g) **Pugmill mixer.** The batch mixer shall have a rating plate attached showing the manufacturer's rated capacity and shall be an approved type capable of producing a uniform mixture within the job tolerances. If not enclosed, the mixer box shall be equipped with a dust hood to prevent loss of dust. The clearance of the blades from all fixed and moving parts shall not exceed three-quarters (3/4) inch.

The capacity of the pugmill mixer will be determined by the Engineer based on 115% of the calculated net volume of the mixer below the center of the mixer shafts and 100 pounds per cubic foot material. If the mixer will not operate efficiently at the approved capacity, or if its production does not coordinate with other plant units, the right is reserved to reduce the size of the batch until the desired efficiency is obtained. The Engineer's decision as to the permissible capacity of the pugmill mixer will be final.

The mixer shall be heated by an approved method and shall have a capacity of not less than 2,000 pounds for any composition required under these specifications. The amount of material which the Contractor will be permitted to mix per batch shall be determined by the Engineer. The mixer shall be of the twin-shaft type.

- (h) **Time lock.** The mixer shall be equipped with an accurate time lock to control the operations of a complete mixing cycle. It shall lock the weigh hopper gate after the charging of the mixer until the closing of the mixer gate at the completion of the cycle. It shall lock the asphalt binder bucket or meter throughout the dry mixing period and shall lock the mixer gate throughout the dry and wet mixing periods. The dry mixing period is defined as the interval of time between the opening of the weigh hopper gate and the start of introduction of asphalt binder. The wet mixing period is the interval of time between the start of introduction of asphalt binder and the opening of the mixer gate.

The heated aggregates and mineral filler shall be mixed in the pugmill mixer for a period of not less than ten (10) seconds. The asphalt binder shall then be added, and the mixing continued. The time required to add the asphalt binder shall be not more than 15 seconds. The total time required for adding the asphalt binder and completing the wet mixing period shall be not less than 35 seconds, or longer if necessary, to produce a homogeneous mixture in which all particles of aggregate are coated uniformly. If a question as to the degree of coating should arise, AASHTO T 195 shall be used. The total mixing time shall be a minimum of 45 seconds consisting of dry and wet mixing. The times of dry and wet mixing shall be set by the Engineer. The same size batch weights shall be used in the production of asphalt, unless permission to change is granted in writing by the Engineer.

The control of the timing shall be flexible and capable of being set at intervals of five (5) seconds or less throughout a total cycle. The setting of time intervals shall be at the direction of the Engineer.

- (i) **Batch counter.** An approved mechanical batch and/or tonnage counter shall be installed as part of the time lock device. It shall register only upon the actuation of the asphalt weigh bucket or valve release. It shall not register any dry batches or any material released during the operation of pulling the bins.
- (j) **Screens.** The screens used in separating the aggregates shall be of the vibrating types, and when operated at normal speeds shall separate the aggregates satisfactorily. The screening system shall be equipped with a scalping screen having openings not more than one-half (1/2) inch larger than the largest size aggregate used in preparing the asphalt. The screening system shall have a tailing pipe for the removal of oversized aggregate. The discharge point of the tailing pipe shall be located so that it will not create a hazard or nuisance. The screens shall produce aggregate in the proper bins, as required.

Efficiency of separation based on laboratory sieves, shall be such that no more than 20% of the material in the bin is smaller than neither the nominal size nor more than 10% over size for that bin.

- (k) **Hot aggregate bin.** The plant shall be equipped with a minimum of four (4) aggregate storage bins of sufficient capacity to supply the mixer when it is operating at full capacity. Bins shall be arranged to assure separate and adequate storage of appropriate fractions of the mineral aggregates. Separate dry storage shall be provided for mineral filler, and the plant shall be equipped to feed the material into the aggregate weigh hopper. Each bin shall be provided with overflow pipes, of such size and at such locations as to prevent backing up of material into other compartments or bins. Material from the overflow pipe shall not be returned to the hot elevator. Each compartment shall be provided with its individual outlet gate, constructed so that when the gate is closed, there shall be no leakage. Gates shall cut off quickly and completely. Bins shall be so constructed that samples can be readily obtained. A sampling device having the same width as the hot aggregate bin outlet gates shall be provided for this purpose. Hot aggregate bins shall not be modified in any manner nor shall divider plates be removed.
  - (l) **Temperature recording instrument.** The plant shall be equipped with either a recording pyrometer or a recording thermometer having at least two (2) terminals when a single dryer is used, and at least three (3) terminals when a dual dryer is used. The type and accuracy of the recording instrument shall be approved by the Engineer. Unless otherwise approved, one (1) terminal shall be installed at a suitable location at the discharge of each dryer and the others near the discharge gate in each bin compartment used for fine aggregate. The temperature recording instrument shall be capable of making accurate charts of the temperatures during the day's run. The recording instrument shall be installed at a point free from the dust and vibration of the plant. If this instrument is not located as to indicate clearly to the plant operator the temperature of the mineral aggregates at the discharge of each dryer, a non-recording pyrometer shall also be installed in view of the plant operator. At the end of each days run, the record sheet of the recording instrument shall be submitted to the Engineer.
- (3) **Dryer drum plants.** Dryer drum plants shall be according to the following.
- (a) **General.** General requirements shall be according to paragraph 402-4.2 a. (1) titled GENERAL, except a surge bin meeting the requirements of paragraph 402-4.2 a.(1)(d) titled SURGE BINS shall be utilized.

The heated aggregates, mineral filler, and asphalt binder shall be proportioned by electronic proportioning equipment and mixed to produce a homogenous mixture in which all particles of aggregate are coated uniformly. If a question as to the degree of coating should arise, AASHTO T 195 shall be used. If the Engineer ascertains that proper mixing is not being obtained, adjustments shall be made in the plant

operation (production rate, dryer drum slope, etc.) to assure that these conditions are met.

- (b) **Vibrating scalping screen.** The combined aggregates shall pass over a vibrating scalper that will remove all material and aggregate greater than the nominal top size gradation permitted by the specification for the mixture being produced, or as set by the Engineer, prior to the aggregates being placed on the weigh belt. The scalper shall be independent of other proportioning or weighing equipment.
- (c) **Aggregate weighing equipment.** The combined aggregates shall be weighed on continuous belt weighing devices meeting the requirements of the NIST Handbook #44. The weigh belts shall be self-aligning with a gravity belt takeup and rigid wind guards at the weighing section. Sun screens may be required by the Engineer at the weighing section. Means shall be provided to divert the aggregate into a truck, after passing over the weigh belt scales.
- (d) **Mineral filler system.** Mineral filler shall be proportioned to the mixing zone of the asphalt plant by a variable speed vane feeder and storage system or other systems approved by the Engineer. Means must be provided to divert material from the proportioning unit for purposes of calibration. The feeder shall be provided with an automatic cutoff system in the event the feeder is blocked or is devoid of material.
- (e) **Asphalt binder system.** The asphalt binder system shall consist of a temperature compensating meter and pump. Other asphalt binder systems may be used if approved by the Engineer. The pump and meter shall be installed as close to the asphalt binder storage tanks as possible using rigid pipe with a minimum of piping length and bends. The diameter of the pipe shall be consistent throughout the system. Means shall be provided to automatically stop the plant in the event asphalt binder ceases to flow through the meter.
- (f) **Dryer drum mixer.** Dryer drum mixer components shall have a minimum capacity of 60 tons per hour of asphalt. The units shall have a recording pyrometer or thermometer that records the discharge temperature of the mixture.
  - 1. **Single unit dryer drum mixers.** The single unit dryer drum mixer shall be a revolving cylindrical drum capable of heating, drying, and mixing the combined aggregates, mineral filler when required, and asphalt binder to produce a uniformly coated, homogenous asphalt meeting all applicable specifications. The dryer burner shall be equipped with automatic controls.
  - 2. **Dual unit dryer drum mixers.** The dryer portion of the dual unit dryer drum mixer shall be a revolving cylindrical drum capable of heating and drying the combined aggregates to the required specifications. The mixer portion of the dual unit dryer drum mixer shall be either a revolving cylindrical drum or a continuous twin shaft pugmill with a compatible mixing capacity to the dryer production rating. The unit shall be capable of mixing the heated and dried combined aggregates, mineral filler when required, and asphalt binder to produce a uniformly coated, homogenous asphalt meeting all applicable specifications.
- (g) **Secondary dust collector.** The collected baghouse dust shall be returned to the dryer at a uniform rate at a point where the asphalt binder is added to the mixing zone of the asphalt plant.

If positive dust control equipment (PDCE) is required, it shall consist of a system that is an integral part of the production process. The system shall accurately weigh all of the secondary dust collected in the baghouse, transfer the material to a storage silo, accurately weigh the required amount of fines to be returned from the storage silo, and transfer them back to the mixture. The PDCE weighing devices shall have an accuracy of 0.5% of the actual weight of the material. The system

shall be capable of automatically monitoring the dust collection process and adjusting the amount of asphalt binder added to the mixture. The entire system shall be interlocked with the plant controls to respond to production rate changes, start up, and shut down situations. The weighing process shall be displayed and recorded in 0.1 units. The PDCE shall be capable of accurately wasting dust without having any adverse effects on the mixture.

**(h) Proportioning control systems.**

1. **Aggregate feed control.** Each feeder shall have an adjustable feed control, which can be locked, with a master control that will automatically increase or decrease the production rate of each feeder proportionately when the total rate of production is changed. The revolutions per minute, tons per hour, etc. of all feeders shall be measured at the tail shaft of the feeder. The aggregate feeders shall have an accuracy of  $\pm 1.0\%$  of the actual quantity of material incorporated.
2. **Aggregate weighing.** The main proportioning weigh belt shall be electronically interfaced with the asphalt binder and mineral filler system to proportion the required amount of each material simultaneously to the mixer. The aggregate weighing systems shall have an accuracy of  $\pm 0.5\%$  of the actual material weighed by the belts. The weighing system shall also have a high-low adjustable tolerance indicator that will signal the operator audibly when the actual production rate differs from the preset rate by more than 3.0%.
3. **Mineral filler control.** Mineral filler shall be added to the mixer by a variable speed proportioning system interfaced with the aggregate weigh belt that will indicate total dry aggregate combined (aggregates + mineral filler) weight to the asphalt proportioning system. The mineral filler system shall have an accuracy of  $\pm 0.5\%$  if the mineral filler is measured by weight, or  $\pm 8.0\%$  if the mineral filler is measured solely by volume of the actual material measured by the system. The mineral filler shall be added in the mixer at the same point the asphalt binder is added such that no mineral filler is lost as fugitive dust. Other systems will be permitted if approved by the Engineer.
4. **Asphalt binder control.** The required quantity of asphalt binder shall be proportioned to the mixer via a temperature compensating meter that will correct the quantity of asphalt binder to 60°F, or a system approved by the Engineer. This system shall be electronically interfaced with the combined dry aggregates and mineral filler. The meter shall have an accuracy of  $\pm 0.4\%$  of the actual material metered.
5. **Aggregate moisture compensators.** The moisture compensation devices shall be capable of electronically converting the wet aggregate weight to dry aggregate weight. Other systems will be permitted if approved by the Engineer.

**(i) Control console.** The following items shall be part of the operator's control console.

1. **Aggregate feed controls.** The variable speed controls, both total and proportional for each feeder and combined aggregates shall be indexed in units with a minimum unit of 0.1. The rate in revolutions per minute, tons per hour, etc. shall be displayed by a digital readout for each feeder with a minimum unit of 0.1 revolutions per minute or one (1) ton per hour, etc.
2. **Aggregate weight indicator.** The accumulated wet weight of material in tons that passes over each weigh belt shall be available at the control console with a minimum unit of 0.1 ton. The dry weight of material, in tons per hour, passing over each weigh belt shall be displayed by digital readouts with a minimum unit of one (1) ton per hour.

3. **Mineral filler control.** Mineral filler shall be controlled by a variable speed control with a minimum unit of 0.1 and shall be displayed in revolutions per minute, tons per hour, etc. with a minimum unit of 0.1 revolutions per minute or 0.1 tons per hour, etc.
  4. **Asphalt binder control.** The asphalt binder control shall be capable of presetting the actual asphalt binder content directly as a percent of the total weight of mixture with a minimum unit of 0.1%. The asphalt binder rate shall be displayed to a minimum unit of 0.1. A control shall be provided to set the specific gravity or weight per gallon of the asphalt binder. The temperature of the asphalt binder shall be recorded by a recording pyrometer or thermometer at the console.
  5. **Aggregate moisture compensators.** The compensators shall be part of the operator's console and shall have a minimum unit of 0.1%. The control shall be lockable if the moisture setting is not printed as part of the record.
  6. **Asphalt temperature.** The temperature of the mixture shall be recorded in degrees Fahrenheit by a recording pyrometer or thermometer at the console.
- (j) **Recording of proportions.** The plant shall be equipped with a digital printer that will automatically print the following data at six (6) minute intervals during production time and on demand. All readings shall show the date, month and year, and time to the nearest minute for each print.
1. Accumulated dry aggregate in tons to the nearest 0.1 ton.
  2. Accumulated mineral filler in revolutions, tons, etc., to the nearest 0.1 unit.
  3. Accumulated asphalt binder in gallons, tons, etc., to the nearest 0.1 unit.
  4. Aggregate moisture compensators in percent as set at the panel. Required when accumulated dry aggregate is printed in wet aggregate weight.

Another system approved by the Engineer, such as a fully computerized system, that will provide the control and documentation of the above equipment, will be permitted.

- b. **Hauling equipment.** Trucks used for hauling asphalt shall have tight, clean, smooth metal beds. To prevent the asphalt from sticking to the truck beds, the truck beds shall be lightly coated with a minimum amount of paraffin oil, lime solution, or other material approved by the Engineer. Petroleum products shall not be used for coating truck beds. Each truck shall have a suitable cover to protect the mixture from adverse weather. When necessary, to ensure that the mixture will be delivered to the site at the specified temperature, truck beds shall be insulated or heated, and covers shall be securely fastened.
- c. **Asphalt pavers.** Asphalt pavers shall be self-contained, power-propelled units equipped with augers, activated screed or a strike off assembly and be capable of being heated. The augers, activated screed or strike off assembly shall be adjustable either automatically or by adding additional sections so the paver will place, compact or strike off the asphalt to the full width being placed. All width extensions shall have the same placement features and equipment functions as provided on the main body of the paver. Pavers with extendible type screeds shall have a minimum ten (10) foot basic screed, except on projects with 7,500 square yards or less of asphalt. For these smaller projects, a minimum eight (8) foot basic screed will be permitted. Augers shall be extended as additional sections of screed are bolted on or automatically adjustable screeds are extended. The augers need not be extended when the screed extensions on each side of the machine are one (1) foot or less if the finished surface of the mat is uniform. Pavers used for shoulders and similar construction shall be capable of spreading and finishing asphalt in widths shown on the plans. The use of any machine obsolete in design or in poor mechanical condition will not be permitted.

The asphalt paver shall be equipped with a control system capable of automatically maintaining the specified screed grade and elevation. The device shall be effective in leveling depressions in the surface of the existing pavement, the leveling course and the binder course.

The automatic electronic grade control device shall be capable of controlling the elevation of the screed relative to either a preset grade control stringline or a grade reference device traveling on the adjacent pavement surface. The traveling grade reference device shall be not less than 30 feet in length.

The paver shall be equipped with a receiving hopper having sufficient capacity for a uniform spreading operation. The hopper shall be equipped with a distribution system to uniformly place a non-segregated mixture in front of the screed. The distribution system shall have chain curtains, deflector plates, and/or other devices designed and built by the paver manufacturer to prevent segregation during distribution of the mixture from the hopper to the paver screed. The Contractor shall submit a written certification that the devices recommended by the paver manufacturer to prevent segregation have been installed and are operational. Prior to paving, the Contractor, in the presence of the Engineer, shall visually inspect paver parts specifically identified by the manufacturer's check list for excessive wear and the need for replacement. The Contractor shall supply the completed check list to the Engineer noting the condition of the parts. Worn parts shall be replaced. The Engineer may require an additional inspection prior to placement of the surface course or at other times throughout the work.

The screed or strike-off assembly shall effectively produce a finished surface of the required smoothness and texture without tearing, shoving, or gouging the mixture. If the spreading and finishing equipment in use leaves tracks or indented areas or produces other blemishes in the pavement that are not satisfactorily corrected by the scheduled operations, the use of such equipment shall be discontinued.

The paver shall be capable of paving to a minimum width specified in the contract documents.

The paver shall be capable of operating at forward speeds consistent with satisfactory placement of the mixture.

A straightedge at least four (4) feet in length and equipped with a carpenter's level shall be available at the spreading and finishing machine to check the surface of the asphalt for transverse slope and longitudinal surface variations.

- d. **Rollers.** The number, type, and weight of rollers shall be sufficient to compact the asphalt without detrimentally affecting the material. Rollers shall be steel wheel. Split drum rollers are not acceptable. They shall be in good condition, clean, capable of reversing without backlash, and of operating at slow speeds to avoid displacement of the asphalt. The wheels shall be equipped with adjustable scrapers and sprinkling apparatuses using a water-soluble asphalt release agent, approved by the engineer, to prevent the bituminous mixture from sticking to the wheels. All rollers shall be specifically designed and suitable for compacting asphalt concrete and shall be properly used. Rollers that impair the stability of any layer of a pavement structure or underlying soils shall not be used.

No roller shall be used that has in any way been thrown out of its original balance by the application of attachments not approved by the Engineer. All bearings shall be tight.

- (1) **Steel wheel rollers.** The roller shall be self-propelled and provide a smooth operation when starting, stopping, or reversing directions. The steering mechanism shall provide for positive control of the roller. Roller wheels shall be smooth and free from openings or projections which will mar the surface on which the roller is operated. Motor rollers shall be equipped with drip pans to contain oil, grease, or gasoline drips generated by the roller operation. The roller shall be provided with adjustable scrapers which shall be used when necessary to keep the surface of the wheels clean.

When used on a hot-mix asphalt surface, the roller shall be equipped with water tanks and sprinkling devices which shall be used to wet the wheels and prevent material pickup.

(a) **Tandem rollers.** The Contractor shall provide means for determining the weight of the roller as distributed on each axle. Ballast shall be included in determining the weight.

The rear wheel may be crowned at the rate of not more than 3/16 inch in 4-1/2 feet. The front wheel shall be divided into at least two (2) sections and shall show no noticeable crown. The weight of the roller shall meet requirements of the specific item of work being constructed.

(b) **Three-wheel rollers.** The rear wheels of three-wheel rollers may be crowned at the rate of not more than 1/16 inch in 20 inches and shall be propelled with a differential gear. The front wheel shall be divided into at least two (2) sections, shall show no noticeable crown, and shall overlap the compression area of each rear wheel by not less than 1-1/2 inch. The weight of the roller shall meet requirements of the specific item of work being constructed.

e. **Pavement surface test equipment.** Required surface testing and analysis equipment and their jobsite transportation shall be provided by the Contractor.

(1) **Straightedge.** The 16 foot or 12-foot straightedge shall consist of a metal I-beam mounted between two (2) wheels spaced 16 feet or 12 feet between the axles. Scratcher bolts, which can be easily and accurately adjusted, shall be set at the 1/4, 1/2, and 3/4 points between the axles. A handle suitable for pushing and guiding shall be attached to the straightedge.

(2) **Profile testing device.** The profile testing device shall have a decal displayed to indicate it has been tested through the Profile Equipment Verification (PEV) Program administered by the Department.

(a) **California profilograph.** The California Profilograph shall be either computerized or manual and have a frame 25 feet in length supported upon multiple wheels at either end. The profile shall be recorded from the vertical movement of a wheel attached to the frame at midpoint.

The California Profilograph shall be calibrated according to the manufacturer's recommendations and California Test 526. All calibration traces and calculations shall be submitted to the Engineer for the project file.

(b) **Inertial profiler.** The inertial profiler shall be either an independent device or a system that can be attached to another vehicle using one (1) or two (2) non-contact sensors to measure the pavement profile. The inertial profiler shall be capable of performing a simulation of the California Profilograph to provide results in the Profile Index format.

The inertial profiler shall be calibrated according to the manufacturer's recommendations. All calibration traces and calculations shall be submitted to the Engineer for the project file.

(c) **Trace analysis.** The Contractor shall reduce/evaluate these traces using a 0.00-inch blanking band and determine a Profile Index in inches per mile for each section of finished pavement surface. Traces produced using a computerized profile testing device will be evaluated without further reduction. When using a manual profile testing device, the Contractor shall provide an electronic scanner, a computer, and software to reduce the trace. All analysis equipment (electronic scanner, computerized recorder, etc.) shall be able to accept 0.00 inches for the blanking band.



All traces from pavement sections tested with the profile testing device shall be recorded on paper with scales of 300-to-1 longitudinally and 1-to-1 vertically. Equipment and software settings of the profile testing device and analysis equipment shall be set to those values approved through the PEV Program.

The Engineer may retest the pavement at any time to verify the accuracy of the equipment.

**402-4.3 Aggregate stockpile management.** Aggregate stockpiles shall be constructed in a manner that prevents segregation and intermixing of deleterious materials. Aggregates from different sources shall be stockpiled, weighed and batched separately at the asphalt batch plant. Aggregates that have become segregated or mixed with earth or foreign material shall not be used.

A continuous supply of materials shall be provided to the work to ensure continuous placement.

**402-4.4 Preparation of asphalt binder.** The asphalt binder shall be heated in a manner that will avoid local overheating and provide a continuous supply of the asphalt binder to the mixer at a uniform temperature. The temperature of unmodified asphalt binder delivered to the mixer shall be sufficient to provide a suitable viscosity for adequate coating of the aggregate particles but shall not exceed 325°F when added to the aggregate. The temperature of modified asphalt binder shall be no more than 350°F when added to the aggregate.

**402-4.5 Preparation of mineral aggregate.** The aggregate for the asphalt shall be heated and dried. The temperature of the aggregate and mineral filler shall not exceed 350°F when the asphalt binder is added. Particular care shall be taken so that aggregates high in calcium or magnesium content are not damaged by overheating. The temperature shall not be lower than is required to obtain complete coating and uniform distribution on the aggregate particles and to provide a mixture of satisfactory workability.

**402-4.6 Preparation of asphalt mixture.** The aggregates and the asphalt binder shall be weighed or metered and mixed in the amount specified by the JMF. The combined materials shall be mixed until the aggregate obtains a uniform coating of asphalt binder and is thoroughly distributed throughout the mixture. Wet mixing time shall be the shortest time that will produce a satisfactory mixture, but not less than 25 seconds for batch plants. The wet mixing time for all plants shall be established by the Contractor, based on the procedure for determining the percentage of coated particles described in AASHTO T 195, for each individual plant and for each type of aggregate used. The wet mixing time will be set to achieve 95% of coated particles. For continuous mix plants, the minimum mixing time shall be determined by dividing the weight of its contents at operating level by the weight of the mixture delivered per second by the mixer. The moisture content of all asphalt upon discharge shall not exceed 0.5%.

For batch plants, wet mixing time begins with the introduction of asphalt binder into the mixer and ends with the opening of the mixer discharge gate. Mixing time should be the shortest time required to obtain uniform distribution of aggregate sizes and thorough coating of aggregate particles with asphalt binder.

**402-4.7 Application of tack coat.** Immediately before placing the asphalt mixture, the underlying course shall be cleaned of all dust and debris. A tack coat shall be applied in accordance with Item 603 titled EMULSIFIED ASPHALT TACK COAT to all vertical and horizontal asphalt and concrete surfaces prior to placement of the first and each subsequent lift of asphalt mixture.

**402-4.8 Laydown plan, transporting, placing, and finishing.** Prior to the placement of the asphalt, the Contractor shall prepare a laydown plan with the sequence of paving lanes and width to minimize the number of cold joints; the location of any temporary ramps; laydown temperature; and estimated time of completion for each portion of the work (milling, paving, rolling, cooling, etc.). The laydown plan and any modifications shall be approved by the Engineer.

The mixture shall be deposited from haul units directly into the laydown machine hopper and placed in a continuous operation.

Deliveries shall be scheduled so that placing and compacting of asphalt is uniform with minimum stopping and starting of the paver. Hauling over freshly placed material shall not be permitted until the material has been compacted, as specified, and allowed to cool to approximately ambient temperature. The Contractor, at their expense, shall be responsible for repair of any damage to the pavement caused by hauling operations.

Edges of existing asphalt pavement abutting the new work shall be saw cut and the cut off material and laitance removed. Apply a tack coat in accordance with Item 603 titled EMULSIFIED ASPHALT TACK COAT before new asphalt material is placed against it.

The speed of the paver shall be regulated to eliminate pulling and tearing of the asphalt mat. The paver speed shall be mated with the required roller speed and shall not exceed that which coincides with the average rate of delivery of asphalt to the paver to provide, as nearly as possible, continuous operation of the paver. In no case shall the speed of the paver exceed 50 feet per minute

Placement of the asphalt mix shall begin along the centerline of a crowned section or on the high side of areas with a one-way slope unless shown otherwise on the laydown plan as accepted by the Engineer. The asphalt mix shall be placed in consecutive adjacent lanes having a minimum width as specified in the contract documents. Additional screed sections attached to widen the paver to meet the minimum lane width requirements must include additional auger sections to move the asphalt mixture uniformly along the screed extension.

The longitudinal joint in one (1) course shall offset the longitudinal joint in the course immediately below by at least one (1) foot; however, the joint in the surface top course shall be at the centerline of crowned pavements. Transverse joints in one (1) course shall be offset by at least ten (10) feet from transverse joints in the previous course. Transverse joints in adjacent lanes shall be offset a minimum of ten (10) feet. On areas where irregularities or unavoidable obstacles make the use of mechanical spreading and finishing equipment impractical, the asphalt may be spread and luted by hand tools.

The Resident Engineer may at any time, reject any batch of asphalt, on the truck or placed in the mat, which is rendered unfit for use due to contamination, segregation, incomplete coating of aggregate, or overheated asphalt mixture. Such rejection may be based on only visual inspection or temperature measurements. In the event of such rejection, the Contractor may take a representative sample of the rejected material in the presence of the Resident Engineer, and if it can be demonstrated in the laboratory, in the presence of the Resident Engineer, that such material was erroneously rejected, payment will be made for the material at the contract unit price.

Paving operations shall be conducted in a manner to prevent medium or high segregation. Plant operations, hauling of the mix, paver operations, and the compacted mat shall be continually monitored for segregation. Areas of segregation in the surface course, as determined by the Resident Engineer, shall be removed and replaced at the Contractor's expense. The area shall be removed by saw cutting and milling a minimum of the construction lift thickness as specified for the approved mix design. The area to be removed and replaced shall be a minimum width of the paver and a minimum of ten (10) feet long.

**402-4.9 Compaction of the asphalt mixture.** After spreading, rolling shall be done immediately. Two (2) or four (4) passes, at the discretion of the Engineer, with a steel wheel roller weighing no more than ten (10) tons, shall be made for compaction. Care should be taken to avoid over rolling or rolling when material is too cool. To prevent adhesion of the mixture to the roller, the wheels shall be kept properly moistened using a water-soluble asphalt release agent approved by the engineer. Rolling operations shall be conducted in such a manner that shoving or distortion will not develop. The amount of rolling shall be limited to only that necessary for compacting the porous friction course and bonding it to the underlying surface course. Any mixture, which becomes loose, broken, mixed with dirt, or in any way defective, shall be removed and replaced with fresh mixture and immediately compacted to conform to the surrounding area. Such rework shall be done at the Contractor's expense. Spreading of the mixture shall be done

carefully with particular attention given to making the operation as continuous as possible. Hand working shall be kept to an absolute minimum.

**402-4.10 Joints.** The formation of all joints shall be made to ensure a continuous bond between the courses. All joints shall present the same texture as other sections of the course and meet the requirements for smoothness and grade.

The roller shall not pass over the unprotected end of the freshly laid asphalt except when necessary to form a transverse joint. When necessary to form a transverse joint, it shall be made by means of placing a bulkhead or by tapering the course. The tapered edge shall be cut back to its full depth and width on a straight line to expose vertical face prior to placing the adjacent lane. In both methods, all contact surfaces shall be coated an asphalt tack coat before placing any fresh asphalt against the joint.

Longitudinal joints which have been left exposed for more than four (4) hours; the surface temperature has cooled to less than 175°F; or are irregular, damaged, uncompacted, or otherwise defective shall be cut back with a cutting wheel or pavement saw a maximum of three (3) inches to expose a clean, sound, uniform vertical surface for the full depth of the course. All cutback material and any laitance produced from cutting joints shall be removed from the project. Asphalt tack coat in accordance with Item 603 titled EMULSIFIED ASPHALT TACK COAT shall be applied to the clean, dry joint prior to placing any additional fresh asphalt against the joint. The cost of this work shall be considered incidental to the cost of the asphalt.

The Contractor may provide additional joint density QC by use of joint heaters at the Contractor's expense. Electrically powered infrared heating equipment should consist of one (1) or more low-level radiant energy heaters to uniformly heat and soften the pavement joints. The heaters should be configured to uniformly heat an area up to 18 inches in width and three (3) inches in depth. Infrared equipment shall be thermostatically controlled to provide a uniform, consistent temperature increase throughout the layer being heated up to a maximum temperature range of 200°F to 300°F.

Propane powered infrared heating equipment shall be attached to the paving machine and the output of infrared energy shall be in the one (1) to six (6) micron range. Converters shall be arranged end to end directly over the joint to be heated in sufficient numbers to continuously produce, when in operation, a minimum of 240,000 BTU per hour. The joint heater shall be positioned not more than 1 in above the pavement to be heated and in front of the paver screed and shall be fully adjustable. Heaters will be required to be in operation at all times.

The heaters shall be operated so they do not produce excessive heat when the units pass over new or previously paved material.

**402-4.11 Nighttime paving requirements.** The Contractor shall provide adequate lighting during any nighttime construction. A lighting plan must be submitted by the Contractor and approved by the Engineer prior to the start of any nighttime work. All work shall be in accordance with the approved construction safety and phasing plan and lighting plan.

**402-4.12 Protection of pavement.** After final rolling, no vehicular traffic of any kind shall be permitted on the pavement until it has cured at least 12 hours or unless otherwise authorized by the Engineer. Newly constructed pavement areas shall not be opened to aircraft traffic until 24 hours after completion or unless otherwise authorized by the Engineer

### CONTRACTOR QUALITY CONTROL (QC)

**402-5.1 General.** The Contractor shall develop a Contractor Quality Control Program (CQCP) in accordance with Item 100 titled CONTRACTOR QUALITY CONTROL PROGRAM (CQCP). No partial payment will be made for materials without an approved CQCP.

**402-5.2 Contractor quality control (QC) facilities.** The Contractor shall provide or contract for testing facilities in accordance with Item 100 titled CONTRACTOR QUALITY CONTROL PROGRAM

(CQCP). The Engineer shall be permitted unrestricted access to inspect the Contractor's QC facilities and witness QC activities. The Engineer will advise the Contractor in writing of any noted deficiencies concerning the QC facility, equipment, supplies, or testing personnel and procedures. When the deficiencies are serious enough to be adversely affecting the test results, the incorporation of the materials into the work shall be suspended immediately and will not be permitted to resume until the deficiencies are satisfactorily corrected.

**402-5.3 Contractor QC testing.** The Contractor shall perform all QC tests necessary to control the production and construction processes applicable to these specifications and as set forth in the approved CQCP. The testing program shall include, but not necessarily be limited to, tests for the control of asphalt content, aggregate gradation, temperatures, aggregate moisture, field compaction, and surface smoothness. A QC Testing Plan shall be developed as part of the CQCP.

- a. **Asphalt content.** A minimum of two (2) tests shall be performed per day in accordance with AASHTO T 308 or AASHTO T 164 for determination of asphalt content. When using AASHTO T 308, the correction factor shall be determined as part of the first test performed at the beginning of plant production; and as part of every tenth test performed thereafter. The asphalt content for the day will be determined by averaging the test results.
- b. **Gradation.** Aggregate gradations shall be determined a minimum of twice per day from mechanical analysis of extracted aggregate in accordance with the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 11-08, *Aggregate Gradation Control System (AGCS)*.
- c. **Moisture content of aggregate.** The moisture content of aggregate used for production shall be determined a minimum of once per day in accordance with AASHTO T 255.
- d. **Moisture content of asphalt.** The moisture content shall be determined once per day in accordance with AASHTO T 329.
- e. **Temperatures.** Temperatures shall be checked, at least four (4) times per day, at necessary locations to determine the temperatures of the dryer, the asphalt binder in the storage tank, the asphalt at the plant, and the asphalt at the job site.
- f. **Smoothness for contractor quality control.** The Contractor shall perform smoothness testing in transverse and longitudinal directions daily to verify that the construction processes are producing pavement with variances less than one-quarter (1/4) inch in 16 feet, identifying areas that may pond water which could lead to hydroplaning of aircraft. If the smoothness criterion is not met, appropriate changes and corrections to the construction process shall be made by the Contractor before construction continues

The Contractor may use a 16 or 12-foot straightedge or a profile testing device approved by the Engineer. Straight-edge testing shall start with one-half (1/2) the length of the straightedge at the edge of pavement section being tested and then moved ahead one-half (1/2) the length of the straightedge for each successive measurement. Testing shall be continuous across all joints. The surface irregularity shall be determined by placing the freestanding (unleveled) straightedge on the pavement surface and allowing it to rest upon the two (2) highest spots covered by its length, and measuring the maximum gap between the straightedge and the pavement surface in the area between the two (2) high points. If an external reference device is used, the data may be evaluated using the FAA profile program, ProFAA, or FHWA ProVal, using the 12-foot straightedge simulation function.

Smoothness readings shall not be made across grade changes or cross slope transitions. The transition between new and existing pavement shall be evaluated separately for conformance with the contract documents.

- (1) **Transverse measurements.** Transverse measurements shall be taken for each day's production placed. Transverse measurements shall be taken perpendicular to the pavement centerline each 50 feet or more often as determined by the Resident

Engineer. The joint between lanes shall be tested separately to facilitate smoothness between lanes.

- (2) Longitudinal measurements.** Longitudinal measurements shall be taken for each day's production placed. Longitudinal tests shall be parallel to the centerline of paving; at the center of paving lanes when widths of paving lanes are less than 20 feet; and at the third points of paving lanes when widths of paving lanes are 20 feet or greater.

Deviations on the final surface course in either the transverse or longitudinal direction that will trap water greater than one-quarter (1/4) inch shall be removed and replaced with new material at the Contractor's expense.

- g. Grade.** Grade shall be evaluated daily to allow adjustments to paving operations when grade measurements do not meet specifications. As a minimum, grade shall be evaluated prior to and after the placement of the first lift and after placement of the surface lift.

Measurements will be taken at appropriate grade lines (as a minimum at center and edges of paving lane) and longitudinal spacing as shown on cross-sections and plans. The final surface of the pavement will not vary from the grade line elevations and cross-sections specified in the contract documents by more than 0.05 feet vertically and 0.1 feet laterally. The documentation will be provided by the Contractor to the Resident Engineer by the end of the following working day.

Areas with humps or depressions that exceed grade or smoothness criteria and that retain water on the surface shall be removed and replaced with new material at the Contractors expense. Skin patching or hand working shall not be permitted.

- 402-5.4 Sampling.** When directed by the Resident Engineer, the Contractor shall sample and test any material that appears inconsistent with similar material being sampled, unless such material is voluntarily removed and replaced, or deficiencies corrected by the Contractor. All sampling shall be in accordance with standard procedures specified.

- 402-5.6 QC reports.** The Contractor shall maintain records and shall submit reports of QC activities daily in accordance with Item 100 titled CONTRACTOR QUALITY CONTROL PROGRAM (CQCP).

### MATERIAL ACCEPTANCE

- 402-6.1 Acceptance sampling and testing.** Unless otherwise specified, all acceptance sampling and testing necessary to determine conformance with the requirements specified in this section will be performed by the Resident Engineer at no cost to the Contractor except that coring as required in this section shall be completed and paid for by the Contractor.

- a. Quality assurance (QA) testing laboratory.** The QA testing laboratory performing these acceptance tests will be accredited in accordance with the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 6-08, *Minimum Private Laboratory Requirements for Construction Materials Testing or Mix Design*.
- b. Lot size.** A standard lot will consist of one (1) day's production not to exceed 2,000 tons. Where more than one (1) plant is simultaneously producing asphalt for the job, the lot sizes will apply separately for each plant.
- c. Sampling.** Random sampling locations will be determined by the Resident Engineer. Samples shall be taken from material deposited into trucks at the plant or at the job site in accordance with ASTM D979. The sample of asphalt may be put in a covered metal tin and placed in an oven for not less than 30 minutes nor more than 60 minutes to maintain the material at or above the compaction temperature as specified in the JMF. Samples shall be tested to control uniformity in asphalt content and gradation.

- (1) **Asphalt content.** Asphalt content will be determined a minimum once per lot in accordance with AASHTO T 308 or AASHTO T 164.
- (2) **Gradation.** Aggregate gradations will be determined a minimum of once per lot from mechanical analysis of extracted aggregate in accordance with the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 11-08, *Aggregate Gradation Control System (AGCS)*.
- (3) **Pavement thickness.** One (1) core will be taken by the Contractor for each lot in the presence of the Resident Engineer. Random sampling locations will be determined by the Resident Engineer.

The Contractor will cut minimum five (5) inches diameter samples in accordance with AASHTO R 67. The Contractor shall furnish all tools, labor, and materials for cleaning, and filling the cored pavement. Laitance produced by the coring operation shall be removed immediately after coring, and core holes shall be filled within one (1) day after sampling in a manner acceptable to the Resident Engineer.

#### 402-6.2 Acceptance criteria.

- a. **General.** Acceptance will be based on the implementation of the Contractor Quality Control Program (CQCP) and the following characteristics of the completed pavements:
  - (1) Asphalt content
  - (2) Gradation
  - (3) Thickness
  - (4) Grade
  - (5) Profilograph smoothness
    - (a) Profilograph smoothness and acceptance only apply when the overall project is a new or reconstructed runway or taxiway greater than 500 feet in length. Profilograph roughness is not applicable to aprons and should be used with caution on projects to rehabilitate runways and/or taxiways unless the project includes provisions to correct existing deficiencies.
- b. **Asphalt content.** The asphalt content will be determined by averaging the test results. Should the average asphalt content for any two (2) consecutive lots not fall within job mix tolerances, the Contractor shall cease production until such out-of-tolerance conditions have been remedied. Any material placed after the Contractor has been informed of two (2) consecutive failing tests, shall be rejected and removed at the Contractor's expense.
- c. **Gradation.** If any two (2) consecutive lots fail to meet the tolerances of the job mix formula gradation, the Contractor shall cease plant production until such out-of-tolerance conditions have been remedied. Any material placed after the Contractor has been informed of two (2) consecutive failing tests, shall be rejected and removed at the Contractor's expense.
- d. **Thickness.** When the measurement of any core is more than the maximum or less than the minimum allowable thickness, as shown in the table below, additional cores shall be taken at 20 foot intervals, parallel to and at right angles to the runway centerline until the completed PFC is within such maximum or minimum thickness for the lot being tested.

#### Allowable Finished PFC Thickness

	Nominal	Maximum	Minimum
	in	in	in
3/4 inch aggregate	1.0	1.50	0.75
1/2 inch aggregate	0.75	1.25	0.50

- e. Grade.** The final finished surface of the pavement of the completed project shall be surveyed to verify that the grade elevations and cross-sections specified in the contract documents do not deviate more than 0.05 feet vertically or 0.1 feet laterally.

Cross-sections of the pavement shall be taken at a minimum 50 foot longitudinal spacing and at all longitudinal grade breaks. Minimum cross-section grade points shall include grade at centerline,  $\pm 10$  feet of centerline, and edge of pavement.

The survey and documentation shall be stamped and signed by a professional licensed surveyor. Payment for sublots that do not meet grade for over 25% of the lot shall be reduced by 5% and not be more than 95%.

- f. Profilograph smoothness for QA acceptance.** The final profilograph shall be the full length of the project to facilitate testing of roughness between lots. The Contractor, in the presence of the Resident Engineer shall perform a profilograph smoothness test on the completed project with a profilograph as specified in paragraph 402-4.2 titled EQUIPMENT. Data and results shall be provided within 48 hours of profilograph smoothness tests.

The pavement shall have an average profile index less than 15 inches per mile per one-tenth (1/10) mile. The equipment shall utilize electronic recording and automatic computerized reduction of data to indicate "must grind" bumps and the Profile Index for the pavement using a 0.2-inch blanking band. The bump template must span one (1) inch with an offset of 0.4 inches. The profilograph must be calibrated prior to use and certified through the Profile Equipment Verification (PEV) Program administered by the Department. Profilograms shall be recorded on a longitudinal scale of one (1) inch equals 25 feet and a vertical scale of one (1) inch equals one (1) inch. Profilograph shall be performed one (1) foot right and left of project centerline and 15 feet right and left of project centerline. Any areas that indicate "must grind" shall be corrected with diamond grinding or by removing and replacing full depth of surface course, as directed by the Engineer. Where corrections are necessary, a second profilograph run shall be performed to verify that the corrections produced an average profile index of 15 inches per mile per one-tenth (1/10) mile or less.

#### METHOD OF MEASUREMENT

- 402-7.1** The quantity of porous friction course shall be measured for payment by the number of square yards of pavement as specified, completed and accepted by the Resident Engineer.

#### BASIS OF PAYMENT

- 402-8.1** Payment for accepted quantities of work performed by the Contractor and measured by the Resident Engineer shall be made at the contract unit as specified in paragraph 402-7.1 of this section. Payment shall be full compensation for furnishing all materials; for all preparation and storage of materials; for cleaning the existing surface; for mixing, hauling, placing, and compacting the mixture (including initial test section); and for all tools, equipment, and incidentals necessary to complete each item. No separate payment is included in the contract for furnishing and batching mineral filler, or anti-stripping agents, should such items be required.

Rehabilitation of the existing pavement surface and the tack coat shall be measured and paid for at their respective contract prices.

- a. Adjusted payment for thickness.** Out-of-tolerance areas shall be deducted from the total quantity for payment. If, in the Engineer's judgment, such out of tolerance areas warrant removal, the PFC shall be removed and the underlying course shall be cleaned, at the Contractor's expense.
- b. Adjusted payment for grade.** Payment for lots which do not meet grade for over 25% of the subplot shall be reduced by 5% and not be more than 95%.

- c. Profilograph smoothness.** The Contractor will receive full payment when the profilograph average profile index is in accordance with the contract documents. When the final average profile index for the entire length of pavement does not exceed 15 inches per mile per one-tenth (1/10) mile, payment will be made at the contract unit price for the completed pavement.

### REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

#### **ASTM International (ASTM)**

ASTM D 979	Sampling Bituminous Paving Mixtures
ASTM D 995	Mixing Plants for Hot-Mixed Hot-Laid Bituminous Paving Mixtures

#### **American Association of State Highway and Transportation Officials (AASHTO)**

AASHTO M 320	Standard Specification for Performance-Graded Asphalt Binder
AASHTO R 67	Standard Practice for Sampling Asphalt Mixtures after Compaction (Obtaining Cores)
AASHTO T 88	Standard Method of Test for Particle Size Analysis of Soils
AASHTO T 90	Standard Method of Test for Determining the Plastic Limit and Plasticity Index of Soils
AASHTO T 164	Standard Method of Test for Quantitative Extraction of Asphalt Binder from Hot-Mix Asphalt (HMA)
AASHTO T 195	Standard Method of Test for Determining Degree of Particle Coating of Bituminous-Aggregate Mixtures
AASHTO T 255	Standard Method of Test for Total Evaporable Moisture Content of Aggregate by Drying
AASHTO T 308	Standard Method of Test for Determining the Asphalt Binder Content of Hot Mix Asphalt (HMA) by the Ignition Method
AASHTO T 329	Standard Method of Test for Moisture Content of Asphalt Mixtures by Oven Method

#### **Illinois Department of Transportation, Bureau of Materials Illinois Laboratory Test Procedure (ITP)**

##### *Manual of Test Procedures for Materials*

AASHTO T 11	Illinois Modified, Standard Method of Test for Materials Finer Than 75- $\mu$ m (No. 200) Sieve in Mineral Aggregates by Washing
ITP 19	Bulk Density ("Unit Weight") and Voids in Aggregate

##### *Manual of Aggregate Quality Test Procedures*

ITP 21	Organic Impurities in Fine Aggregates for Concrete
ITP 71	Effect of Organic Impurities in Fine Aggregate on Strength of Mortar
AASHTO T 96	Illinois Modified, Standard Method of Test for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine



AASHTO T 104	Illinois Modified, Standard Method of Test for Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate
ITP 113	Lightweight Pieces in Aggregate
ITP 203	Deleterious Particles in Coarse Aggregate
ITP 204	Deleterious Particles in Fine Aggregate

**Illinois Department of Transportation, Bureau of Materials Policy Memoranda (PM)**

PM 1-08	Performance Graded Asphalt Binder Acceptance Procedure
PM 4-08	Approval of Hot-Mix Asphalt Plants and Equipment
PM 6-08	Minimum Private Laboratory Requirement for Construction Materials Testing or Mix Design
PM 11-08	Aggregate Gradation Control System (AGCS)
PM 12-08	Crushed Gravel Producer Self-Testing Program
PM 13-08	Slag Producer Self-Testing Program

**Illinois Department of Transportation, Bureau of Materials Qualified Product List**

Certified Sources for Performance Graded Asphalt Binder

**Illinois Department of Transportation, Aeronautics Policy Memoranda (PM)**

PM 96-3	Requirements for Quality Assurance on Projects With Bituminous Concrete Paving
PM 2011-1	Requirements for Laboratory, Testing, Quality Control, and Paving of Porous Friction Course
PM	HMA Comparison Samples

**END OF ITEM 402**

## Item 403 Asphalt Mix Pavement Base Course

### DESCRIPTION

- 403-1.1** This item shall consist of pavement courses composed of mineral aggregate and asphalt binder mixed in a central mixing plant and placed on a prepared course as specified in the contract documents. Each course shall be constructed to the depth, typical section, and elevation required by the plans and shall be rolled, finished, and approved before the placement of the next course.

### MATERIALS

- 403-2.1 Aggregate.** Aggregates shall consist of crushed stone, crushed gravel, crushed slag, screenings, natural sand and mineral filler, as required. The aggregates should have no known history of detrimental pavement staining due to ferrous sulfides, such as pyrite. Coarse aggregate is the material retained on the No. 4 sieve. Fine aggregate is the material passing the No. 4 sieve.

- a. Coarse aggregate.** Coarse aggregate shall consist of crushed stone, crushed gravel, or crushed slag and shall be clean, sound, tough, durable particles, free from films of matter that would prevent thorough coating and bonding with the asphalt material and free from organic matter and other deleterious substances.

- (1) Description.** The natural and manufactured materials used as coarse aggregate are defined as follows.

- (a) Gravel.** Gravel shall be the coarse granular material resulting from the reduction of rock by the action of the elements and having subangular to rounded surfaces. It may be partially crushed.

- (b) Crushed gravel.** Crushed gravel shall be the product resulting from crushing, by mechanical means, and shall consist entirely of particles obtained by crushing gravel. The acceptance and use of crushed gravel shall be according to the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 12-08, *Crushed Gravel Producer Self-Testing Program*.

- (c) Crushed stone.** Crushed stone shall be the angular fragments resulting from crushing undisturbed, consolidated deposits of rock by mechanical means. Crushed stone shall be divided into the following, when specified.

- 1. Carbonate crushed stone.** Carbonate crushed stone shall be either dolomite or limestone. Dolomite shall contain 11.0% or more magnesium oxide (MgO). Limestone shall contain less than 11.0% magnesium oxide (MgO).

- 2. Crystalline crushed stone.** Crystalline crushed stone shall be either metamorphic or igneous stone, including but is not limited to, quartzite, granite, rhyolite and diabase.

- (d) Crushed slag.** Crushed slag shall be the graded product resulting from the processing of air-cooled blast furnace slag. Air-cooled blast furnace slag shall be the nonmetallic product, consisting essentially of silicates and alumino-silicates of lime and other bases, which is developed in a molten condition simultaneously with iron in a blast furnace. It shall be air-cooled and shall have a compact weight (ITP 19) of not less than 70 pounds per cubic foot. The acceptance and use of air-cooled

blast furnace slag shall be according to the current Illinois Department of Transportation, Bureau of Materials Policy Memoranda (PM) 12-08, *Crushed Gravel Producer Self-Testing Program* and 13-08, *Slag Producer Self-Testing Program*.

- (e) **Crushed sandstone.** Crushed sandstone shall be the angular fragments resulting from crushing, by mechanical means, a cemented sand composed predominantly of quartz grains. Sandstone shall have an Insoluble Residue of 50.0% or higher.
- (f) **Crushed concrete.** Crushed concrete shall be the angular fragments resulting from crushing Portland cement concrete by mechanical means. The acceptance and use of crushed concrete shall be according to Item 219 titled RECYCLED CONCRETE AGGREGATE BASE COURSE.
- (g) **Crushed steel slag.** Crushed steel slag shall be the graded product resulting from the processing of steel slag. Steel slag shall be the nonmetallic product which is developed in a molten condition simultaneously with steel in an open hearth, basic oxygen, or electric furnace. The acceptance and use of crushed steel slag shall be according to the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 13-08, *Slag Producer Self-Testing Program*.
- (2) **Quality.** The coarse aggregate shall be Class B Quality or better according to the quality standards listed in the following table.

### Coarse Aggregate Quality

Quality Test	Class
	B
Na <sub>2</sub> SO <sub>4</sub> Soundness 5 Cycle, Illinois Modified AASHTO T 104 <sup>1</sup> , % Loss max.	15
Los Angeles Abrasion, Illinois Modified AASHTO T 96, % Loss max.	40 <sup>2</sup>
Deleterious Materials <sup>3</sup>	
Shale, % max.	2.0
Clay Lumps, % max.	0.5
Coal & Lignite, % max.	---
Soft & Unsound Fragments, % max.	6.0
Other Deleterious, % max.	2.0
Total Deleterious, % max.	6.0

1. Does not apply to crushed concrete.
2. Does not apply to crushed slag or crushed steel slag.
3. Test shall be run according to ITP 203.

- b. **Fine aggregate.** Fine aggregate shall consist of sand, stone sand, chats, slag sand, or steel slag sand. For gradation FA 22, uncrushed material will not be permitted.
- (1) **Description.** The natural and manufactured materials used as fine aggregate are defined as follows.
- (a) **Sand.** Sand shall be the fine granular material resulting from the natural disintegration of rock. Sand produced from deposits simultaneously with, and by the same operations as, gravel coarse aggregate may contain crushed particles in the quantity resulting normally from the crushing and screening of oversize particles.
- (b) **Stone sand.** Stone sand shall be produced by washing, or processing by air separation, the fine material resulting from crushing rock quarried from undisturbed, consolidated deposits, or crushing gravel. The acceptance and use of crushed

gravel stone sand shall be according to the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 12-08, *Crushed Gravel Producer Self-Testing Program*.

- (c) **Chats.** Chats shall be the tailings resulting from the separation of metals from rocks in which they occur.
- (d) **Slag sand.** Slag sand shall be the graded product resulting from the screening of air-cooled blast furnace slag. Air-cooled blast furnace slag shall be the nonmetallic product, consisting essentially of silicates and alumino-silicates of lime and other bases, which is developed in a molten condition simultaneously with iron in a blast furnace.

The acceptance and use of air-cooled blast furnace slag sand shall be according to the current Illinois Department of Transportation, Bureau of Materials Policy Memoranda (PM) 12-08, *Crushed Gravel Producer Self-Testing Program* and 13-08, *Slag Producer Self-Testing Program*.

- (e) **Steel slag sand.** Steel slag sand shall be the graded product resulting from the screening of crushed steel slag. Crushed steel slag shall be the nonmetallic product which is developed in a molten condition simultaneously with steel in an open hearth, basic oxygen, or electric furnace. The acceptance and use of steel slag sand shall be according to the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 13-08, *Slag Producer Self-Testing Program*.
- (2) **Quality.** The fine aggregate shall be Class B Quality or better according to the quality standards listed in the following table.

#### Fine Aggregate Quality

Quality Test	Class
	B
Na <sub>2</sub> SO <sub>4</sub> Soundness 5 Cycle, Illinois Modified AASHTO T 104, % Loss max.	15
Minus No. 200 Sieve Material, Illinois Modified AASHTO T 11, % max. <sup>1</sup>	6 <sup>4</sup>
Deleterious Materials <sup>2, 3</sup>	
Shale, % max.	3.0
Clay Lumps, % max.	3.0
Coal & Lignite, & Shells, % max.	3.0
Conglomerate, % max.	3.0
Other Deleterious, % max.	3.0
Total Deleterious, % max.	5.0

1. Fine aggregate used for hot-mix asphalt (HMA) shall not contain more than three percent clay (2 micron or smaller) particles as determined by Illinois Modified AASHTO T 88.
2. Applies only to sand.
3. Tests shall be run according to ITP 204.
4. Does not apply to Gradations FA 20 or FA 21.

- (3) **Gradation requirements.** The fine aggregate gradation shall be FA 1, FA 2, FA 20, FA 21, or FA 22.

### Gradation Requirements

Sieve Size	Gradation Percent Passing				
	FA 1	FA 2	FA 20	FA 21	FA 22
3/8 inch	100	100	100	100	100
No. 4	97±3	97±3	97±3	97±3	
No. 8			80±20	80±20	
No. 16	65±20	65±20	50±15	57±18	8±8
No. 50	16±13	20±10	19±11	30±10	
No. 100	5±5	5±5	10±7	20±10	
No. 200			4±4	9±9	2±2

- c. **Sampling.** The current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 11-08, *Aggregate Gradation Control System (AGCS)*, shall be used in sampling coarse and fine aggregate, and ASTM C183 shall be used in sampling mineral filler.

**403-2.2 Mineral filler.** Mineral filler may be added in addition to material naturally present in the aggregate. Mineral filler shall consist of dry limestone dust, fly ash, cement kiln dust, or lime kiln dust and shall meet the following requirements.

- a. **Gradation.** The gradation shall be according to the following.

### Gradation Requirements

Sieve Size	Percent Passing
No. 30	100
No. 100	92±8
No. 200	82±18

- b. **Loss on ignition.** The loss on ignition for all products shall be a maximum of 5% when tested according to the ITP, *Loss on Ignition for Mineral Filler*.
- c. **Additional requirements.**

### Mineral filler Requirements

Material Test	Requirement	Standard
Plasticity Index	4 maximum	AASHTO T 90

- 403-2.3 Asphalt binder.** Asphalt binder selection shall be based on the geographic location within the state, the intended use of the pavement, and the design aircraft, as listed in the following table.

**Asphalt Binder Selection**

Airport Location	Design Aircraft	PG Binder Grade	
		Runway & Taxiway	Apron
IDOT Districts 1-6	60,000 lb or More	SBS PG 70-28	SBS PG 76-28
	Under 60,000 lb	PG 64-22	PG 64-22
IDOT Districts 7-9	60,000 lb or More	SBS PG 70-22	SBS PG 76-22
	Under 60,000 lb	PG 64-22	PG 64-22

These materials shall be free from water and shall not foam when heated to any temperature below the actual flash point. When requested, producers shall provide the Engineer with viscosity/temperature relationships for the performance graded asphalt binders delivered and incorporated in the work.

Asphalt binder materials will be accepted according to the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 1-08, *Performance Graded Asphalt Binder Acceptance Procedure* and/or be listed on the current Illinois Department of Transportation's published Qualified Producer List of *Certified Sources for Performance Graded Asphalt Binder*.

The Contractor shall provide a copy of the manufacturer's certificate of analysis (COA) for the asphalt binder. The test reports shall be provided to and approved by the Resident Engineer before the asphalt binder is applied. The furnishing of the vendor's certified test report for the asphalt material shall not be interpreted as a basis for final acceptance. The manufacturer's COA may be subject to verification by testing the material delivered for use on the project.

- a. **Performance graded (PG) asphalt binder.** The asphalt binder shall meet the requirements of AASHTO M 320, Table 1 "Standard Specification for Performance Graded Asphalt Binder" for the grade shown on the plans. Air blown asphalt will not be allowed.
- b. **Modified performance graded (PG) asphalt binder.** The asphalt binder shall meet the requirements of AASHTO M 320, Table 1 "Standard Specification for Performance Graded Asphalt Binder" for the grade shown on the plans. Elastomers shall be added to the base asphalt binder to achieve the specified performance grade and shall be either a styrene-butadiene (SB) diblock or styrene-butadiene-styrene (SBS) triblock copolymer without oil extension, or a styrene-butadiene rubber (SBR). Air blown asphalts, acid modification, and other modifiers will not be allowed. Asphalt modification at asphalt plants will not be allowed. The modified asphalt binder shall be smooth, homogeneous, and be according to the requirements shown in Table 1 or 2 for the grade shown on the plans.

- 403-2.4 Anti-stripping agent.** If it is determined that an additive is required, the additive may be hydrated lime, slaked quicklime, or a liquid additive, at the Contractor's option.

Dry hydrated lime shall be added at a rate of 1.0% to 1.5% by weight of total dry aggregate. Slurry shall be added in such quantity as to provide the required amount of hydrated lime solids by weight of total dry aggregate.

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## COMPOSITION

**403-3.1 Composition of mixture.** The asphalt plant mix shall be composed of a mixture of well-graded aggregate, filler and anti-strip agent if required, and asphalt binder. The several aggregate fractions shall be sized, handled in separate size groups, and combined in such proportions that the resulting mixture meets the grading requirements of the job mix formula (JMF).

**403-3.2 Job mix formula (JMF) laboratory.** The Contractor shall provide a laboratory, at the plant, according to the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 6-08, *Minimum Private Laboratory Requirements for Construction Materials Testing or Mix Design*. The laboratory shall be of sufficient size and be furnished with the necessary equipment and supplies for adequately and safely performing the Contractor's QC testing.

The laboratory and equipment furnished by the Contractor shall be properly maintained. The Contractor shall maintain a record of calibration results at the laboratory. The Engineer may inspect measuring and testing devices at any time to confirm both calibration and condition. If the Engineer determines the equipment is not within the limits of dimensions or calibration described in the appropriate test method, the Engineer may stop production until corrective action is taken. If laboratory equipment becomes inoperable, the Contractor shall cease mix production.

**403-3.3 Job mix formula (JMF).** No asphalt mixture shall be placed until an acceptable mix design has been submitted to the Engineer for review and accepted in writing. The Engineer's review shall not relieve the Contractor of the responsibility to select and proportion the materials to comply with this section.

When the project requires asphalt mixtures of differing aggregate gradations and/or binders, a separate JMF shall be submitted for each mix. Add anti-stripping agent to meet tensile strength requirements.

The asphalt mixture shall be designed using procedures contained in Asphalt Institute MS-2 Mix Design Manual, 7th Edition. Samples shall be prepared and compacted using the gyratory compactor in accordance with AASHTO T 312.

Should a change in sources of materials be made, a new JMF must be submitted to the Engineer for review and accepted in writing before the new material is used. After the initial production JMF has been approved by the Engineer and a new or modified JMF is required for whatever reason, the subsequent cost of the new or modified JMF, including a new test strip when required by the Engineer, will be borne by the Contractor.

The Resident Engineer may request samples at any time for testing, prior to and during production, to verify the quality of the materials and to ensure conformance with the applicable specifications.

The JMF shall be submitted in writing by the Contractor at least 45 days prior to the start of paving operations. The JMF shall be developed within the same construction season using aggregates proposed for project use. The submitted JMF shall include the following items as a minimum:

- a. Manufacturer's certificate of analysis (COA) for the asphalt binder used in the JMF. Asphalt binder shall be identified by the Illinois Department of Transportation material and producer code number and the producer name and location.
- b. Manufacturer's certificate of analysis (COA) for the anti-stripping agent if used in the JMF.
- c. Course and fine aggregate and mineral filler shall be identified by the Illinois Department of Transportation material and producer code number and the producer name and location.
- d. Percent passing each sieve size for individual gradation of each aggregate cold feed and/or hot bin; percent by weight of each cold feed and/or hot bin used; and the total combined gradation in the JMF.

- e. Specific Gravity and absorption of each course and fine aggregate.
- f. Percentage of each individual aggregate.
  - (1) Percent natural sand.
  - (2) Percent fractured faces.
  - (3) Percent by weight of flat particles, elongated particles, and flat and elongated particles (and criteria).
- g. Summary of Superpave design and optimum design data.
  - (1) Asphalt Content (AC)
  - (2) Mixture Air Voids (AV)
  - (3) Mixture Bulk Specific Gravity ( $G_{mb}$ )
  - (4) Mixture Theoretical Maximum Specific Gravity ( $G_{mm}$ )
  - (5) Aggregate Bulk (Dry) Specific Gravity ( $G_{sb}$ )
  - (6) Aggregate Effective Specific Gravity ( $G_{se}$ )
  - (7) Effective Binder Content ( $P_{be}$ )
  - (8) Absorbed Binder ( $P_{ba}$ )
  - (9) Volume of Effective Asphalt ( $V_{be}$ )
  - (10) Voids Filled with Asphalt (VFA)
  - (11) Voids in Mineral Aggregate (VMA)
- h. Number gyrations.
- i. Laboratory mixing and compaction temperatures.
- j. Supplier recommended mixing and compaction temperatures.
- k. Plot of the combined gradation on the 0.45 power gradation curve.
- l. Graphical plots of AV, VMA, and unit weight versus AC. To achieve minimum VMA during production, the mix design needs to account for material breakdown during production.
- m. Tensile Strength Ratio (TSR).
- n. Type and amount of anti-strip agent when used.
- o. Date the JMF was developed.
- p. Percentage and properties (asphalt content, asphalt binder properties, and aggregate properties) of reclaimed asphalt pavement (RAP).



### Asphalt Design Criteria

Traffic Mix					
Design Parameter	Aircraft 60,000 Pounds Or More <sup>1</sup>		Aircraft Under 60,000 Pounds		Automobile <sup>5</sup>
	Runway/Taxiway	Apron	Runway/Taxiway	Apron	Roadways/Parking Lots
N <sub>ini</sub> <sup>2</sup>	7	7	5	5	5
N <sub>des</sub> <sup>3</sup>	50	50	30	30	30
N <sub>max</sub>	74	74	42	42	42
Air Voids (AV) <sup>4</sup>	2-4	2-4	2-4	2-4	2-4
VFA (min %)	75-90	75-90	75-90	75-90	75-90

1. Stone sand, gradation FA 20 or FA 21, shall be required as part of the fine aggregate portion of the JMF. The exact amount of stone sand will be determined by the Contractor. The percentage of stone sand will be verified as acceptable by the Department based upon the Contractor's final proposed JMF. The Department reserves the right to request a change in the amount of stone sand at any point in the mix design process, as well as during production, based upon performance of the mix during placement.
2. Number of gyrations on a Department approved Superpave gyratory compactor.
3. Value may be changed in order to obtain an acceptable mix design when approved by the Engineer
4. To be specified in plan documents. In general, target air voids are 2%-3% for lower traffic airports and 3%-4% for higher traffic airports.
5. To be specified in plan documents. Highways N<sub>50</sub> mix may be substituted for above roadway/parking lot criteria.

The mineral aggregate shall be of such size that the percentage composition by weight, as determined by laboratory sieves, will conform to the gradation or gradations specified in Table 2 when tested in accordance with the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 11-08, *Aggregate Gradation Control System (AGCS)*.

The gradation below represents the limits that shall determine the suitability of aggregate for use from the sources of supply, be well graded from coarse to fine and shall not vary from the low limit on one (1) sieve to the high limit on the adjacent sieve, or vice versa.

### Aggregate - Asphalt Pavements

Sieve Size	Percentage by Weight Passing Sieve	
	1" Maximum	Ideal Target
1 inch	100	100
3/4 inch	93-97	95
1/2 inch	75-79	77
3/8 inch	64-68	66
No. 4	45-51	48
No. 8	34-40	37
No. 16	27-33	30
No. 30	19-23	21
No. 100	6-10	8
No. 200	4-6	5
Asphalt Content	4.5-7.0	5.5
Recommended Minimum Construction Lift Thickness	3 inch	3 inch

Locally available Department gradations may be blended to meet the JMF.

Before constructing the test strip, target values shall be determined by applying gradation correction factors to the JMF when applicable. After any JMF adjustment, the JMF shall become the Adjusted Job Mix Formula (AJMF). Upon completion of the first acceptable test strip, the JMF shall become the AJMF regardless of whether or not the JMF has been adjusted. If an adjustment/plant change is made, the Engineer may require a new test strip to be constructed. If the asphalt placed during the initial test strip is determined to be unacceptable to remain in place by the Engineer, it shall be removed and replaced.

The limitations between the JMF and AJMF are as follows.

#### JMF Tolerances

Sieve Size	Tolerance
No. 4	±5%
No. 8	±5%
No. 16	±5%
No. 30	±4%
No. 100	±2%
No. 200	±2%
Asphalt Content	±0.30%
Temperature	±20°F

Any adjustments outside the above limitations will require a new mix design.

**403-3.4 Reclaimed asphalt pavement (RAP).** Reclaimed asphalt pavement shall consist of reclaimed asphalt pavement (RAP), coarse aggregate, fine aggregate, mineral filler, and asphalt. Recycled asphalt shingles (RAS) shall not be allowed. The RAP shall be of a consistent gradation and asphalt content and properties. When RAP is fed into the plant, the maximum RAP size shall not exceed 1-1/2 inches. The reclaimed asphalt mix shall be designed using procedures contained in the Asphalt Institute MS-2 Mix Design Manual, 7th Edition. The percentage of asphalt in the RAP shall be established for the mixture design according to AASHTO T 164 using the appropriate dust correction procedure. RAP shall only be used for shoulder surface course mixes and for any intermediate courses. The use of RAP containing Coal Tar shall not be allowed. Coal Tar surface treatments must be removed prior to recycling underlying asphalt material. The amount of RAP shall be limited to 30%.

For the PG graded asphalt binder selected, adjust as follows:

- a. For 0-20% RAP, there is no change in virgin asphalt binder content.
- b. For >20 to 30% RAP, select asphalt binder one (1) grade softer, i.e., PG 64-22 would soften to PG 58-28.

**403-3.5 Test strip. (For Method II only; 2,000 tons/pay item and Over).** A test strip will be required at the beginning of production for each mixture with a quantity of 2,000 tons or more according to the current Illinois Department of Transportation, Bureau of Materials Manual of Test Procedures for Materials, *Hot-Mix Asphalt Test Strip Procedures, Appendix B.4*. Full production shall not begin until an acceptable test strip has been constructed and accepted in writing by the Engineer. The Contractor shall prepare and place a quantity of asphalt according to the approved JMF. The underlying grade or pavement structure upon which the test strip is to be constructed shall be the same as the remainder of the course represented by the test strip.

The Contractor will not be allowed to place the test strip until the Contractor quality control program (CQCP) has been accepted, in writing, by the Engineer.

The test strip will consist of at least 300 tons. The test strip shall be placed in two (2) lanes of the same width and depth to be used in production with a longitudinal cold joint. The cold joint must be cut back using the same procedure that will be used during production. The cold joint for the test strip will be an exposed construction joint at least four (4) hours old or when the mat has cooled to less than 160°F. The equipment used in construction of the test strip shall be the same type, configuration and weight to be used on the project.

The Contractor shall follow the following procedures for constructing a test strip.

**a. Contractor/Department test strip team.** A team of both Contractor and Department personnel shall construct a test strip and evaluate mix produced at the plant. The test strip team may consist of the following, as necessary:

- (1) Engineer
- (2) Resident Engineer
- (3) Contractor's QC Manager, required
- (4) Contractor's Density Tester

**b. Communications.** The Contractor shall advise the team members of the anticipated start time of production for the mix. The QC Manager shall direct the activities of the test strip team. A Department appointed representative from the test strip team will act as spokesperson for the Department.

**c. Acceptance criteria.**

(1) **Mix design and plant proportioning.** The mix design shall be approved by the Department prior to the test strip. Target values shall be provided by the Contractor and will be approved by the Department prior to constructing the test strip.

(2) **Evaluation of growth curves.** The completed test strip shall have a minimum density of 94.0 percent (6.0 percent air voids) of the maximum theoretical specific gravity of the mix. Individual test results (average of two cores) below 94.0% shall constitute a failing test section. The maximum density of individual test results (average of two cores) shall be 99.0% of the maximum theoretical specific gravity of the mix. Mixtures which exhibit density potential less than or greater than the density ranges specified shall be considered to have a potential density problem which is normally sufficient cause for mix adjustment.

If an adjustment has been made, the Engineer may require an additional test strip be constructed and evaluated. This information shall then be compared to the AJMF and required design criteria for acceptance.

(3) **Evaluation of required plant tests.** If the results of the required plant tests exceed the JMF target value control limits, the Contractor shall make allowable mix adjustments/plant changes, resample, and retest. If the Engineer determines additional adjustments to the mix will not produce acceptable results, a new mix design may be required.

**d. Test strip method.** The Contractor shall produce 300 tons of mix for the test strip. The test strip will be included in the cost of the mix and will not be paid for separately since the Contractor may continue production, at their own risk, after the test strip has been completed.

The procedures listed below shall be followed to construct a test strip.

- (1) **Location of test strip.** The test strip shall be located on a relatively flat portion of the project. Descending/ascending grades should be avoided.
- (2) **Constructing the test strip.** After the Contractor has produced and placed approximately 225 to 250 tons of mix, paving shall cease, and a growth curve shall be

constructed. After completion of the first growth curve, paving shall resume for the remaining 50 to 75 tons, and the second growth curve shall be constructed within this area. The Contractor shall use normal rolling procedures for all portions of the test strip except for the growth curve areas which shall be compacted solely with a vibratory roller as directed by the QC Manager.

- (3) **Required plant tests.** A set of mixture samples shall be taken at such a time as to represent the mixture in between the two (2) growth curve trucks.

The mixture sampled to represent the test strip shall also include material sufficient for the Department to conduct a Hamburg Wheel test according to AASHTO T 324.

e. **Compaction requirements.**

- (1) **Compaction equipment.** The Contractor shall provide a vibratory roller meeting the following requirements.

The vibratory roller shall be self-propelled and provide a smooth operation when starting, stopping or reversing directions. The vibrating drum amplitude and frequency shall be approximately the same in each direction and meet the following minimum requirements: drum diameter 48 inches, length of drum 66 inches, vibrators 1,600 vibrations per minute, unit static force on vibrating drum 125 pounds per lineal inch, total applied force 325 pounds per lineal inch, adjustable eccentrics, and reversible eccentrics on nondriven drums. The total applied force for various combinations of vibrations per minute and eccentric positions shall be shown on decals on the vibrating roller or on a chart maintained with the roller. The vibratory roller shall be equipped with water tanks and sprinkling devices, or other approved methods, which shall be used to wet the wheels to prevent material pickup.

A vibrating reed tachometer (hand type) shall be furnished with each vibratory roller. The vibrating reed tachometer shall have a range of 1,000 to 4,000 vibrations per minute. The vibrating reed tachometer shall have two (2) rows of reeds, one (1) ranging from 1,000 to 2,000 vibrations per minute and the other from 2,000 to 4,000 vibrations per minute.

It shall be the responsibility of the test strip team to verify specification compliance before commencement of growth curve construction. An appropriate amplitude shall be selected on the basis of roller weight and mat thickness to achieve maximum density. The vibratory roller speed shall be balanced with frequency so as to provide compaction at a rate of not less than ten (10) impacts per one (1) foot.

- (2) **Compaction temperature.** In order to make an accurate analysis of the density potential of the mixture, the temperature of the mixture on the pavement at the beginning of the growth curve shall not be less than 280°F.
- (3) **Compaction and testing.** The Contractor shall direct the roller speed and number of passes required to obtain a completed growth curve. The nuclear gauge shall be placed near the center of the hot mat and the position marked for future reference. With the bottom of the nuclear gauge and source rod clean, a one (1) minute nuclear reading (without mineral filler) shall be taken after each pass of the roller. Rolling shall continue until a growth curve can be plotted, the maximum density determined, and three (3) consecutive passes show no appreciable increase in density or evident destruction of the mat.
- (4) **Final testing.** A core set (two cores, results averaged) shall be taken and will be secured by the Department from each growth curve to represent the density of the in-place mixture. Additional random core sets may be required as determined by the Engineer.

- f. **Nuclear/core correlation.** A correlation of core and nuclear gauge test results may be performed on-site as defined in the Illinois Department of Transportation, Bureau of

Materials Manual of Test Procedures for Materials, *Standard Test Method for Correlating Nuclear Gauge Densities with Core Densities, Appendix B.3.* the Department's *Standard Test Method for Correlating Nuclear Gauge Densities with Core Densities.* All correlation locations should be cooled with ice or dry ice so that cores can be taken as soon as possible. Three (3) locations should be selected. Two (2) sites should be located on the two (2) growth curves from the first acceptable test strip. The third location should be in an area corresponding to the second set of mixture samples taken at the plant. This correlation should be completed at the same time by the Contractor prior to the next day's production. Smoothness of the test strip shall be to the satisfaction of the Engineer.

- g. Documentation.** All test strips, required plant tests, and rolling pattern information (including growth curves) will be tabulated by the Contractor with a copy provided to each team member and the original retained in the project files.

If the test strip is unacceptable, necessary adjustments to the JMF, plant operation, placing procedures, and/or rolling procedures shall be made and another test strip shall be placed. Unacceptable test strips shall be removed at the Contractor's expense.

### CONSTRUCTION METHODS

- 403-4.1 Weather limitations.** The asphalt surface course shall be placed only when the air temperature in the shade is at least 40°F and the forecast is for rising temperatures. The asphalt shall not be placed upon a wet surface or when the surface temperature of the underlying course is less than specified in the table below. The temperature requirements may be waived by the Engineer, if requested; however, all other requirements including compaction shall be met.

#### Surface Temperature Limitations of Underlying Course

Mat Thickness	Base Temperature (Minimum)
	°F
3 inches or greater	40
Greater than 1 inch but less than 3 inches	45
Less than 1 inch	50

- 403-4.2 Equipment.** The Contractor is responsible for the proper operation and maintenance of all equipment necessary for handling materials and performing all parts of the work to meet this specification.

- a. Asphalt plant.** The asphalt plant shall be the batch-type or dryer drum plant. Plants used for the preparation of asphalt shall be evaluated for prequalification rating and conform to the requirements of the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 4-08, *Approval of Hot-Mix Asphalt Plants and Equipment.* The plants shall not be used to produce mixtures concurrently for more than one (1) project or for private work unless permission is granted in writing by the Engineer. The plant units shall be so designed, coordinated and operated that they will function properly and produce asphalt having uniform temperatures and compositions within the tolerances specified. The plant units shall meet the following requirements. The Engineer, shall have access, at all times, to all areas of the plant for checking adequacy of equipment; inspecting operation of the plant: verifying weights, proportions, and material properties; and checking the temperatures maintained in the preparation of the mixtures.

- (1) **General.** The plant shall be approved before production begins. All asphalt plants shall be capable of producing asphalt within the specification tolerances for gradation and asphalt binder content. The plant owner shall be responsible for demonstrating this capability through a production and testing program defined by the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 4-08, *Approval of Hot-Mix Asphalt Plants and Equipment*. If the plant fails to maintain this capability, the Department may require the demonstration to be repeated at any time. Failure to maintain the capability may result in loss of plant approval status. Accessibility to the top of truck beds shall be provided by dual platforms or other suitable device to enable the Resident Engineer to obtain samples and mixture temperature data.

For all types of plants, the ingredients shall be heated and combined in such a manner as to produce asphalt which when discharged from the plant will in general vary not more than 20°F from the temperature set by the Engineer. In all cases, the mix temperature shall not be more than 350°F or less than 250°F. Wide variations in the mixture temperature of successive loads may be cause for rejection of the asphalt.

During the drying process, the moisture content of the aggregate shall be reduced such that the moisture content of the asphalt at time of discharge from the mixer will not exceed 0.3%. For certain aggregates such as air-cooled blast furnace slag, and other highly absorptive aggregates, special handling and treatment such as double drying may be required.

All hot bins shall be emptied and all aggregate in the dryer and collector conveyors shall be removed prior to starting production or resuming once production has been interrupted for the purpose of producing a different mixture.

- (a) **Storage facilities.** The plant used in the preparation of the asphalt shall be located where it will have adequate storage and transportation facilities. Sufficient space shall be provided for separate stockpiles of each gradation, source, and quality of aggregate required. If necessary, to prevent the intermixing of the different materials, or if stockpiles join together, suitable partitions shall be used between adjacent stockpiles. All aggregates shall be kept separated until they are fed in their proper proportions onto a belt conveyor or into the boot of the cold aggregate elevator. The aggregates shall be handled in such a manner as to prevent contamination, degradation and segregation.
- (b) **Aggregate/RAP bins and feeders.** The plant shall be provided with accurate mechanical means for uniformly feeding each aggregate and Reclaimed Asphalt Pavement (RAP) used in the proper proportions so that uniform production and uniform temperature will be obtained. A minimum of four (4) bins and feeders for aggregate will be required. If RAP is used, one (1) additional bin and feeder will be required for each RAP fraction used. The bins shall be designed to prevent overflow of material from one (1) bin to another. If any of the materials used in preparing the mixture become intermixed in a bin compartment, the compartment shall be emptied, and the intermixed material shall not be used. Each bin shall be provided with a variable speed belt or apron feeder with adjustable gates which can be locked. Each bin shall have a cutoff system that shall automatically stop the asphalt production when any bin becomes empty. All feeders shall be calibrated to the desired volumes and/or weights for each material/mixture, to the satisfaction of the Engineer. This calibration may require plant modification. The controls of the total quantity of combined materials fed to the dryer shall be by a variable speed system. Other methods may be approved by the Engineer. When the proportioning gates of the feeders are once set for proper blending, they shall be locked or bolted securely, and their positions shall not be changed unless directed by the Engineer.

- (c) **Dust collection.** The plant shall be equipped with a primary dust collector, approved by the Engineer, connected to a secondary dust collector (baghouse or wet-wash).
- (d) **Surge bins.** The Contractor may use an asphalt surge system in the manufacture of asphalt provided the bins meet the following requirements and are operated to the satisfaction of the Engineer. The complete surge system shall be designed and operated to prevent segregation and loss of temperature of the mix. Maximum retention time shall be eight (8) hours unless longer retention time is authorized in writing by the Engineer. When requested, longer retention time will be evaluated according to the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 4-08, *Approval of Hot-Mix Asphalt Plants and Equipment*. The bins shall be insulated and/or heated, and of an enclosed weatherproof type. A combination low level indicator and cutoff system shall be provided that will automatically stop the discharge of mix from the surge bins when the mix falls below the top of the discharge cone. The conveying system used to transport the mix from the mixer to the bins shall be enclosed, heated and/or insulated for effective control of mix temperature.

No surge system will be approved by itself but shall be considered as part of a complete operating asphalt plant. The mix as discharged from the bins shall meet all specification requirements for the mix being produced. Approval for the use of a surge system may be withdrawn at any time, by the Engineer, for unsatisfactory operation.

- (e) **Storage tanks for asphalt binders.** Tanks for the storage of asphalt binder shall be equipped to heat and hold the material at the required temperatures. The heating shall be accomplished by steam coils, hot oil coils, electricity or other approved means so that no flame shall be in contact with the tank. All asphalt binder lines and fittings shall be steam, electric or hot oil jacketed. Provisions shall be made for sampling the asphalt binder from the line leading to the weigh bucket or metering device. If more than one (1) grade of asphalt binder is required for concurrent operations, adequate storage and separate piping to the weigh bucket or metering device for each grade, or other methods approved by the Engineer that prevent intermingling of the asphalt binders, shall be provided. An armored thermometer or pyrometer which will accurately show temperatures between 200°F and 400°F shall be suitably located in the asphalt binder line or within the tank. The instrument shall be located so as to indicate to the plant personnel, the temperature of the asphalt binder.
- (f) **Equipment for weighing asphalt.** The asphalt shall be weighed on an approved scale furnished by the Contractor meeting the requirements of *225 ILCS 470/Weights and Measures Act* of the State of Illinois. Each time the scale is moved, the accuracy shall be retested and certified. For dryer drum plants the load-out scale used to weigh asphalt shall be equipped with an automatic printer. Batch plants shall have an automatic printer to record the weight of all ingredient materials. The automatic printer shall be an integral part of the scale equipment or the scale and printer shall be directly connected in a manner that will prohibit the manual entry of weights, except as provided in paragraph (a), below.
1. If the platform scale equipment measures gross weight, the printer shall record the gross weight as a minimum. Tare and net weights shall be shown on weigh tickets and may be printed automatically or entered manually.
  2. If scale equipment on a platform scale zeros out the truck tare automatically, the printer shall record the net weight as a minimum.
  3. If the scale equipment on a surge bin weigh hopper zeros automatically after discharging each batch, the printer shall record the net weight as a minimum.

4. If the scale equipment on surge bins automatically shuts down the feed system weighing and weighs the amount in the silo before and after discharge, the printer shall record the net weight as a minimum.

The automatic printer shall produce a weight ticket in triplicate. Weights shall be shown in tons to the nearest 0.01 ton.

- (g) **Equipment for anti-strip additives.** When an anti-stripping additive is required and a liquid additive is used, it shall be added to the asphalt binder by means of an approved in-line blending system located between the asphalt binder supply tank and distribution onto the heated aggregate. The in-line blending system shall be installed in such a location that the liquid additive cannot recirculate and contaminate the asphalt binder supply tank. The in-line blending system shall be capable of delivering a consistent and controllable stream of material to the asphalt binder under all operating weather conditions and shall be capable of controlling the introduction of additive into the asphalt binder within  $\pm 10\%$  of the amount specified or required. The Contractor shall use methods and procedures for handling and storage of the additive which meet the manufacturer's safety recommendations.

When hydrated lime is used as the anti-strip additive, a separate bin or tank and feeder system shall be provided to store and accurately proportion the lime onto the aggregate either as a slurry, as dry lime applied to damp aggregates, or as dry lime injected onto the hot aggregates prior to adding the liquid asphalt cement. If the hydrated lime is added either as a slurry or as dry lime on damp aggregates, the lime and aggregates shall be mixed by a power driven pugmill to provide a uniform coating of the lime prior to entering the dryer. If dry hydrated lime is added to the hot dry aggregates in a dryer-drum plant, the lime shall be added in such a manner that the lime will not become entrained into the air stream of the dryer-drum and that thorough dry mixing shall occur prior to the injection point of the liquid asphalt. When a batch plant is used, the hydrated lime shall be added to the mixture in the weigh hopper or as approved by the Engineer. The feeder system shall be controlled by a proportioning device which shall provide accuracy to within  $\pm 10\%$  of the specified amount of hydrated lime solids. The proportioning device shall have a convenient and accurate means of calibration and shall be interlocked with the aggregate feed or weight system so as to maintain the required proportion. A flow indicator or sensor shall be provided and interlocked with the plant controls such that the production of the mixture will be interrupted if there is a stoppage of the hydrated lime feed. The stockpiling of hydrated lime treated aggregate will not be permitted. The methods of introducing and mixing the anti-stripping additive and aggregate shall be subject to approval by the Engineer prior to beginning production.

- (h) **Equipment for RAP.** When the RAP option is used, the plant shall be modified to ensure a homogenous, uniformly coated mix is obtained. A scalping screen, crushing unit or comparable sizing device shall be used in the RAP feed system to remove or reduce oversized material. Modifications shall be approved by the Engineer.
- (i) **Stabilizing additive.** When a stabilizing additive such as a cellulose or mineral fiber is required to prevent asphalt binder drain down, adequate dry storage shall be provided for the stabilizing fiber additive. A separate feed system shall be provided to proportion the fiber into the mixture uniformly and in desired quantities. The feed system shall be interlocked with the aggregate feed or weigh system to maintain the correct proportions for all rates of production and batch sizes. The proportion of fibers shall be controlled at all times within  $\pm 10\%$  of the amount of fibers required. The fiber system shall provide in-process monitoring consisting of either a digital display of output or a printout of the feed-rate, in pounds per minute. Flow indicators or sensing devices for the fiber system shall be provided and interlocked with plant



controls so mix production shall be interrupted if fiber introduction fails, or if the output rate is not within the specified tolerances.

1. **Batch plant.** Stabilizing additive shall be pneumatically added through a separate inlet directly into the weigh hopper above the pugmill. The addition of fibers shall be timed to occur during the hot aggregate charging of the hopper. Adequate mixing time will be required to ensure proper blending of the aggregate and fiber additive. Both the wet and dry mixing times shall each be increased a minimum of five (5) seconds beyond the standard mixing time. The actual mixing time increase shall be determined by the Engineer based on individual plant characteristics. If concentrations of mastic (fiber, asphalt binder, and fines) are visible behind the paver, the batch size shall be reduced in 10% increments until the problem is alleviated.
2. **Drum mix plant.** Stabilizing additive shall be introduced using specialized equipment to mix the asphalt binder with loose fibers at the time of introduction into the drum mixer. This equipment shall be approved by the Engineer. Care shall be taken to ensure the loose fibers do not become entrained in the exhaust system of the plant.

(2) **Batching plants.** Batch plants shall be according to the following.

- (a) **Dryers.** The plant shall be equipped with a revolving cylindrical dryer or dryers capable of heating and drying all of the fine and coarse aggregates to a temperature of 250°F to 350°F.
- (b) **Equipment for weighing or measuring aggregate/RAP.** The equipment shall include a means for accurately weighing each size of aggregate/RAP in a weigh hopper suspended on scales and of ample size to hold a full batch without hand raking or running over. The gate shall close tightly so that no material is allowed to leak into the pugmill mixer while a batch is being weighed.

The scale shall be the springless dial type, shall be designed as an integral unit of the batching equipment, and shall be constructed to withstand the usage for which they are intended. Load cells with digital readouts may be used if approved by the Engineer. The scale shall have a capacity of not more than twice the weight of the approved capacity of the mixer.

Except for permanently located plants, springless dial scales shall be provided with suitable markers inside the glass cover and in front of the dial which may be set to show the position of the dial indicator for the required load or the various accumulative loads when more than one (1) aggregate is weighed in the same hopper. Markers shall have distinctive colors for the various materials to be weighed. Dials shall be placed so that they can be viewed without parallax by the operator.

The value of the minimum graduation interval of any scale used for weighing materials shall be not more than 0.2% of the batch weight and not more than 0.1% of the capacity of the scale, except that graduation intervals less than five (5) pounds when weighing aggregates and less than two (2) pounds when weighing cement and finely divided minerals will not be required. In the case of beam scales, the same requirement shall also apply to the graduation of each individual beam with respect to the weight of material normally weighed on it. The value of the minimum graduation interval of any scale used for weighing mixing water shall be not less than two (2) pounds. All scales shall be designed and built to a maximum tolerance of 0.4% of the net load in the hopper.

Scales shall be housed or otherwise protected against the effect of wind in a manner meeting the approval of the Engineer.

The scales shall be calibrated by an independent company. The independent company shall have scale testing equipment and standard weights meeting the requirements of NIST. The scale calibration will be observed by the Engineer. Scales shall be calibrated at the beginning of each construction season or each 12-month period, and each time the scales are moved, or when scale components are repaired or replaced.

Once a scale is calibrated, the settings shall not be altered. The concrete producer shall submit for approval by the Engineer, a method to verify the settings have not been altered. If at any time the Engineer determines the settings have been altered, a new calibration will be required.

Means of access for inspection purposes shall be safe and shall meet the approval of the Engineer. In the case of permanently located plants, the means of access shall be an inclined stairway with the handrail located so that its upward flight will end on the scale operator's platform. It shall be firmly attached to the supporting members of the bin. The weigh platform shall have an approved floor of metal grid or two (2) inch plank.

- (c) **Dust collection.** Material collected from the primary collector shall be discharged into a hopper which is equipped with the means of either wasting stored dust or metering and conveying its contents into the boot of the hot elevator. Metering of dust from the hopper shall be accomplished by either an adjustable variable speed vane or auger feeder. Feed shall be actuated by a control located in the discharge chute between the dryer and the hot elevator and shall only occur when aggregate is being discharged from the dryer. In all cases, the hopper used for storing the primary material shall be equipped with a low-bin indicator.

Material collected in the secondary collector (baghouse) shall not be stored internally but shall be discharged directly into a silo. Feed of the material from the silo to the mix shall be accomplished only by weight. In no case shall the collected secondary material be returned to the hot elevator. To meet job mix formula criteria, it may be necessary to waste some or all of the collected secondary material.

- (d) **Mineral filler system.** The mineral filler shall be weighed in the aggregate weigh hopper. It shall be conveyed to the weigh hopper by approved means. The feeding method shall operate in such manner as will enable small fractions of the material to be weighed. The chute used to introduce the mineral filler into the weigh hopper shall be so constructed that none of the material is retained in it after the required amount has been deposited in the weigh hopper.
- (e) **Equipment for weighing or measuring asphalt binder.** The equipment used for weighing or measuring the asphalt binder shall consist either of an approved weigh bucket or metering device. If a weigh bucket is used, it shall be a non-tilting type and shall be completely suspended from a springless dial scale. Load cells with digital readouts may be used if approved by the Engineer. The weigh bucket, its discharge valve or valves and spray bar shall be adequately heated and shall have a capacity of at least 15% in excess of the weight of asphalt binder required in any batch. Adequately heated, quick-acting, non-drip valves shall be used in charging the bucket.

If a metering device is used, it shall be of an approved design and have a capacity of at least 15% in excess of the quantity of asphalt binder used in a batch. The controls shall be constructed so that they may be locked at any dial setting and will automatically reset to that reading after the addition of asphalt binder to the mix. The dial shall be in full view of the mixer operator. The flow of asphalt binder shall be automatically controlled so that it will begin when the dry mixing period is over. The section of the asphalt line between the charging valve and the spray bar shall be provided with a valve and outlet for calibrating-verifying the meter.

Either the weigh bucket or the meter device shall discharge all the asphalt binder required for one (1) batch in not more than 15 seconds after the flow has started. The size and spacing of the spray bar openings shall provide a uniform application of asphalt binder the full length of the mixer.

- (f) **Accuracy of scales.** The scales shall meet the requirements of *225 ILCS 470/Weights and Measures Act* of the State of Illinois. The scales shall be calibrated at the beginning of each construction season and as often as the Engineer may deem necessary to assure their continued accuracy. Ten (10) standard 50-pound weights meeting the requirements of NIST shall be available at the asphalt plant for use in calibrating and testing the weighing equipment. The scales shall be inspected frequently for sensitivity, sluggishness or damage. They shall be checked for accuracy at intervals of not more than one (1) week by obtaining the net weight, on truck scales, of a truck load of asphalt.
- (g) **Pugmill mixer.** The batch mixer shall have a rating plate attached showing the manufacturer's rated capacity and shall be an approved type capable of producing a uniform mixture within the job tolerances. If not enclosed, the mixer box shall be equipped with a dust hood to prevent loss of dust. The clearance of the blades from all fixed and moving parts shall not exceed three-quarters (3/4) inch.

The capacity of the pugmill mixer will be determined by the Engineer based on 115% of the calculated net volume of the mixer below the center of the mixer shafts and 100 pounds per cubic foot material. If the mixer will not operate efficiently at the approved capacity, or if its production does not coordinate with other plant units, the right is reserved to reduce the size of the batch until the desired efficiency is obtained. The Engineer's decision as to the permissible capacity of the pugmill mixer will be final.

The mixer shall be heated by an approved method and shall have a capacity of not less than 2,000 pounds for any composition required under these specifications. The amount of material which the Contractor will be permitted to mix per batch shall be determined by the Engineer. The mixer shall be of the twin-shaft type.

- (h) **Time lock.** The mixer shall be equipped with an accurate time lock to control the operations of a complete mixing cycle. It shall lock the weigh hopper gate after the charging of the mixer until the closing of the mixer gate at the completion of the cycle. It shall lock the asphalt binder bucket or meter throughout the dry mixing period and shall lock the mixer gate throughout the dry and wet mixing periods. The dry mixing period is defined as the interval of time between the opening of the weigh hopper gate and the start of introduction of asphalt binder. The wet mixing period is the interval of time between the start of introduction of asphalt binder and the opening of the mixer gate.

The heated aggregates, RAP when used, and mineral filler shall be mixed in the pugmill mixer for a period of not less than ten (10) seconds. The asphalt binder shall then be added, and the mixing continued. The time required to add the asphalt binder shall be not more than 15 seconds. The total time required for adding the asphalt binder and completing the wet mixing period shall be not less than 35 seconds, or longer if necessary, to produce a homogeneous mixture in which all particles of aggregate are coated uniformly. If a question as to the degree of coating should arise, AASHTO T 195 shall be used. When the RAP option is used, the mix time may vary in relation to the nature of the aggregate. The total mixing time shall be a minimum of 45 seconds consisting of dry and wet mixing. The times of dry and wet mixing shall be set by the Engineer. The same size batch weights shall be used in the production of asphalt, unless permission to change is granted in writing by the Engineer.

The control of the timing shall be flexible and capable of being set at intervals of five (5) seconds or less throughout a total cycle. The setting of time intervals shall be at the direction of the Engineer.

- (i) **Batch counter.** An approved mechanical batch and/or tonnage counter shall be installed as part of the time lock device. It shall register only upon the actuation of the asphalt weigh bucket or valve release. It shall not register any dry batches or any material released during the operation of pulling the bins.
- (j) **Screens.** The screens used in separating the aggregates shall be of the vibrating types, and when operated at normal speeds shall separate the aggregates satisfactorily. The screening system shall be equipped with a scalping screen having openings not more than one-half (1/2) inch larger than the largest size aggregate used in preparing the asphalt. The screening system shall have a tailing pipe for the removal of oversized aggregate. The discharge point of the tailing pipe shall be located so that it will not create a hazard or nuisance. The screens shall produce aggregate in the proper bins, as required.

Efficiency of separation based on laboratory sieves, shall be such that no more than 20% of the material in the bin is smaller than neither the nominal size nor more than 10% over size for that bin.

- (k) **Hot aggregate bin.** The plant shall be equipped with a minimum of four (4) aggregate storage bins of sufficient capacity to supply the mixer when it is operating at full capacity. Bins shall be arranged to assure separate and adequate storage of appropriate fractions of the mineral aggregates. Separate dry storage shall be provided for mineral filler, and the plant shall be equipped to feed the material into the aggregate weigh hopper. Each bin shall be provided with overflow pipes, of such size and at such locations as to prevent backing up of material into other compartments or bins. Material from the overflow pipe shall not be returned to the hot elevator. Each compartment shall be provided with its individual outlet gate, constructed so that when the gate is closed, there shall be no leakage. Gates shall cut off quickly and completely. Bins shall be so constructed that samples can be readily obtained. A sampling device having the same width as the hot aggregate bin outlet gates shall be provided for this purpose. Hot aggregate bins shall not be modified in any manner nor shall divider plates be removed.
  - (l) **Temperature recording instrument.** The plant shall be equipped with either a recording pyrometer or a recording thermometer having at least two (2) terminals when a single dryer is used, and at least three (3) terminals when a dual dryer is used. The type and accuracy of the recording instrument shall be approved by the Engineer. Unless otherwise approved, one (1) terminal shall be installed at a suitable location at the discharge of each dryer and the others near the discharge gate in each bin compartment used for fine aggregate. The temperature recording instrument shall be capable of making accurate charts of the temperatures during the day's run. The recording instrument shall be installed at a point free from the dust and vibration of the plant. If this instrument is not located as to indicate clearly to the plant operator the temperature of the mineral aggregates at the discharge of each dryer, a non-recording pyrometer shall also be installed in view of the plant operator. At the end of each days run, the record sheet of the recording instrument shall be submitted to the Engineer.
- (3) **Dryer drum plants.** Dryer drum plants shall be according to the following.
- (a) **General.** General requirements shall be according to paragraph 403-4.2 a. (1) titled GENERAL, except a surge bin meeting the requirements of paragraph 403-4.2 a.(1)(d) titled SURGE BINS shall be utilized.

The heated aggregates, mineral filler, asphalt binder, and RAP when used, shall be proportioned by electronic proportioning equipment and mixed to produce a homogenous mixture in which all particles of aggregate are coated uniformly. If a question as to the degree of coating should arise, AASHTO T 195 shall be used. If the Engineer ascertains that proper mixing is not being obtained, adjustments shall be made in the plant operation (production rate, dryer drum slope, etc.) to assure that these conditions are met.

- (b) **Vibrating scalping screen.** The combined aggregates, and RAP if used, shall pass over a vibrating scalper that will remove all material and aggregate greater than the nominal top size gradation permitted by the specification for the mixture being produced, or as set by the Engineer, prior to the aggregates being placed on the weigh belt. The scalper shall be independent of other proportioning or weighing equipment.
- (c) **Aggregate/RAP weighing equipment.** The combined aggregates, and RAP if used, shall be weighed on continuous belt weighing devices meeting the requirements of the NIST Handbook #44. The weigh belts shall be self-aligning with a gravity belt takeup and rigid wind guards at the weighing section. Sun screens may be required by the Engineer at the weighing section. Means shall be provided to divert the aggregate/RAP into a truck, after passing over the weigh belt scales.
- (d) **Mineral filler system.** Mineral filler shall be proportioned to the mixing zone of the asphalt plant by a variable speed vane feeder and storage system or other systems approved by the Engineer. Means must be provided to divert material from the proportioning unit for purposes of calibration. The feeder shall be provided with an automatic cutoff system in the event the feeder is blocked or is devoid of material.
- (e) **Asphalt binder system.** The asphalt binder system shall consist of a temperature compensating meter and pump. Other asphalt binder systems may be used if approved by the Engineer. The pump and meter shall be installed as close to the asphalt binder storage tanks as possible using rigid pipe with a minimum of piping length and bends. The diameter of the pipe shall be consistent throughout the system. Means shall be provided to automatically stop the plant in the event asphalt binder ceases to flow through the meter.
- (f) **Dryer drum mixer.** Dryer drum mixer components shall have a minimum capacity of 60 tons per hour of asphalt. The units shall have a recording pyrometer or thermometer that records the discharge temperature of the mixture.
  - 1. **Single unit dryer drum mixers.** The single unit dryer drum mixer shall be a revolving cylindrical drum capable of heating, drying, and mixing the combined aggregates, RAP if used, mineral filler when required, and asphalt binder to produce a uniformly coated, homogenous asphalt meeting all applicable specifications. The dryer burner shall be equipped with automatic controls.
  - 2. **Dual unit dryer drum mixers.** The dryer portion of the dual unit dryer drum mixer shall be a revolving cylindrical drum capable of heating and drying the combined aggregates to the required specifications. The mixer portion of the dual unit dryer drum mixer shall be either a revolving cylindrical drum or a continuous twin shaft pugmill with a compatible mixing capacity to the dryer production rating. The unit shall be capable of mixing the heated and dried combined aggregates, RAP if used, mineral filler when required, and asphalt binder to produce a uniformly coated, homogenous asphalt meeting all applicable specifications.
- (g) **Secondary dust collector.** The collected baghouse dust shall be returned to the dryer at a uniform rate at a point where the asphalt binder is added to the mixing zone of the asphalt plant.

If positive dust control equipment (PDCE) is required, it shall consist of a system that is an integral part of the production process. The system shall accurately weigh all of the secondary dust collected in the baghouse, transfer the material to a storage silo, accurately weigh the required amount of fines to be returned from the storage silo, and transfer them back to the mixture. The PDCE weighing devices shall have an accuracy of 0.5% of the actual weight of the material. The system shall be capable of automatically monitoring the dust collection process and adjusting the amount of asphalt binder added to the mixture. The entire system shall be interlocked with the plant controls to respond to production rate changes, start up, and shut down situations. The weighing process shall be displayed and recorded in 0.1 units. The PDCE shall be capable of accurately wasting dust without having any adverse effects on the mixture.

**(h) Proportioning control systems.**

1. **Aggregate/RAP feed control.** Each feeder shall have an adjustable feed control, which can be locked, with a master control that will automatically increase or decrease the production rate of each feeder proportionately when the total rate of production is changed. The revolutions per minute, tons per hour, etc. of all feeders shall be measured at the tail shaft of the feeder. The aggregate/RAP feeders shall have an accuracy of  $\pm 1.0\%$  of the actual quantity of material incorporated.
2. **Aggregate/RAP weighing.** The main proportioning weigh belt shall be electronically interfaced with the asphalt binder, RAP if used, and mineral filler system to proportion the required amount of each material simultaneously to the mixer. The aggregate, and RAP if used, weighing systems shall have an accuracy of  $\pm 0.5\%$  of the actual material weighed by the belts. The weighing system shall also have a high-low adjustable tolerance indicator that will signal the operator audibly when the actual production rate differs from the preset rate by more than 3.0%.
3. **Mineral filler control.** Mineral filler shall be added to the mixer by a variable speed proportioning system interfaced with the aggregate weigh belt that will indicate total dry aggregate combined (aggregates + mineral filler) weight to the asphalt proportioning system. The mineral filler system shall have an accuracy of  $\pm 0.5\%$  if the mineral filler is measured by weight, or  $\pm 8.0\%$  if the mineral filler is measured solely by volume of the actual material measured by the system. The mineral filler shall be added in the mixer at the same point the asphalt binder is added such that no mineral filler is lost as fugitive dust. Other systems will be permitted if approved by the Engineer.
4. **Asphalt binder control.** The required quantity of asphalt binder shall be proportioned to the mixer via a temperature compensating meter that will correct the quantity of asphalt binder to 60°F, or a system approved by the Engineer. This system shall be electronically interfaced with the combined dry aggregates, RAP if used, and mineral filler. The meter shall have an accuracy of  $\pm 0.4\%$  of the actual material metered.
5. **Aggregate/RAP moisture compensators.** The moisture compensation devices shall be capable of electronically converting the wet aggregate/RAP weight to dry aggregate/RAP weight. Other systems will be permitted if approved by the Engineer.

**(i) Control console.** The following items shall be part of the operator's control console.

1. **Aggregate/RAP feed controls.** The variable speed controls, both total and proportional for each feeder and combined aggregates or RAP if used, shall be indexed in units with a minimum unit of 0.1. The rate in revolutions per minute,

tons per hour, etc. shall be displayed by a digital readout for each feeder with a minimum unit of 0.1 revolutions per minute or one (1) ton per hour, etc.

2. **Aggregate/RAP weight indicator.** The accumulated wet weight of material in tons that passes over each weigh belt shall be available at the control console with a minimum unit of 0.1 ton. The dry weight of material, in tons per hour, passing over each weigh belt shall be displayed by digital readouts with a minimum unit of one (1) ton per hour.
  3. **Mineral filler control.** Mineral filler shall be controlled by a variable speed control with a minimum unit of 0.1 and shall be displayed in revolutions per minute, tons per hour, etc. with a minimum unit of 0.1 revolutions per minute or 0.1 tons per hour, etc.
  4. **Asphalt binder control.** The asphalt binder control shall be capable of presetting the actual asphalt binder content directly as a percent of the total weight of mixture with a minimum unit of 0.1%. The asphalt binder rate shall be displayed to a minimum unit of 0.1. A control shall be provided to set the specific gravity or weight per gallon of the asphalt binder. The temperature of the asphalt binder shall be recorded by a recording pyrometer or thermometer at the console.
  5. **Aggregate/RAP moisture compensators.** The compensators shall be part of the operator's console and shall have a minimum unit of 0.1%. The control shall be lockable if the moisture setting is not printed as part of the record.
  6. **Asphalt temperature.** The temperature of the mixture shall be recorded in degrees Fahrenheit by a recording pyrometer or thermometer at the console.
- (j) **Recording of proportions.** The plant shall be equipped with a digital printer that will automatically print the following data at six (6) minute intervals during production time and on demand. All readings shall show the date, month and year, and time to the nearest minute for each print.
1. Accumulated dry aggregate/RAP in tons to the nearest 0.1 ton.
  2. Accumulated mineral filler in revolutions, tons, etc., to the nearest 0.1 unit.
  3. Accumulated asphalt binder in gallons, tons, etc., to the nearest 0.1 unit.
  4. Aggregate/RAP moisture compensators in percent as set at the panel. Required when accumulated dry aggregate/RAP is printed in wet aggregate/RAP weight.

Another system approved by the Engineer, such as a fully computerized system, that will provide the control and documentation of the above equipment, will be permitted.

- b. **Hauling equipment.** Trucks used for hauling asphalt shall have tight, clean, and smooth metal beds. To prevent the asphalt from sticking to the truck beds, the truck beds shall be lightly coated with a minimum amount of paraffin oil, lime solution, or other material approved by the Engineer. Petroleum products shall not be used for coating truck beds. Each truck shall have a suitable cover to protect the mixture from adverse weather. When necessary, to ensure that the mixture will be delivered to the site at the specified temperature, truck beds shall be insulated or heated, and covers shall be securely fastened.
- c. **Material transfer vehicle (MTV).** Material transfer vehicles to transfer the material from the hauling equipment to the paver shall be self-propelled with a swing conveyor that can deliver material to the paver without making contact with the paver. The MTV shall be able to move back and forth between the hauling equipment and the paver providing material transfer to the paver, while allowing the paver to operate at a constant speed. The MTV will have remixing and storage capability to prevent physical and thermal segregation.

An MTV is required for runway and taxiway construction on pavements designed for aircraft weighing 100,000 pounds or more. The MTV is recommended for all pavements where the weight of the MTV will not damage the pavement structure.

- d. Asphalt pavers.** Asphalt pavers shall be self-propelled with an activated heated screed, capable of spreading and finishing courses of asphalt that will meet the specified thickness, smoothness, and grade. The paver shall have sufficient power to propel itself and the hauling equipment without adversely affecting the finished surface. Asphalt pavers shall be self-contained, power-propelled units equipped with augers, activated screed or a strike off assembly and be capable of being heated. The augers, activated screed or strike off assembly shall be adjustable either automatically or by adding additional sections so the paver will place, compact or strike off the asphalt to the full width being placed. All width extensions shall have the same placement features and equipment functions as provided on the main body of the paver. Pavers with extendible type screeds shall have a minimum ten (10) foot basic screed, except on projects with 7,500 square yards or less of asphalt. For these smaller projects, a minimum eight (8) foot basic screed will be permitted. Augers shall be extended as additional sections of screed are bolted on or automatically adjustable screeds are extended. The augers need not be extended when the screed extensions on each side of the machine are one (1) foot or less if the finished surface of the mat is uniform. Pavers used for shoulders and similar construction shall be capable of spreading and finishing asphalt in widths shown on the plans. The use of any machine obsolete in design or in poor mechanical condition will not be permitted.

The asphalt paver shall be equipped with a control system capable of automatically maintaining the specified screed grade and elevation. The device shall be effective in leveling depressions in the surface of the existing pavement, the leveling course and the binder course.

The automatic electronic grade control device shall be capable of controlling the elevation of the screed relative to either a preset grade control stringline or a grade reference device traveling on the adjacent pavement surface. The traveling grade reference device shall be not less than 30 feet in length.

The paver shall be equipped with a receiving hopper having sufficient capacity for a uniform spreading operation. The hopper shall be equipped with a distribution system to uniformly place a non-segregated mixture in front of the screed. The distribution system shall have chain curtains, deflector plates, and/or other devices designed and built by the paver manufacturer to prevent segregation during distribution of the mixture from the hopper to the paver screed. The Contractor shall submit a written certification that the devices recommended by the paver manufacturer to prevent segregation have been installed and are operational. Prior to paving, the Contractor, in the presence of the Engineer, shall visually inspect paver parts specifically identified by the manufacturer's check list for excessive wear and the need for replacement. The Contractor shall supply the completed check list to the Engineer noting the condition of the parts. Worn parts shall be replaced. The Engineer may require an additional inspection prior to placement of the surface course or at other times throughout the work.

The screed or strike off assembly shall effectively produce a finished surface of the required smoothness and texture without tearing, shoving or gouging the mixture. If the spreading and finishing equipment in use leaves tracks or indented areas or produces other blemishes in the pavement that are not satisfactorily corrected by the scheduled operations, the use of such equipment shall be discontinued.

The paver shall be capable of paving to a minimum width specified in the contract documents.

The paver shall be capable of being operated at forward speeds consistent with satisfactory placement of the mixture.



A straightedge at least four (4) feet in length and equipped with a carpenter's level shall be available at the spreading and finishing machine to check the surface of the asphalt for transverse slope and longitudinal surface variations.

- e. **Rollers.** The number, type, and weight of rollers shall be sufficient to compact the asphalt to the required density while it is still in a workable condition without crushing of the aggregate, depressions or other damage to the pavement surface. Rollers shall be in good condition, clean, capable of without backlash, and of operating at slow speeds to avoid displacement of the asphalt. All rollers shall be specifically designed and suitable for compacting asphalt concrete and shall be properly used. Rollers that impair the stability of any layer of a pavement structure or underlying soils shall not be used.

No roller shall be used that has in any way been thrown out of its original balance by the application of attachments not approved by the Engineer. All bearings shall be tight.

- (1) **Self-propelled pneumatic-tired roller.** The roller shall be of the oscillating wheel type consisting of not less than seven (7) pneumatic-tired wheels revolving on two (2) axles, and capable of being ballasted to the weight required. The tires on the front and rear wheels shall be staggered so that the tire sidewalls will have a minimum overlap of one-half (1/2) inch. The roller shall provide for a smooth operation when starting, stopping or reversing direction.

The tires shall withstand inflation pressures between 60 and 120 pounds per square inch. The roller shall be equipped with an adequate scraping or cleaning device on each tire to prevent the accumulation of material on the tires. The roller shall be equipped with a water system which will keep all tires uniformly wet to prevent material pickup.

The Contractor shall provide means for determining the weight of the roller as distributed on each wheel. Ballast shall be included in determining the weight.

- (2) **Steel wheel rollers.** The roller shall be self-propelled and provide a smooth operation when starting, stopping, or reversing directions. The steering mechanism shall provide for positive control of the roller. Roller wheels shall be smooth and free from openings or projections which will mar the surface on which the roller is operated. Motor rollers shall be equipped with drip pans to contain oil, grease, or gasoline drips generated by the roller operation. The roller shall be provided with adjustable scrapers which shall be used when necessary to keep the surface of the wheels clean.

When used on a hot-mix asphalt surface, the roller shall be equipped with water tanks and sprinkling devices which shall be used to wet the wheels and prevent material pickup.

- (a) **Tandem rollers.** The Contractor shall provide means for determining the weight of the roller as distributed on each axle. Ballast shall be included in determining the weight.

The rear wheel may be crowned at the rate of not more than 3/16 inch in 4-1/2 feet. The front wheel shall be divided into at least two (2) sections and shall show no noticeable crown. The weight of the roller shall meet requirements of the specific item of work being constructed.

- (b) **Three-wheel rollers.** The rear wheels of three-wheel rollers may be crowned at the rate of not more than 1/16 inch in 20 inches and shall be propelled with a differential gear. The front wheel shall be divided into at least two (2) sections, shall show no noticeable crown, and shall overlap the compression area of each rear wheel by not less than 1-1/2 inch. The weight of the roller shall meet requirements of the specific item of work being constructed.

- (3) **Vibratory roller.** The vibratory roller shall be self-propelled and provide a smooth operation when starting, stopping or reversing directions. The vibrating drums amplitude and frequency shall be approximately the same in each direction and meet the following

minimum requirements: drum diameter 48 inches, length of drum 66 inches, vibrators 1,600 vibrations per minute, unit static force on vibrating drums 125 pounds per inch, total applied force 325 pounds per inch, adjustable eccentrics, and reversible eccentrics on nondriven drums. The total applied force for various combinations of vibrations per minute and eccentric positions shall be shown on decals on the vibrating roller or on a chart maintained with the roller. The vibratory roller shall be equipped with water tanks and sprinkling devices, or other approved methods, which shall be used to wet the wheels to prevent material pickup.

A vibrating reed tachometer (hand type) shall be furnished with each vibratory roller. The vibrating reed tachometer shall have a range of 1,000 to 4,000 vibrations per minute. The vibrating reed tachometer shall have two (2) rows of reeds, one (1) ranging from 1,000 to 2,000 vibrations per minute and the other from 2,000 to 4,000 vibrations per minute.

**(4) Oscillatory roller.** The oscillatory roller shall be self-propelled and provide a smooth operation when starting, stopping, or reversing directions. The oscillatory roller shall be able to operate in a mode that will provide tangential impact force with or without vertical impact force by using at least one drum. The oscillatory roller shall be equipped with water tanks and sprinkling devices, or other approved methods, which shall be used to wet the drums to prevent material pickup. The drum(s) amplitude and frequency of the tangential and vertical impact force shall be approximately the same in each direction and meet the following requirements:

- (a) The minimum diameter of the drum(s) shall be 48 inches;
- (b) The minimum length of the drum(s) shall be 66 inches;
- (c) The minimum unit static force on the drum(s) shall be 125 lb/in;
- (d) The minimum force on the oscillatory drum shall be 18,000 lb; and
- (e) Self-adjusting eccentrics, and reversible eccentrics on non-driven drum(s).

**f. Density device.** The Contractor shall have on site a density gauge during all paving operations in order to assist in the determination of the optimum rolling pattern, type of roller and frequencies, as well as to monitor the effect of the rolling operations during production paving. The Contractor shall also supply a qualified technician during all paving operations to calibrate the density gauge and obtain accurate density readings for all new asphalt. These densities shall be supplied to the Resident Engineer upon request at any time during construction. No separate payment will be made for supplying the density gauge and technician.

**g. Pavement surface test equipment.** Required surface testing and analysis equipment and their jobsite transportation shall be provided by the Contractor.

**(1) Straightedge.** The 16-foot or 12-foot straightedge shall consist of a metal I-beam mounted between two (2) wheels spaced 16 or 12 feet between the axles. Scratcher bolts, which can be easily and accurately adjusted, shall be set at the 1/4, 1/2, and 3/4 points between the axles. A handle suitable for pushing and guiding shall be attached to the straightedge.

**403-4.3 Aggregate stockpile management.** Aggregate stockpiles shall be constructed in such a manner that prevents segregation and intermixing of deleterious materials. Aggregates from different sources shall be stockpiled, weighed and batched separately at the concrete batch plant. Aggregates that have become segregated or mixed with earth or foreign material shall not be used.

A continuous supply of materials shall be provided to the work to ensure continuous placement.

**403-4.4 Preparation of asphalt binder.** The asphalt binder shall be heated in a manner that will avoid local overheating and provide a continuous supply of the asphalt material to the mixer at a

uniform temperature. The temperature of the unmodified asphalt binder delivered to the mixer shall be sufficient to provide a suitable viscosity for adequate coating of the aggregate particles but shall not exceed 325°F when added to the aggregate. The temperature of modified asphalt binder shall be no more than 350°F when added to the aggregate.

**403-4.5 Preparation of mineral aggregate.** The aggregate for the asphalt shall be heated and dried. The maximum temperature and rate of heating shall be such that no damage occurs to the aggregates. The temperature of the aggregate and mineral filler shall not exceed 350°F when the asphalt binder is added. Particular care shall be taken that aggregates high in calcium or magnesium content are not damaged by overheating. The temperature shall not be lower than is required to obtain complete coating and uniform distribution on the aggregate particles and to provide a mixture of satisfactory workability.

**403-4.6 Preparation of asphalt mixture.** The aggregates and the asphalt binder shall be weighed or metered and introduced into the mixer in the amount specified by the JMF. The combined materials shall be mixed until the aggregate obtains a uniform coating of asphalt binder and is thoroughly distributed throughout the mixture. Wet mixing time shall be the shortest time that will produce a satisfactory mixture, but not less than 25 seconds for batch plants. The wet mixing time for all plants shall be established by the Contractor, based on the procedure for determining the percentage of coated particles described in AASHTO T 195, for each individual plant and for each type of aggregate used. The wet mixing time will be set to achieve 95% of coated particles. For continuous mix plants, the minimum mixing time shall be determined by dividing the weight of its contents at operating level by the weight of the mixture delivered per second by the mixer. The moisture content of all asphalt upon discharge shall not exceed 0.5%.

For batch plants, wet mixing time begins with the introduction of asphalt binder into the mixer and ends with the opening of the mixer discharge gate. Mixing time should be the shortest time required to obtain uniform distribution of aggregate sizes and thorough coating of aggregate particles with asphalt binder.

**403-4.7 Application of prime and tack coat.** Immediately before placing the asphalt mixture, the underlying course shall be cleaned of all dust and debris.

A prime coat in accordance with Item 602 titled EMULSIFIED ASPHALT PRIME COAT shall be applied to aggregate base prior to placing the asphalt mixture.

A tack coat shall be applied in accordance with Item 603 titled EMULSIFIED ASPHALT TACK COAT to all vertical and horizontal asphalt and concrete surfaces prior to placement of the first and each subsequent lift of asphalt mixture.

**403-4.8 Laydown plan, transporting, placing, and finishing.** Prior to the placement of the asphalt, the Contractor shall prepare a laydown plan with the sequence of paving lanes and width to minimize the number of cold joints; the location of any temporary ramps; laydown temperature; and estimated time of completion for each portion of the work (milling, paving, rolling, cooling, etc.). The laydown plan and any modifications shall be approved by the Engineer.

Deliveries shall be scheduled so that placing and compacting of asphalt is uniform with minimum stopping and starting of the paver. Hauling over freshly placed material shall not be permitted until the material has been compacted, as specified, and allowed to cool to approximately ambient temperature. The Contractor, at their expense, shall be responsible for repair of any damage to the pavement caused by hauling operations.

The Contractor shall survey each lift of asphalt base course and certify to the Resident Engineer that every lot of each lift meets the grade tolerances of paragraph specified in the contract documents before the next lift can be placed.

Edges of existing asphalt pavement abutting the new work shall be saw cut and the cut off material and laitance removed. Apply a tack coat in accordance with Item 603 titled EMULSIFIED ASPHALT TACK COAT before new asphalt material is placed against it.

The speed of the paver shall be regulated to eliminate pulling and tearing of the asphalt mat. The paver speed shall be mated with the required roller speed and shall not exceed that which coincides with the average rate of delivery of asphalt to the paver to provide, as nearly as possible, continuous operation of the paver. In no case shall the speed of the paver exceed 50 feet per minute

Placement of the asphalt mix shall begin along the centerline of a crowned section or on the high side of areas with a one-way slope unless shown otherwise on the laydown plan as accepted by the Engineer. The asphalt mix shall be placed in consecutive adjacent lanes having a minimum width as specified in the contract documents. Additional screed sections attached to widen the paver to meet the minimum lane width requirements must include additional auger sections to move the asphalt mixture uniformly along the screed extension.

The longitudinal joint in one (1) course shall offset the longitudinal joint in the course immediately below by at least one (1) foot; however, the joint in the surface top course shall be at the centerline of crowned pavements. Transverse joints in one (1) course shall be offset by at least ten (10) feet from transverse joints in the previous course. Transverse joints in adjacent lanes shall be offset a minimum of ten (10) feet. On areas where irregularities or unavoidable obstacles make the use of mechanical spreading and finishing equipment impractical, the asphalt may be spread and luted by hand tools.

The Resident Engineer may at any time, reject any batch of asphalt, on the truck or placed in the mat, which is rendered unfit for use due to contamination, segregation, incomplete coating of aggregate, or overheated asphalt mixture. Such rejection may be based on only visual inspection or temperature measurements. In the event of such rejection, the Contractor may take a representative sample of the rejected material in the presence of the Resident Engineer, and if it can be demonstrated in the laboratory, in the presence of the Resident Engineer, that such material was erroneously rejected, payment will be made for the material at the contract unit price.

Paving operations shall be conducted in a manner to prevent medium or high segregation. Plant operations, hauling of the mix, paver operations, and the compacted mat shall be continually monitored for segregation. Areas of segregation in the surface course, as determined by the Resident Engineer, shall be removed and replaced at the Contractor's expense. The area shall be removed by saw cutting and milling a minimum of the construction lift thickness as specified for the approved mix design. The area to be removed and replaced shall be a minimum width of the paver and a minimum of ten (10) feet long.

**403-4.9 Compaction of asphalt mixture.** Immediately after each lift of asphalt course mixture is placed, each lift shall be compacted with equipment meeting the following requirements.

- a. **Breakdown roller.** The break down roller shall be a vibratory roller, pneumatic-tired roller, oscillatory roller, steel-wheeled tandem roller or steel wheeled three-wheel roller.
- b. **Intermediate roller.** The intermediate roller shall be a pneumatic-tired roller or oscillatory roller. A vibratory roller may be used on mixtures containing polymer modified asphalt binder.
- c. **Final roller.** The final roller shall be a vibratory roller operated in static mode, an oscillatory roller operated in tangential impact mode only, or steel-wheeled tandem roller.

Rolling of the first lane of asphalt shall start longitudinally at the edge having the lower elevation and progress to the other edge, overlapping on successive trips to obtain uniform coverage. The roller shall not pass over an unprotected edge of the freshly laid asphalt, unless directed by the Resident Engineer. When directed by the Resident Engineer, the edge shall be rolled with a pneumatic-tired roller.

When laying the asphalt adjacent to a previously placed lane, the first pass of the roller shall be along the longitudinal joint on the fresh mixture with the compression wheel not more than six (6) inches from the joint. The second pass of the roller shall overlap the longitudinal joint not

more than 12 inches on the previously placed lane, after which the rolling shall proceed from the low side of the transverse slope to the high side, overlapping uniformly. Each stop shall be regulated to prevent trapping of water on the rolled surface. The steel-wheeled rollers shall be operated with the compression wheels toward the direction of paving.

The speed of the roller at all times shall be slow enough to avoid displacement of the asphalt. If displacement occurs, it shall be corrected at once by raking and applying fresh asphalt where required. To prevent adhesion of the asphalt to the roller, the wheels shall be kept properly moistened without an excess of water.

Rolling of the asphalt shall be continued until all roller marks are eliminated and the asphalt is satisfactorily compacted.

In all places inaccessible to the rollers, such as locations adjacent to curbs, gutters, headers, manholes, and similar structures, the required compaction shall be secured with tampers.

Any asphalt that becomes loose and broken, mixed with dirt, contains check-cracking, or in any way defective shall be removed and replaced with fresh hot mixture and immediately compacted to conform to the surrounding area. This work shall be done at the Contractor's expense. Skin patching shall not be allowed.

**403-4.10 Joints.** The formation of all joints shall be made in such a manner as to ensure a continuous bond between the courses and obtain the required density. All joints shall have the same texture as other sections of the course and meet the requirements for smoothness and grade.

The roller shall not pass over the unprotected end of the freshly laid asphalt except when necessary to form a transverse joint. When necessary to form a transverse joint, it shall be made by means of placing a bulkhead or by tapering the course. The tapered edge shall be cut back to its full depth and width on a straight line to expose a vertical face prior to placing the adjacent lane. In both methods, all contact surfaces shall be coated with an asphalt tack coat before placing any fresh asphalt against the joint.

Longitudinal joints which are have been left exposed for more than four (4) hours; the surface temperature has cooled to less than 175°F; or are irregular, damaged, uncompacted or otherwise defective shall be cut back with a cutting wheel or pavement saw a maximum of three (3) inches to expose a clean, sound, uniform vertical surface for the full depth of the course. All cutback material and any laitance produced from cutting joints shall be removed from the project. Asphalt tack coat in accordance with Item 603 titled EMULSIFIED ASPHALT TACK COAT shall be applied to the clean, dry joint prior to placing any additional fresh asphalt against the joint. The cost of this work shall be considered incidental to the cost of the asphalt.

The Contractor may provide additional joint density QC by use of joint heaters at the Contractor's expense. Electrically powered infrared heating equipment should consist of one (1) or more low-level radiant energy heaters to uniformly heat and soften the pavement joints. The heaters should be configured to uniformly heat an area up to 18 inches in width and three (3) inches in depth. Infrared equipment shall be thermostatically controlled to provide a uniform, consistent temperature increase throughout the layer being heated up to a maximum temperature range of 200°F to 300°F.

Propane powered infrared heating equipment shall be attached to the paving machine and the output of infrared energy shall be in the one (1) to six (6) micron range. Converters shall be arranged end to end directly over the joint to be heated in sufficient numbers to continuously produce, when in operation, a minimum of 240,000 BTU per hour. The joint heater shall be positioned not more than one (1) inch above the pavement to be heated and in front of the paver screed and shall be fully adjustable. Heaters will be required to be in operation at all times.

The heaters shall be operated so they do not produce excessive heat when the units pass over new or previously paved material.

**403-4.11 Saw-cut grooving.** Saw-cut grooves shall be provided as specified in Item 621 titled SAW-CUT GROOVES.

**403-4.12 Diamond grinding.** Diamond grinding shall be completed prior to pavement grooving. Diamond grinding shall be accomplished by sawing with saw blades impregnated with industrial diamond abrasive.

Diamond grinding shall be performed with a machine designed specifically for diamond grinding capable of cutting a path at least three (3) feet wide. The saw blades shall be one-eighth (1/8) inch wide with a sufficient number of blades to create grooves between 0.090 and 0.130 inches wide; and peaks and ridges approximately 1/32 inch higher than the bottom of the grinding cut. The actual number of blades will be determined by the Contractor and depend on the hardness of the aggregate. Equipment or grinding procedures that causes ravels, aggregate fractures, spalls or disturbance to the pavement will not be permitted. The Contractor shall demonstrate to the Resident Engineer that the grinding equipment will produce satisfactory results prior to making corrections to the surface. Grinding will be tapered in all directions to provide smooth transitions to areas not requiring grinding. The slurry resulting from the grinding operation shall be continuously removed and the pavement left in a clean condition. The Contractor shall apply a surface treatment per Item 608 titled EMULSIFIED ASPHALT SEAL COAT to all areas that have been subject to grinding.

**403-4.13 Nighttime Paving Requirements.** The Contractor shall provide adequate lighting during any nighttime construction. A lighting plan shall be submitted by the Contractor and approved by the Engineer prior to the start of any nighttime work. All work shall be in accordance with the approved construction safety and phasing plan and lighting plan.

**403-4.14 Protection of pavement.** After final rolling, no vehicular traffic of any kind shall be permitted on the pavement until it has cured at least 12 hours or unless otherwise authorized by the Engineer. Newly constructed pavement areas shall not be opened to aircraft traffic until 24 hours after completion or unless otherwise authorized by the Engineer.

#### CONTRACTOR QUALITY CONTROL (QC)

**403-5.1 General.** The Contractor shall develop a Contractor Quality Control Program (CQCP) in accordance with Item 100 titled CONTRACTOR QUALITY CONTROL PROGRAM (CQCP). No partial payment will be made for materials that are subject to specific QC requirements without an approved CQCP.

**403-5.2 Contractor quality control (QC) facilities.** The Contractor shall provide or contract for testing facilities in accordance with Item 100 titled CONTRACTOR QUALITY CONTROL PROGRAM (CQCP). The Engineer shall be permitted unrestricted access to inspect the Contractor's QC facilities and witness QC activities. The Engineer will advise the Contractor in writing of any noted deficiencies concerning the QC facility, equipment, supplies, or testing personnel and procedures. When the deficiencies are serious enough to be adversely affecting the test results, the incorporation of the materials into the work shall be suspended immediately and will not be permitted to resume until the deficiencies are satisfactorily corrected.

**403-5.3 Quality control (QC) testing.** The Contractor shall perform all QC tests necessary to control the production and construction processes applicable to these specifications and as set forth in the approved CQCP. The testing program shall include, but not necessarily be limited to, tests for the control of asphalt content, aggregate gradation, temperatures, aggregate moisture, field compaction, and surface smoothness. A QC Testing Plan shall be developed as part of the CQCP.

**a. Asphalt content.** A minimum of two (2) tests shall be performed per day in accordance with AASHTO T 308 or AASHTO T 164 for determination of asphalt content. When using AASHTO T 308, the correction factor shall be determined as part of the first test performed at the beginning of plant production; and as part of every tenth test performed thereafter. The asphalt content for the day will be determined by averaging the test results.

- b. **Gradation.** Aggregate gradations shall be determined a minimum of twice per lot from mechanical analysis of extracted aggregate in accordance with the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 11-08, *Aggregate Gradation Control System (AGCS)*.
- c. **Moisture content of aggregate.** The moisture content of aggregate used for production shall be determined a minimum of once per day in accordance with AASHTO T 255.
- d. **Moisture content of asphalt.** The moisture content of the asphalt shall be determined once per day in accordance with AASHTO T 329.
- e. **Temperatures.** Temperatures shall be checked, at least four (4) times per lot, at necessary locations to determine the temperatures of the dryer, the asphalt binder in the storage tank, the asphalt at the plant, and the asphalt at the job site.
- f. **In-place density monitoring.** The Contractor shall conduct any necessary testing to ensure that the specified density is being achieved. A nuclear gauge may be used to monitor the pavement density in accordance with ASTM D2950.
- g. **Grade.** Grade shall be evaluated daily to allow adjustments to paving operations when grade measurements do not meet specifications. As a minimum, grade shall be evaluated prior to the placement of the first lift and then prior to and after placement of the surface lift.

Measurements will be taken at appropriate grade lines (as a minimum at center and edges of paving lane) and longitudinal spacing as shown on cross-sections and specified in the contract documents. The final surface of the pavement will not vary from the grade line elevations and cross-sections specified in the contract documents by more than 0.05 feet vertically and 0.1 feet laterally. The documentation will be provided by the Contractor to the Resident Engineer by the end of the following working day.

Areas with humps or depressions that exceed grade or smoothness criteria and that retain water on the surface must be ground off provided the course thickness after grinding is not more than one-half (1/2) inch less than the thickness specified in the contract documents.

The Contractor shall repair low areas or areas that cannot be corrected by grinding by removal of deficient areas to the depth of the final course plus one-half (1/2) inch and replacing with new material. Skin patching is not allowed.

**403-5.4 Sampling.** When directed by the Resident Engineer, the Contractor shall sample and test any material that appears inconsistent with similar material being sampled, unless such material is voluntarily removed and replaced, or deficiencies corrected by the Contractor. All sampling shall be in accordance with standard procedures specified.

**403-5.5 Control charts.** The Contractor shall maintain linear control charts both for individual measurements and moving average of the last four (4) tests for aggregate gradation, asphalt content, and voids.

Control charts shall be posted in a location satisfactory to the Resident Engineer and kept current. As a minimum, the control charts shall identify the project number, the contract item number, the test number, each test parameter, the limits applicable to each test parameter, and the Contractor's test results. The Contractor shall use the control charts as part of a process control system for identifying potential problems and assignable causes before they occur. If the Contractor's projected data during production indicates a problem and the Contractor is not taking satisfactory corrective action, the Engineer may halt production or acceptance of the material.

- a. **Individual measurements and moving average.** Control charts for individual measurements and moving average of the last four (4) tests shall be established to maintain process control within tolerance for aggregate gradation. and asphalt content. The control

charts shall use the JMF target values as indicators of central tendency for the following test parameters with associated limits:

### Control Chart Limits for Individual Measurements

Sieve	Individual Test	Moving Average of 4
1/2 inch	±6%	±4%
No. 4	±6%	±4%
No. 8	±5%	±3%
No. 30	±3%	±2.5%
No. 200	±2%	±1%
Asphalt Content	±0.45%	±0.2%
Voids	±1.2%	±1%

- b. Corrective action.** The CQCP shall indicate that appropriate action shall be taken when the process is believed to be out of tolerance. The plan shall contain sets of rules to gauge when a process is out of control and detail what action will be taken to bring the process into control. As a minimum, a process shall be deemed out of control and production stopped and corrective action taken, if:

**(1) Corrective action for required plant tests.**

- (a) Individual test results.** When an individual test result exceeds its control limit, the Contractor shall immediately resample and retest. If at the end of the day no material remains from which to resample, the first sample taken the following day shall serve as the resample as well as the first sample of the day. This result shall be recorded as a retest. If the retest passes, the Contractor may continue the required plant test frequency. Additional check samples should be taken to verify mix compliance.

- 1. Voids and asphalt binder content.** If the retest for voids or asphalt binder content exceeds control limits, asphalt production shall cease and immediate corrective action shall be instituted by the Contractor. After corrective action, asphalt production shall be restarted, the asphalt production shall be stabilized, and the Contractor shall immediately resample and retest. asphalt production may continue when approved by the Engineer. The corrective action shall be documented.
- 2. Gradation.** For gradation retest failures, immediate corrective action shall be instituted by the Contractor. After corrective action, the Contractor shall immediately resample and retest. The corrective action shall be documented.

- (b) Moving average.** When the moving average values trend toward the moving average control limits, the Contractor shall take corrective action and increase the sampling and testing frequency. The corrective action shall be documented.

The Contractor shall notify the Engineer whenever the moving average values exceed the moving average control limits. If two (2) consecutive moving average values fall outside the moving average control limits, the Contractor shall cease operations. Corrective action shall be immediately instituted by the Contractor. Operations shall not be reinstated without the approval of the Engineer. Failure to cease operations shall subject all subsequently produced material to be considered unacceptable.



(c) **Asphalt production control.** If the Contractor is not controlling the production process and is making no effort to take corrective action, the operation shall stop.

- (2) **Corrective action for required field tests (density).** When an individual density test exceeds the control limits, the Contractor shall immediately retest in a location that is halfway between the failed test site and the finish roller. If the retest passes, the Contractor shall continue the normal density test frequency. An additional density check test should be performed to verify the mix compaction.

If the retest fails, the Contractor shall immediately conduct one (1) of the following procedures.

(a) **Low density.** If the failing density retest indicates low densities, the Contractor shall immediately increase the compaction effort, review all mixture test results representing the asphalt being produced, and make corrective action as needed. The Contractor shall immediately perform a second density retest within the area representing the increased compaction effort and mixture adjustments.

(b) **High density.** If the failing density retest indicates high densities, the Contractor shall cease production and placement until all mixture test results are reviewed and corrective action is taken. If the high-density failure is a result of a change in the mixture, any existing material in the surge bin may be subject to rejection by the Engineer. After restart of asphalt production, a second density retest shall then be performed in the area representing the mixture adjustments.

If the second retest from either procedure passes, production and placement of the asphalt may continue. The increased compaction effort for low density failures shall not be reduced to that originally being used unless it is determined by investigation that the cause of the low density was unrelated to compaction effort, the cause was corrected, and tests show the corrective action has increased the density within the required limits.

If the second retest fails, production and placement of the asphalt shall cease until the Contractor has completed an investigation and the problem causing the failing densities has been determined. If the Contractor's corrective action is approved by the Engineer, production and placement of the asphalt may then be resumed. The Contractor shall increase the frequency of density testing to show, to the satisfaction of the Engineer, that the corrective action taken has corrected the density problem.

If the Contractor is not controlling the compaction process and is making no effort to take corrective action, the operation, as directed by the Engineer, shall stop.

- 403-5.6 Quality control (QC) reports.** The Contractor shall maintain records and shall submit reports of QC activities daily in accordance with the CQCP described in Item 100 titled CONTRACTOR QUALITY CONTROL PLAN (CQCP).

## MATERIAL ACCEPTANCE

- 403-6.1. Quality assurance acceptance sampling and testing.** Unless otherwise specified, all acceptance sampling and testing necessary to determine conformance with the requirements specified in this section will be performed by the Resident Engineer at no cost to the Contractor except that coring as required in this section shall be completed and paid for by the Contractor. Refer to Illinois Department of Transportation, Aeronautics Policy Memorandum (PM) 96-3, *Requirements for Quality Assurance on Projects With Bituminous Concrete Paving*.

**(For Method I only: Under 2,000 tons/pay item)** After the completion of compaction, the pavement will be tested for acceptance by the Resident Engineer and accepted on the basis of percent air voids in the final compacted mat. The HMA base course shall be compacted to a minimum density of 93 percent (7 percent air voids) and a maximum of 99 percent (1 percent air voids) of the Theoretical Maximum Specific Gravity (AASHTO T 209). If during construction,

the density test fails below 93 percent, additional approved rollers shall be required. Failure to achieve density within these limits shall be cause for rejection of the material, as determined by the Department.

Two random nuclear density tests shall be taken for each 500 tons of mix placed. Each nuclear density test shall be the average of five (5) nuclear tests taken as a cross-section of the pavement. The Resident Engineer shall have a nuclear gauge and qualified operator on the project when constructing this item. One random mix sample shall be taken from each 1,000 tons of mix laid, for Extraction, Maximum Specific Gravity, and Air Void tests.

A minimum of one core set (2 cores, results averaged) shall be collected from a location centered on a longitudinal construction joint. The minimum density of the joint shall be 90 percent of the Maximum Theoretical Specific Gravity. When a longitudinal joint sealant is applied, longitudinal joint density testing will not be required on the joint(s) sealed.

Joint density results below an average of 90% shall result in an immediate suspension of paving operations until sufficient investigation and solution to the density problem is agreed to by the Engineer. The result of this deficiency will be a 5% penalty on all production done on the day the core represents.

**(For Method II only: 2,000 tons/pay item and Over)**. After the completion of compaction, the pavement will be tested and accepted on the basis of Percentage of material Within specification Limits (PWL).

The HMA surface course shall be compacted to a minimum density of 93 percent (7 percent air voids) and a maximum of 99 percent (1 percent air voids) of the Theoretical Maximum Specific Gravity (AASHTO T 209) and accepted by the following statistical procedure. When more than one base course mix design is used on the same project, each mix will be evaluated separately under the statistical acceptance procedure specified herein.

- a. **Quality assurance (QA) testing laboratory.** The QA testing laboratory performing these acceptance tests will be accredited in accordance with the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 6-08, *Minimum Private Laboratory Requirements for Construction Materials Testing or Mix Design*.
- b. **Lot size.** A standard lot will consist of one (1) day's production not to exceed 2,000 tons. Each lot will be divided into approximately equal sublots with individual sublots equivalent to 500 tons of asphalt. When only one (1) or two (2) sublots are produced in a day's production, the sublots will be combined with the production lot from the previous or next day. A lot shall consist of the average of four (4) sublot samples but shall not exceed six (6) sublots. The minimum number of sublots per lot shall be three (3). Where three (3) sublots are produced, they will constitute a lot. Where one (1) or two (2) sublots are produced, they will be incorporated into the previous or next lot. Where more than one (1) plant is simultaneously producing asphalt for the job, the lot sizes will apply separately for each plant.
- c. **Partial lots.** When operational conditions cause a lot to be terminated before the specified number of tests have been made for the lot or for overages or minor placements to be considered as partial lots, the following procedure will be used to adjust the lot size and the number of tests for the lot.

Where three (3) sublots have been produced, they will constitute a lot. The final lot may thus contain up to six (6) sublots. Where one (1) or two (2) sublots have been produced, they will be incorporated into the next lot or the previous lot and the total number of sublots will be used in the acceptance criteria calculation, that is,  $n=5$  or  $n=6$ .

- d. **Asphalt air voids.** Plant-produced asphalt will be tested for air voids on a sublot basis.

- (1) **Sampling.** Random sampling locations will be determined by the Resident Engineer. Samples shall be taken from material deposited into trucks at the plant or at the job site in accordance with ASTM D979. The sample of asphalt may be put in a covered metal tin and placed in an oven for not less than 30 minutes nor more than 60 minutes to maintain the material at or above the compaction temperature as specified in the JMF.
  - (2) **Testing.** Air voids will be determined for each subplot in accordance with AASHTO T 269 for a set of compacted specimens prepared in accordance with AASHTO T 312.
- e. **In-place asphalt mat and joint density.** Each subplot will be tested for in-place mat and joint density as a percentage of the theoretical maximum density (TMD).
- (1) **Sampling.** The Contractor will cut minimum five (5) inches diameter samples in accordance with AASHTO R 67. The Contractor shall furnish all tools, labor, and materials for cleaning, and filling the cored pavement. Laitance produced by the coring operation shall be removed immediately after coring, and core holes shall be filled within one (1) day after sampling in a manner acceptable to the Resident Engineer.
  - (2) **Bond.** Each lift of asphalt shall be bonded to the underlying layer. If cores reveal that the surface is not bonded, additional cores shall be taken as directed by the Resident Engineer to determine the extent of unbonded areas. Unbonded areas shall be removed by milling and replaced at the Contractor's expense as directed by the Engineer.
  - (3) **Thickness.** Thickness of each lift of surface course will be evaluated by the Resident Engineer for compliance to the requirements specified in the contract documents after any necessary corrections for grade. Measurements of thickness will be made using the cores extracted for each subplot for density measurement. The maximum allowable deficiency at any point will not be more than one-quarter (1/4) inch less than the thickness indicated for the lift. Average thickness of lift, or combined lifts, will not be less than the indicated thickness. Where the thickness tolerances are not met, the lot or subplot shall be corrected by the Contractor at his expense by removing the deficient area and replacing with new pavement. The Contractor, at his expense, may take additional cores as approved by the Engineer to circumscribe the deficient area.
  - (4) **Mat density.** One (1) core shall be taken from each subplot. Random sampling locations will be determined by the Resident Engineer. Cores for mat density shall not be taken closer than one (1) foot from a transverse or longitudinal joint. The bulk specific gravity of each cored sample will be determined in accordance with AASHTO T 166. The percent compaction (density) of each sample will be determined by dividing the bulk specific gravity of each subplot sample by the TMD for that subplot.
  - (5) **Joint density.** One (1) core centered over the longitudinal joint shall be taken for each subplot which contains a longitudinal joint. Random sampling locations will be determined by the Resident Engineer. The bulk specific gravity of each core sample will be determined in accordance with AASHTO T 166. The percent compaction (density) of each sample will be determined by dividing the bulk specific gravity of each joint density sample by the average TMD for the lot. The TMD used to determine the joint density at joints formed between lots will be the lower of the average TMD values from the adjacent lots. The minimum joint density shall be 90% of the TMD.

When a longitudinal joint sealant is applied, longitudinal joint density testing will not be required on the joint(s) sealed.

#### 403-6.2 Acceptance criteria.

- a. **General.** Acceptance will be based on the implementation of the Contractor Quality Control Program (CQCP) and the following characteristics of the completed pavements:
  - (1) Air voids

- (2) Mat density
  - (3) Joint density
  - (4) Grade
- b. Air voids and mat density.** Acceptance of each lot of plant produced material for air voids, voids in mineral aggregate and mat density will be based on the percentage of material within specification limits (PWL). If the PWL of the lot equals or exceeds 90%, the lot will be acceptable
- c. Joint density.** Acceptance of each lot of plant produced asphalt for joint density will be based on PWL. If the PWL of the lot is equal to or exceeds 90%, the lot will be acceptable. If the PWL of the lot is less than 90%, the Contractor shall evaluate the reason and act accordingly. If the PWL is less than 80%, the Contractor cease operations. Production may resume once the reason for poor compaction has been determined and appropriate measures have been taken to ensure proper compaction. If the PWL is less than 71%, the pay factor for the lot used to complete the joint will be reduced by 5%.
- d. Grade.** The final finished surface of the pavement of the completed project shall be surveyed to verify that the grade elevations and cross-sections specified in the contract documents do not deviate more than one-half (1/2) inch vertically or 0.1 feet laterally.

Cross-sections of the pavement shall be taken at a minimum 50-foot longitudinal spacing and at all longitudinal grade breaks. Minimum cross-section grade points shall include grade at centerline,  $\pm 10$  feet of centerline, and edge of pavement.

The survey and documentation shall be stamped and signed by a professional licensed surveyor. Payment for sublots that do not meet grade for over 25% of the sublot shall be reduced by 5% and not be more than 95%.

- 403-6.3 Percentage of material within specification limits (PWL).** The PWL will be determined in accordance with procedures specified in Item 110 titled METHOD OF ESTIMATING PERCENTAGE OF MATERIAL WITHIN SPECIFICATION LIMITS (PWL). The specification tolerance limits (L) for lower and (U) for upper are contained in the table below.

#### Acceptance Limits for Air Voids and Density

Test Property	Pavement Specification Tolerance Limits	
	L	U
Air Voids (%)	Design Voids – 1.35	Design Voids + 1.35
Density (%)	93.0 <sup>1</sup>	
Joint Density (%)	90.0	--

1. Applies to all asphalt mixes other than Leveling Course placed less than 1.25 inches thick.

- a. Outliers.** All individual tests for mat density and air voids will be checked for outliers (test criterion) in accordance with ASTM E178, at a significance level of 5%. Outliers will be discarded, and the PWL will be determined using the remaining test values.

**403-6.4 Resampling pavement for mat density.**

- a. General.** Resampling of a lot of pavement will only be allowed for mat density and then, only if the Contractor requests same in writing, within 48 hours after receiving the written test results from the Resident Engineer. Only one (1) resampling per lot will be permitted. Results of the resampling and retesting shall be final.

- (1) A redefined PWL will be calculated for the resampled lot. The number of tests used to calculate the redefined PWL will include the initial tests made for that lot plus the retests.
  - (2) The cost for resampling and retesting shall be borne by the Contractor.
- b. **Payment for resampled lots.** The redefined PWL for a resampled lot will be used to evaluate the acceptance of that lot.
  - c. **Outliers.** Check for outliers in accordance with ASTM E178, at a significance level of 5%. Outliers will be discarded, and density determined using the remaining test values.

#### METHOD OF MEASUREMENT

- 403-7.1** The quantity of asphalt shall be measured for payment by the number of tons of asphalt used for pavement as specified, completed and accepted by the Resident Engineer.
- Recorded batch weights or truck scale weights will be used to determine the basis for the tonnage.

#### BASIS OF PAYMENT

- 403-8.1 (For Method I only: Under 2,000 tons/pay item).** Payment for accepted quantities of work performed by the Contractor and measured by the Resident Engineer shall be made at the contract unit price as specified in paragraph 403-7.1 of this section. Acceptance shall be based upon the test results for density. Acceptance test results that do not meet the limits set forth in paragraph 403-6.1 QUALITY ASSURANCE ACCPETANCE SAMPLING AND TESTING, Method I, shall be cause for a payment adjustment, or removal and replacement, of the material placed in the failed subplot(s), as determined by the Department.

The total project payment for asphalt shall not exceed 103% of the product of the contract plan quantity of asphalt used in the accepted work

**(For Method II only: 2,000 tons/pay item and Over).** Payment for accepted quantities of work performed by the Contractor and measured by the Resident Engineer shall be made at the contract unit price as specified in paragraph 403-7.1 of this section adjusted based on results of tests for air voids and mat density, and joint density. Payment shall be compensation for furnishing all materials, for all preparation, mixing, and placing of these materials, and for all labor, equipment, tools, and incidentals necessary to complete the item.

The total project payment for asphalt shall not exceed 103% of the product of the contract plan quantity of asphalt used in the accepted work.

- d. **Adjusted payment.** The pay factor for each individual lot shall be calculated in accordance with the Pay Adjustment Schedule table below. A pay factor shall be calculated for both mat density and air voids. The lot pay factor shall be the higher of the two values when calculations for both mat density and air voids are 100% or higher. The lot pay factor shall be the product of the two values when only one of the calculations for either mat density or air voids is 100% or higher. The lot pay factor shall be the lower of the two values when calculations for both mat density and air voids are less than 100%. If PWL for joint density is less than 71% then the lot pay factor shall be reduced by 5% but be no higher than 95%.

For each lot accepted, the adjusted contract unit price shall be the product of the lot pay factor for the lot and the contract unit price. Payment shall be subject to the total project limitations specified in paragraph 401-8.1. Payment in excess of 100% for accepted lots of

asphalt shall be used to offset payment for accepted lots of asphalt pavement that achieve a lot pay factor less than 100%.

Payment for sublots which do not meet grade in accordance with paragraph 403-6.2d after correction for over 25% of the subplot shall be reduced by 5%.

#### Pay Adjustment Schedule<sup>1</sup>

Percentage of Material Within Specification Limits (PWL)	Lot Pay Factor (percent of contract unit price)
96 – 100	106
90 – 95	PWL + 10
75 – 89	0.5 PWL + 55
55 – 74	1.4 PWL - 12
Below 55	Reject

1. Although it is theoretically possible to achieve a pay factor of 106% for each lot, actual payment above 100% shall be subject to the total project limitation specified in paragraph 403-8.1.

#### REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

##### ASTM International (ASTM)

- ASTM D 979 Standard Practice for Sampling Bituminous Paving Mixtures  
 ASTM E 178 Standard Practice for Dealing with Outlying Observations

##### American Association of State Highway and Transportation Officials (AASHTO)

- AASHTO M 320 Standard Specification for Performance-Graded Asphalt Binder  
 AASHTO R 67 Standard Practice for Sampling Asphalt Mixtures after Compaction (Obtaining Cores)  
 AASHTO T 88 Standard Method of Test for Particle Size Analysis of Soils  
 AASHTO T 90 Standard Method of Test for Determining the Plastic Limit and Plasticity Index of Soils  
 AASHTO T 164 Standard Method of Test for Quantitative Extraction of Asphalt Binder from Hot-Mix Asphalt (HMA)  
 AASHTO T 166 Standard Method of Test for Bulk Specific Gravity ( $G_{mb}$ ) of Compacted Hot Mix Asphalt (HMA) Using Saturated Surface-Dry Specimens  
 AASHTO T 195 Standard Method of Test for Determining Degree of Particle Coating of Bituminous-Aggregate Mixtures  
 AASHTO T 209 Standard Method of Test for Theoretical Maximum Specific Gravity ( $G_{mm}$ ) and Density of Hot-Mix Asphalt (HMA)

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AASHTO T 255	Standard Method of Test for Total Evaporable Moisture Content of Aggregate by Drying
AASHTO T 269	Standard Method of Test for Percent Air Voids in Compacted Dense and Open Asphalt Mixtures
AASHTO T 308	Standard Method of Test for Determining the Asphalt Binder Content of Hot Mix Asphalt (HMA) by the Ignition Method
AASHTO T 312	Standard Method of Test for Preparing and Determining the Density of Asphalt Mixture Specimens by Means of the Superpave Gyrotory Compactor
AASHTO T 324	Standard Method of Test for Hamburg Wheel-Track Testing of Compacted Hot Mix Asphalt (HMA)
AASHTO T 329	Standard Method of Test for Moisture Content of Hot Mix Asphalt (HMA) by Oven Method

**Asphalt Institute (AI)**

MS-2	Mix Design Manual, 7th Edition
MS-26	Asphalt Binder Handbook
	AI State Binder Specification Database

**Illinois Department of Transportation, Bureau of Materials Illinois Laboratory Test Procedure (ITP)***Manual of Test Procedures for Materials*

AASHTO T 11	Illinois Modified, Standard Method of Test for Materials Finer Than 75- $\mu$ m (No. 200) Sieve in Mineral Aggregates by Washing
ITP 19	Bulk Density ("Unit Weight") and Voids in Aggregate

*Manual of Aggregate Quality Test Procedures*

ITP 21	Organic Impurities in Fine Aggregates for Concrete
ITP 71	Effect of Organic Impurities in Fine Aggregate on Strength of Mortar
AASHTO T 96	Illinois Modified, Standard Method of Test for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
AASHTO T 104	Illinois Modified, Standard Method of Test for Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate
ITP 113	Lightweight Pieces in Aggregate
ITP 203	Deleterious Particles in Coarse Aggregate
ITP 204	Deleterious Particles in Fine Aggregate

**Illinois Department of Transportation, Bureau of Materials Policy Memoranda (PM)**

PM 1-08	Performance Graded Asphalt Binder Acceptance Procedure
PM 4-08	Approval of Hot-Mix Asphalt Plants and Equipment
PM 6-08	Minimum Private Laboratory Requirement for Construction Materials Testing or Mix Design
PM 11-08	Aggregate Gradation Control System (AGCS)
PM 12-08	Crushed Gravel Producer Self-Testing Program
PM 13-08	Slag Producer Self-Testing Program

**Illinois Department of Transportation, Bureau of Materials Qualified Product List**

Certified Sources for Performance Graded Asphalt Binder

**Illinois Department of Transportation, Aeronautics Policy Memoranda (PM)**

PM 96-3	Requirements for Quality Assurance on Projects With Bituminous Concrete Paving
PM 2003-1	Requirements for Laboratory, Testing, Quality Control, and Paving of Superpave HMA Concrete Mixtures for Airports
PM	HMA Comparison Samples

**END OF ITEM 403**



## Item 404 Fuel-Resistant Asphalt Mix Pavement Surface Course

### DESCRIPTION

- 404-1.1** This item shall consist of surface courses composed of mineral aggregate, fuel-resistant asphalt binder, and additives mixed in a central mixing plant and placed as asphalt mix pavement as specified in the contract documents. This mix is to be used only as a surface course. The purpose of this fuel-resistant asphalt is to provide a fuel-resistant surface where pavements are subjected to fuel spills. The course shall be constructed to the depth, typical section, and elevation required by the plans. Refer to Illinois Department of Transportation, Aeronautics Policy Memorandum (PM) 96-3, *Requirements for Quality Assurance on Projects With Bituminous Concrete Paving*.

### MATERIALS

- 404-2.1 Aggregate.** Aggregates shall consist of crushed stone, crushed gravel, crushed slag, screenings, and mineral filler, as required. The aggregate shall contain no natural sand. The aggregates should have no known history of detrimental pavement staining due to ferrous sulfides. Coarse aggregate is the material retained on the No. 4 sieve. Fine aggregate is the material passing the No. 4 sieve.

- a. Coarse aggregate.** Coarse aggregate shall consist of crushed stone, crushed gravel, or crushed slag and shall be clean, sound, tough, durable particles, free from films of matter that would prevent thorough coating and bonding with the asphalt material and free from organic matter and other deleterious substances.

- (1) Description.** The natural and manufactured materials used as coarse aggregate are defined as follows.

- (a) Gravel.** Gravel shall be the coarse granular material resulting from the reduction of rock by the action of the elements and having subangular to rounded surfaces. It may be partially crushed.

- (b) Crushed gravel.** Crushed gravel shall be the product resulting from crushing, by mechanical means, and shall consist entirely of particles obtained by crushing gravel. The acceptance and use of crushed gravel shall be according to the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 12-08, *Crushed Gravel Producer Self-Testing Program*.

- (c) Crushed stone.** Crushed stone shall be the angular fragments resulting from crushing undisturbed, consolidated deposits of rock by mechanical means. Crushed stone shall be divided into the following, when specified.

- 1. Carbonate crushed stone.** Carbonate crushed stone shall be either dolomite or limestone. Dolomite shall contain 11.0% or more magnesium oxide (MgO). Limestone shall contain less than 11.0% magnesium oxide (MgO).

- 2. Crystalline crushed stone.** Crystalline crushed stone shall be either metamorphic or igneous stone, including but is not limited to, quartzite, granite, rhyolite and diabase.

- (d) Crushed slag.** Crushed slag shall be the graded product resulting from the processing of air-cooled blast furnace slag. Air-cooled blast furnace slag shall be the nonmetallic product, consisting essentially of silicates and aluminosilicates of

lime and other bases, which is developed in a molten condition simultaneously with iron in a blast furnace. It shall be air-cooled and shall have a compact weight (ITP 19) of not less than 70 pounds per cubic foot. The acceptance and use of air-cooled blast furnace slag shall be according to the current Illinois Department of Transportation, Bureau of Materials Policy Memoranda (PM) 12-08, *Crushed Gravel Producer Self-Testing Program* and 13-08, *Slag Producer Self-Testing Program*.

- (e) **Crushed sandstone.** Crushed sandstone shall be the angular fragments resulting from crushing, by mechanical means, a cemented sand composed predominantly of quartz grains. Sandstone shall have an Insoluble Residue of 50.0% or higher.
- (f) **Crushed concrete.** Crushed concrete shall be the angular fragments resulting from crushing Portland cement concrete by mechanical means. The acceptance and use of crushed concrete shall be according to Item 219 titled RECYCLED CONCRETE AGGREGATE BASE COURSE.
- (g) **Crushed steel slag.** Crushed steel slag shall be the graded product resulting from the processing of steel slag. Steel slag shall be the nonmetallic product which is developed in a molten condition simultaneously with steel in an open hearth, basic oxygen, or electric furnace. The acceptance and use of crushed steel slag shall be according to the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 13-08, *Slag Producer Self-Testing Program*.
- (2) **Quality.** The coarse aggregate shall be Class B Quality or better according to the quality standards listed in the following table.

#### Coarse Aggregate Quality

Quality Test	Class
	B
Na <sub>2</sub> SO <sub>4</sub> Soundness 5 Cycle, Illinois Modified AASHTO T 104 <sup>1</sup> , % Loss max.	15
Los Angeles Abrasion, Illinois Modified AASHTO T 96, % Loss max.	40 <sup>2</sup>
Deleterious Materials <sup>3</sup>	
Shale, % max.	2.0
Clay Lumps, % max.	0.5
Coal & Lignite, % max.	---
Soft & Unsound Fragments, % max.	6.0
Other Deleterious, % max.	2.0
Total Deleterious, % max.	6.0

1. Does not apply to crushed concrete.
2. Does not apply to crushed slag or crushed steel slag.
3. Test shall be run according to ITP 203.

- b. **Fine aggregate.** Fine aggregate shall consist of sand, stone sand, chats, slag sand, or steel slag sand. For gradation FA 22, uncrushed material will not be permitted.

- (1) **Description.** The natural and manufactured materials used as fine aggregate are defined as follows.

- (a) **Sand.** Sand shall be the fine granular material resulting from the natural disintegration of rock. Sand produced from deposits simultaneously with, and by the same operations as, gravel coarse aggregate may contain crushed particles in the quantity resulting normally from the crushing and screening of oversize particles.

- (b) **Stone sand.** Stone sand shall be produced by washing, or processing by air separation, the fine material resulting from crushing rock quarried from undisturbed, consolidated deposits, or crushing gravel. The acceptance and use of crushed gravel stone sand shall be according to the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 12-08, *Crushed Gravel Producer Self-Testing Program*.
- (c) **Chats.** Chats shall be the tailings resulting from the separation of metals from rocks in which they occur.
- (d) **Slag sand.** Slag sand shall be the graded product resulting from the screening of air-cooled blast furnace slag. Air-cooled blast furnace slag shall be the nonmetallic product, consisting essentially of silicates and alumino-silicates of lime and other bases, which is developed in a molten condition simultaneously with iron in a blast furnace.
- The acceptance and use of air-cooled blast furnace slag sand shall be according to the current Illinois Department of Transportation, Bureau of Materials Policy Memoranda (PM) 12-08, *Crushed Gravel Producer Self-Testing Program* and 13-08, *Slag Producer Self-Testing Program*.
- (e) **Steel slag sand.** Steel slag sand shall be the graded product resulting from the screening of crushed steel slag. Crushed steel slag shall be the nonmetallic product which is developed in a molten condition simultaneously with steel in an open hearth, basic oxygen, or electric furnace. The acceptance and use of steel slag sand shall be according to the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 13-08, *Slag Producer Self-Testing Program*.
- (2) **Quality.** The fine aggregate shall be Class A Quality or better according to the quality standards listed in the following table.

#### Fine Aggregate Quality<sup>1</sup>

Quality Test	Class
	A
Na <sub>2</sub> SO <sub>4</sub> Soundness 5 Cycle, Illinois Modified AASHTO T 104, % Loss max.	10
Minus No. 200 Sieve Material, Illinois Modified AASHTO T11, % max. <sup>2</sup>	3
Organic Impurities Check, Illinois Modified AASHTO T 21	Yes <sup>3</sup>
Deleterious Materials <sup>3, 4</sup>	
Shale, % max.	3.0
Clay Lumps, % max.	1.0
Coal & Lignite, & Shells, % max.	1.0
Conglomerate, % max.	3.0
Other Deleterious, % max.	3.0
Total Deleterious, % max.	3.0

- Natural sand is not allowed.
- Fine aggregate used for hot-mix asphalt (HMA) shall not contain more than three percent clay (2 micron or smaller) particles as determined by Illinois Modified AASHTO T 88.
- Applies only to sand.
- Tests shall be run according to ITP 204.

- (3) **Gradation requirements.** The fine aggregate gradation shall be FA 1, FA 2, FA 20, FA 21, or FA 22.

### Gradation Requirements

Sieve Size	Gradation Percent Passing				
	FA 1	FA 2	FA 20	FA 21	FA 22
3/8 inch	100	100	100	100	100
No. 4	97±3	97±3	97±3	97±3	
No. 8			80±20	80±20	
No. 16	65±20	65±20	50±15	57±18	8±8
No. 50	16±13	20±10	19±11	30±10	
No. 100	5±5	5±5	10±7	20±10	
No. 200			4±4	9±9	2±2

- c. **Sampling.** The current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 11-08, *Aggregate Gradation Control System (AGCS)*, shall be used in sampling coarse and fine aggregate.

**404-2.2 Mineral filler.** Mineral filler may be added in addition to material naturally present in the aggregate. Mineral filler shall consist of dry limestone dust, fly ash, cement kiln dust, or lime kiln dust and shall meet the following requirements.

- a. **Gradation.** The gradation shall be according to the following.

### Gradation Requirements

Sieve Size	Percent Passing
No. 30	100
No. 100	92±8
No. 200	82±18

- b. **Loss on ignition.** The loss on ignition for all products shall be a maximum of 5% when tested according to the ITP, *Loss on Ignition for Mineral Filler*.
- c. **Additional requirements.**

### Mineral filler Requirements

Material Test	Requirement	Standard
Plasticity Index	4 maximum	AASHTO T 90

**404-2.3 Asphalt binder.** Asphalt binder shall conform to Performance Grade (PG) 82-28 or 88-22 with the changes annotated below:

- a. The original asphalt binder shall be tested according to ASTM D6084. Elastic Recovery at 77°F and shall be a minimum of 85%, using procedure A on the RTFO aged binder.
- b. The original asphalt binder shall be tested according to ASTM D7173 and meet the maximum binder temperature difference of 4°C when using the ASTM D36 Ring-and-Ball apparatus.

- c. The asphalt specimens prepared with the asphalt binder must also meet the fuel resistance requirements as specified in the contract documents. After passing the requirements, the grade of the asphalt binder shall be identified as PG 82-28FR or 88-22FR.

Asphalt binder materials will be accepted according to the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 1-08, *Performance Graded Asphalt Binder Acceptance Procedure* and/or be listed on the current Illinois Department of Transportation's published Qualified Producer List of *Certified Sources for Performance Graded Asphalt Binder*.

The Contractor shall provide a copy of the manufacturer's certificate of analysis (COA) for the asphalt binder. The test reports shall be provided to and approved by the Resident Engineer (RE) before the asphalt binder is applied. The furnishing of the vendor's certified test report for the asphalt material shall not be interpreted as a basis for final acceptance. The manufacturer's COA may be subject to verification by testing the material delivered for use on the project.

- 404-2.4 Anti-stripping agent.** If it is determined that an additive is required, the additive may be hydrated lime, slaked quicklime, or a liquid additive, at the Contractor's option.

Dry hydrated lime shall be added at a rate of 1.0% to 1.5% by weight of total dry aggregate. Slurry shall be added in such quantity as to provide the required amount of hydrated lime solids by weight of total dry aggregate.

## COMPOSITION

- 404-3.1 Composition of mixture.** The asphalt plant mix shall be composed of a mixture of well-graded aggregate, filler and anti-strip agent if required, and asphalt material. The several aggregate fractions shall be sized, handled in separate size groups, and combined in such proportions that the resulting mixture meets the grading requirements of the job mix formula (JMF).

- 404-3.2 Job mix formula (JMF) laboratory.** The Contractor shall provide a laboratory, at the plant, according to the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 6-08, *Minimum Private Laboratory Requirements for Construction Materials Testing or Mix Design*. The laboratory shall be of sufficient size and be furnished with the necessary equipment and supplies for adequately and safely performing the Contractor's QC testing.

The laboratory and equipment furnished by the Contractor shall be properly maintained. The Contractor shall maintain a record of calibration results at the laboratory. The Engineer may inspect measuring and testing devices at any time to confirm both calibration and condition. If the Engineer determines the equipment is not within the limits of dimensions or calibration described in the appropriate test method, the Engineer may stop production until corrective action is taken. If laboratory equipment becomes inoperable, the Contractor shall cease mix production.

- 404-3.3 Job mix formula (JMF).** No asphalt mixture shall be placed until an acceptable mix design has been submitted to the Engineer for review and accepted in writing. The Engineer's review shall not relieve the Contractor of the responsibility to select and proportion the materials to comply with this section.

Add anti-stripping agent to meet tensile strength requirements.

The asphalt mixture shall be designed using procedures contained in the Asphalt Institute MS-2 Mix Design Manual, 7th Edition. Samples shall be prepared and compacted using a Marshall compactor in accordance with ASTM D6926.

If material variability exceeds the standard deviations indicated, the job mix formula and subsequent production targets shall be based on stability greater than specified in the contract documents, and the air voids shall be targeted close to the mid-range of the criteria in order to meet the acceptance requirements.

Should a change in sources of materials be made, a new JMF must be submitted to the Engineer for review and accepted in writing before the new material is used. After the initial production JMF has been approved by the Engineer and a new or modified JMF is required for whatever reason, the subsequent cost of the new or modified JMF, including a new test strip when required by the Engineer, will be borne by the Contractor.

The Resident Engineer may request samples at any time for testing, prior to and during production, to verify the quality of the materials and to ensure conformance with the applicable specifications.

The JMF shall be submitted in writing by the Contractor at least 45 days prior to the start of paving operations. The JMF shall be developed within the same construction season using aggregates proposed for project use. The JMF shall include the following items as a minimum:

- a. Manufacturer's certificate of analysis (COA) for the asphalt binder used in the JMF. Asphalt binder shall be identified by the Illinois Department of Transportation material and producer code number and the producer name and location.
- b. Manufacturer's certificate of analysis (COA) for the anti-stripping agent if used in the JMF.
- c. Course and fine aggregate and mineral filler shall be identified by the Illinois Department of Transportation material and producer code number and the producer name and location.
- d. Percent passing each sieve size for individual gradation of each aggregate cold feed and/or hot bin; percent by weight of each cold feed and/or hot bin used; and the total combined gradation in the JMF.
- e. Specific Gravity and absorption of each coarse and fine aggregate.
- f. Percentage of each individual aggregate.
  - (1) Percent fractured faces.
  - (2) Percent by weight of flat particles, elongated particles, and flat and elongated particles (and criteria).
- g. Summary of design data.
  - (1) Asphalt Content (AC)
  - (2) Mixture Air Voids (AV)
  - (3) Mixture Bulk Specific Gravity ( $G_{mb}$ )
  - (4) Mixture Theoretical Maximum Specific Gravity ( $G_{mm}$ )
  - (5) Aggregate Bulk (Dry) Specific Gravity ( $G_{sb}$ )
  - (6) Aggregate Effective Specific Gravity ( $G_{se}$ )
  - (7) Effective Binder Content ( $P_{be}$ )
  - (8) Absorbed Binder ( $P_{ba}$ )
  - (9) Volume of Effective Asphalt ( $V_{be}$ )
  - (10) Voids Filled with Asphalt (VFA)
  - (11) Voids in Mineral Aggregate (VMA)
- h. Number of blows.
- i. Laboratory mixing and compaction temperatures.
- j. Supplier-recommended field mixing and compaction temperatures.
- k. Plot of the combined gradation on a 0.45 power gradation curve.

- l. Graphical plots of AV, VMA, and unit weight versus AC. To achieve minimum VMA during production, the mix design needs to account for material breakdown during production.
- m. Tensile Strength Ratio (TSR).
- n. Type and amount of anti-strip agent when used.
- o. Asphalt Pavement Analyzer (APA) results.
- p. Date the JMF was developed.
- q. Test results for asphalt resistance to fuel as specified in the contract documents.

### Marshall Design Criteria

Test Properties	All Aircraft	Test Method
Number of blows	50	ASTM D6926
Stability, minimum	2,150 lb	ASTM D6927
Air Voids <sup>1</sup>	2.5% ± 0.2%	ASTM D3203
Minimum voids in mineral aggregate (VMA)	14%	AASHTO T 209
Maximum weight loss by fuel immersion	1.5%	as specified in the contract documents
Tensile Strength Ratio (TSR) <sup>2</sup>	not less than 80 at a saturation of 70-80%	ASTM D4867
Hamburg Wheel Test	Less than 0.2 inches @ 20,000 passes	AASHTO T 324

1. If the water absorption of the combined aggregates in the mix exceeds 1.7%, then the mix must be short term aged in accordance with American Association of State Highway and Transportation Officials (AASHTO) PP-2 – Section 7.2. The short-term aged material will then be used for the Marshall specimens and the maximum specific gravity test.
2. Test specimens for TSR shall be compacted at 7% ± 1.0% air voids. Use freeze-thaw conditioning in lieu of moisture conditioning.

The mineral aggregate shall be of such size that the percentage composition by weight, as determined by laboratory sieves, will conform to the gradation or gradations specified below when tested in accordance with the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 11-08, *Aggregate Gradation Control System (AGCS)*.

The gradation shown below represents the limits that shall determine the suitability of aggregate for use from the sources of supply; be well graded from coarse to fine and shall not vary from the low limit on one (1) sieve to the high limit on the adjacent sieve, or vice versa.

### Aggregate – Fuel-Resistant Asphalt Pavement

Sieve Size	Percentage by Weight Passing Sieves	
	1/2" Maximum	Ideal Target
1/2 inch	100	100
3/8 inch	90-100	95
No. 4	58-78	68
No. 8	40-60	50
No. 16	28-48	38
No. 30	18-38	28
No. 50	11-27	19
No. 100	6-18	12
No. 200	3-6	5
Minimum Voids in Mineral Aggregate (VMA) <sup>1</sup>	14%	16%
Asphalt Content (%)	5.0-7.0	6.0
Recommended Construction Lift Thickness	1-1/2 inch to 3 inches	as specified

1. To achieve minimum VMA during production, the mix design needs to account for material breakdown during production.

The aggregate gradation shown is based on aggregates of uniform specific gravity. The percentages passing the various sieves shall be corrected when aggregates of varying specific gravities are used, as indicated in the Asphalt Institute MS-2 Mix Design Manual, 7th Edition.

#### 404-3.4 Testing requirement for asphalt resistance to fuel. Procedures for testing asphalt resistance to fuel shall be as follows:

- a. Prepare three (3) test specimens in accordance with the Mix Design requirements at optimum asphalt binder content and  $2.5 \pm 0.7\%$  air voids.
- b. Determine the percent air voids in each specimen, if any do not meet the requirements above discard and replace them. Dry the specimens under a fan at room temperature 68°F to 80°F for a minimum of 24 hours.
- c. Totally immerse the sample in kerosene meeting ASTM D3699 at room temperature 68°F to 80°F for 2.0 minutes. (Suspending the sample with metal insect screen in a one (1) gallon paint can has been found to be satisfactory.)
- d. After submersing for 2.0 minutes  $\pm 30$  seconds, remove the sample and immediately surface dry it with a clean paper towel. Then immediately determine the weight in air to the nearest 0.1 grams. Report this as weight "A" (weight before).
- e. Re-submerge the sample in kerosene for 24 hours.
- f. After 24 hours  $\pm 10$  minutes carefully remove the sample from the kerosene and suspension container and place it on an absorptive cloth or paper towel. Dry the specimen under a fan at room temperature for 24 hours.
- g. After drying for 24 hours  $\pm 10$  minutes weigh the sample in air to the nearest 0.1 grams. Report this as weight "B" (weight after immersion).



h. Calculations:

Percent of weight loss by fuel immersion =  $(A - B/A) \times 100$

Where: A = Weight before

B = Weight after

**404-3.5 Recycled asphalt mix pavement.** No reclaimed asphalt pavement (RAP) or recycled asphalt shingles (RAS) shall be permitted in this mix.

**404-3.6 Test strip. (For Method II only; 2,000 tons/pay item and Over).** A test strip will be required at the beginning of production for each mixture with a quantity of 2,000 tons or more according to the current Illinois Department of Transportation, Bureau of Materials Manual of Test Procedures for Materials, *Hot-Mix Asphalt Test Strip Procedures, Appendix B.4*. Full production shall not begin until an acceptable test strip has been constructed and accepted in writing by the Engineer. The Contractor shall prepare and place a quantity of asphalt according to the approved JMF. The underlying grade or pavement structure upon which the test strip is to be constructed shall be the same as the remainder of the course represented by the test strip.

The Contractor will not be allowed to place the test strip until the Contractor quality control program (CQCP) has been accepted, in writing, by the Engineer.

The test strip will consist of at least 300 tons. The test strip shall be placed in two (2) lanes of the same width and depth to be used in production with a longitudinal cold joint. The cold joint must be cut back using the same procedure that will be used during production. The cold joint for the control strip will be an exposed construction joint at least four (4) hours old or when the mat has cooled to less than 160°F. The equipment used in construction of the test strip shall be the same type, configuration and weight to be used on the project.

The Contractor shall follow the following procedures for constructing a test strip.

a. **Contractor/Department test strip team.** A team of both Contractor and Department personnel shall construct a test strip and evaluate mix produced at the plant. The test strip team may consist of the following, as necessary:

- (1) Engineer
- (2) Resident Engineer
- (3) Contractor's QC Manager, required
- (4) Contractor's Density Tester

b. **Communications.** The Contractor shall advise the team members of the anticipated start time of production for the mix. The QC Manager shall direct the activities of the test strip team. A Department appointed representative from the test strip team will act as spokesperson for the Department.

c. **Acceptance criteria.**

(1) **Mix design and plant proportioning.** The mix design shall be approved by the Department prior to the test strip. Target values shall be provided by the Contractor and will be approved by the Department prior to constructing the test strip.

(2) **Evaluation of growth curves.** The completed test strip shall have a minimum density of 94 percent (6 percent air voids) of the maximum theoretical specific gravity of the mix. Individual test results (average of two cores) below 94% shall constitute a failing test section. The maximum density of individual test results (average of two cores) shall be 98% of the maximum theoretical specific gravity of the mix. Mixtures which exhibit density potential less than or greater than the density ranges specified shall be considered to have a potential density problem which is normally sufficient cause for mix adjustment.

If an adjustment has been made, the Engineer may require an additional test strip be constructed and evaluated. This information shall then be compared to the AJMF and required design criteria for acceptance.

**(3) Evaluation of required plant tests.** If the results of the required plant tests exceed the JMF target value control limits, the Contractor shall make allowable mix adjustments/plant changes, resample, and retest. If the Engineer determines additional adjustments to the mix will not produce acceptable results, a new mix design may be required.

**d. Test strip method.** The Contractor shall produce 300 tons of mix for the test strip. The test strip will be included in the cost of the mix and will not be paid for separately since the Contractor may continue production, at their own risk, after the test strip has been completed.

The procedures listed below shall be followed to construct a test strip.

**(1) Location of test strip.** The test strip shall be located on a relatively flat portion of the project. Descending/ascending grades should be avoided.

**(2) Constructing the test strip.** After the Contractor has produced and placed approximately 225 to 250 tons of mix, paving shall cease, and a growth curve shall be constructed. After completion of the first growth curve, paving shall resume for the remaining 50 to 75 tons, and the second growth curve shall be constructed within this area. The Contractor shall use normal rolling procedures for all portions of the test strip except for the growth curve areas which shall be compacted solely with a vibratory roller as directed by the QC Manager.

**(3) Required plant tests.** A set of mixture samples shall be taken at such a time as to represent the mixture in between the two (2) growth curve trucks.

The mixture sampled to represent the test strip shall also include material sufficient for the Department to conduct a Hamburg Wheel test according to AASHTO T 324.

**e. Compaction requirements.**

**(1) Compaction equipment.** The Contractor shall provide a vibratory roller meeting the following requirements.

The vibratory roller shall be self-propelled and provide a smooth operation when starting, stopping or reversing directions. The vibrating drum amplitude and frequency shall be approximately the same in each direction and meet the following minimum requirements: drum diameter 48 inches, length of drum 66 inches, vibrators 1,600 vibrations per minute, unit static force on vibrating drum 125 pounds per lineal inch, total applied force 325 pounds per lineal inch, adjustable eccentrics, and reversible eccentrics on nondriven drums. The total applied force for various combinations of vibrations per minute and eccentric positions shall be shown on decals on the vibrating roller or on a chart maintained with the roller. The vibratory roller shall be equipped with water tanks and sprinkling devices, or other approved methods, which shall be used to wet the wheels to prevent material pickup.

A vibrating reed tachometer (hand type) shall be furnished with each vibratory roller. The vibrating reed tachometer shall have a range of 1,000 to 4,000 vibrations per minute. The vibrating reed tachometer shall have two (2) rows of reeds, one (1) ranging from 1,000 to 2,000 vibrations per minute and the other from 2,000 to 4,000 vibrations per minute.

It shall be the responsibility of the test strip team to verify specification compliance before commencement of growth curve construction. An appropriate amplitude shall be selected on the basis of roller weight and mat thickness to achieve maximum density.

The vibratory roller speed shall be balanced with frequency so as to provide compaction at a rate of not less than ten (10) impacts per one (1) foot.

- (2) **Compaction temperature.** In order to make an accurate analysis of the density potential of the mixture, the temperature of the mixture on the pavement at the beginning of the growth curve shall not be less than 280°F.
  - (3) **Compaction and testing.** The Contractor shall direct the roller speed and number of passes required to obtain a completed growth curve. The nuclear gauge shall be placed near the center of the hot mat and the position marked for future reference. With the bottom of the nuclear gauge and source rod clean, a one (1) minute nuclear reading (without mineral filler) shall be taken after each pass of the roller. Rolling shall continue until a growth curve can be plotted, the maximum density determined, and three (3) consecutive passes show no appreciable increase in density or evident destruction of the mat.
  - (4) **Final testing.** A core shall be taken and will be secured by the Department from each growth curve to represent the density of the in-place mixture. Additional random cores may be required as determined by the Engineer.
- f. **Nuclear/core correlation.** A correlation of core and nuclear gauge test results may be performed on-site as defined in the Illinois Department of Transportation, Bureau of Materials Manual of Test Procedures for Materials, *Standard Test Method for Correlating Nuclear Gauge Densities with Core Densities, Appendix B.3*. All correlation locations should be cooled with ice or dry ice so that cores can be taken as soon as possible. Three (3) locations should be selected. Two (2) sites should be located on the two (2) growth curves from the first acceptable test strip. The third location should be in an area corresponding to the second set of mixture samples taken at the plant. This correlation should be completed at the same time by the Contractor prior to the next day's production. Smoothness of the test strip shall be to the satisfaction of the Engineer.
- g. **Documentation.** All test strips, required plant tests, and rolling pattern information (including growth curves) will be tabulated by the Contractor with a copy provided to each team member and the original retained in the project files.

If the test strip is unacceptable, necessary adjustments to the JMF, plant operation, placing procedures, and/or rolling procedures shall be made and another test strip shall be placed. Unacceptable control strips shall be removed at the Contractor's expense.

## CONSTRUCTION METHODS

- 404-4.1 Weather limitations.** The asphalt surface course shall be placed only when the air temperature in the shade is at least 40°F and the forecast is for rising temperatures. The asphalt shall not be placed upon a wet surface or when the surface temperature of the underlying course is less than specified in the table below. The temperature requirements may be waived by the Engineer, if requested; however, all other requirements including compaction shall be met.

### Surface Temperature Limitations of Underlying Course

Mat Thickness	Base Temperature (Minimum)
	°F
3 inches or greater	40
Greater than 1 inch but less than 3 inches	45
Less than 1 inch	50

**404-4.2 Equipment.** The Contractor is responsible for the proper operation and maintenance of all equipment necessary for handline materials and performing all parts of the work to meet this specification.

**a. Asphalt plant.** The asphalt plant shall be the batch-type or dryer drum plant. Plants used for the preparation of asphalt shall be evaluated for prequalification rating and conform to the requirements the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 4-08, *Approval of Hot-Mix Asphalt Plants and Equipment*. The plants shall not be used to produce mixtures concurrently for more than one (1) project or for private work unless permission is granted in writing by the Engineer. The plant units shall be so designed, coordinated and operated that they will function properly and produce asphalt having uniform temperatures and compositions within the tolerances specified. The plant units shall meet the following requirements. The Engineer shall have access, at all times, to all areas of the plant for checking adequacy of equipment; inspecting operation of the plant: verifying weights, proportions, and material properties; and checking the temperatures maintained in the preparation of the mixtures.

**(1) General.** The plant shall be approved before production begins. All asphalt plants shall be capable of producing asphalt within the specification tolerances for gradation and asphalt binder content. The plant owner shall be responsible for demonstrating this capability through a production and testing program defined by the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 4-08, *Approval of Hot-Mix Asphalt Plants and Equipment*. If the plant fails to maintain this capability, the Department may require the demonstration to be repeated at any time. Failure to maintain the capability may result in loss of plant approval status. Accessibility to the top of truck beds shall be provided by dual platforms or other suitable device to enable the Resident Engineer to obtain samples and mixture temperature data.

For all types of plants, the ingredients shall be heated and combined in such a manner as to produce asphalt which when discharged from the plant will in general vary not more than 20°F from the temperature set by the Engineer. In all cases, the mix temperature shall not be more than 350°F or less than 250°F. Wide variations in the mixture temperature of successive loads may be cause for rejection of the asphalt.

During the drying process, the moisture content of the aggregate shall be reduced such that the moisture content of the asphalt at time of discharge from the mixer will not exceed 0.3%. For certain aggregates such as air-cooled blast furnace slag, and other highly absorptive aggregates, special handling and treatment such as double drying may be required.

All hot bins shall be emptied and all aggregate in the dryer and collector conveyors shall be removed prior to starting production or resuming once production has been interrupted for the purpose of producing a different mixture.

- (a) **Storage facilities.** The plant used in the preparation of the asphalt shall be located where it will have adequate storage and transportation facilities. Sufficient space shall be provided for separate stockpiles of each gradation, source, and quality of aggregate required. If necessary, to prevent the intermixing of the different materials, or if stockpiles join together, suitable partitions shall be used between adjacent stockpiles. All aggregates shall be kept separated until they are fed in their proper proportions onto a belt conveyor or into the boot of the cold aggregate elevator. The aggregates shall be handled in such a manner as to prevent contamination, degradation and segregation.
- (b) **Aggregate bins and feeders.** The plant shall be provided with accurate mechanical means for uniformly feeding each aggregate used in the proper proportions so that uniform production and uniform temperature will be obtained. A minimum of four (4) bins and feeders for aggregate will be required. The bins shall be designed to prevent overflow of material from one (1) bin to another. If any of the materials used in preparing the mixture become intermixed in a bin compartment, the compartment shall be emptied, and the intermixed material shall not be used. Each bin shall be provided with a variable speed belt or apron feeder with adjustable gates which can be locked. Each bin shall have a cutoff system that shall automatically stop the asphalt production when any bin becomes empty. All feeders shall be calibrated to the desired volumes and/or weights for each material/mixture, to the satisfaction of the Engineer. This calibration may require plant modification. The controls of the total quantity of combined materials fed to the dryer shall be by a variable speed system. Other methods may be approved by the Engineer. When the proportioning gates of the feeders are once set for proper blending, they shall be locked or bolted securely, and their positions shall not be changed unless directed by the Engineer.
- (c) **Dust collection.** The plant shall be equipped with a primary dust collector, approved by the Engineer, connected to a secondary dust collector (baghouse or wet-wash).
- (d) **Surge bins.** The Contractor may use an asphalt surge system in the manufacture of asphalt provided the bins meet the following requirements and are operated to the satisfaction of the Engineer. The complete surge system shall be designed and operated to prevent segregation and loss of temperature of the mix. Maximum retention time shall be eight (8) hours unless longer retention time is authorized in writing by the Engineer. When requested, longer retention time will be evaluated according to the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 4-08, *Approval of Hot-Mix Asphalt Plants and Equipment*. The bins shall be insulated and/or heated, and of an enclosed weatherproof type. A combination low level indicator and cutoff system shall be provided that will automatically stop the discharge of mix from the surge bins when the mix falls below the top of the discharge cone. The conveying system used to transport the mix from the mixer to the bins shall be enclosed, heated and/or insulated for effective control of mix temperature.
- No surge system will be approved by itself but shall be considered as part of a complete operating asphalt plant. The mix as discharged from the bins shall meet all specification requirements for the mix being produced. Approval for the use of a surge system may be withdrawn at any time, by the Engineer, for unsatisfactory operation.
- (e) **Storage tanks for asphalt binders.** Tanks for the storage of asphalt binder shall be equipped to heat and hold the material at the required temperatures. The heating shall be accomplished by steam coils, hot oil coils, electricity or other approved means so that no flame shall be in contact with the tank. All asphalt binder lines and fittings shall be steam, electric or hot oil jacketed. Provisions shall be made for

sampling the asphalt binder from the line leading to the weigh bucket or metering device. If more than one (1) grade of asphalt binder is required for concurrent operations, adequate storage and separate piping to the weigh bucket or metering device for each grade, or other methods approved by the Engineer that prevent intermingling of the asphalt binders, shall be provided. An armored thermometer or pyrometer which will accurately show temperatures between 200°F and 400°F shall be suitably located in the asphalt binder line or within the tank. The instrument shall be located so as to indicate to the plant personnel, the temperature of the asphalt binder.

**(f) Equipment for weighing asphalt.** The asphalt shall be weighed on an approved scale furnished by the Contractor meeting the requirements of 225 *ILCS 470/Weights and Measures Act* of the State of Illinois. Each time the scale is moved, the accuracy shall be retested and certified. For dryer drum plants the load-out scale used to weigh asphalt shall be equipped with an automatic printer. Batch plants shall have an automatic printer to record the weight of all ingredient materials. The automatic printer shall be an integral part of the scale equipment or the scale and printer shall be directly connected in a manner that will prohibit the manual entry of weights, except as provided in paragraph (a), below.

1. If the platform scale equipment measures gross weight, the printer shall record the gross weight as a minimum. Tare and net weights shall be shown on weigh tickets and may be printed automatically or entered manually.
2. If scale equipment on a platform scale zeros out the truck tare automatically, the printer shall record the net weight as a minimum.
3. If the scale equipment on a surge bin weigh hopper zeros automatically after discharging each batch, the printer shall record the net weight as a minimum.
4. If the scale equipment on surge bins automatically shuts down the feed system weighing and weighs the amount in the silo before and after discharge, the printer shall record the net weight as a minimum.

The automatic printer shall produce a weight ticket in triplicate. Weights shall be shown in tons to the nearest 0.01 ton.

**(g) Equipment for anti-strip additives.** When an anti-stripping additive is required and a liquid additive is used, it shall be added to the asphalt binder by means of an approved in-line blending system located between the asphalt binder supply tank and distribution onto the heated aggregate. The in-line blending system shall be installed in such a location that the liquid additive cannot recirculate and contaminate the asphalt binder supply tank. The in-line blending system shall be capable of delivering a consistent and controllable stream of material to the asphalt binder under all operating weather conditions and shall be capable of controlling the introduction of additive into the asphalt binder within  $\pm 10\%$  of the amount specified or required. The Contractor shall use methods and procedures for handling and storage of the additive which meet the manufacturer's safety recommendations.

When hydrated lime is used as the anti-strip additive, a separate bin or tank and feeder system shall be provided to store and accurately proportion the lime onto the aggregate either as a slurry, as dry lime applied to damp aggregates, or as dry lime injected onto the hot aggregates prior to adding the liquid asphalt cement. If the hydrated lime is added either as a slurry or as dry lime on damp aggregates, the lime and aggregates shall be mixed by a power driven pugmill to provide a uniform coating of the lime prior to entering the dryer. If dry hydrated lime is added to the hot dry aggregates in a dryer-drum plant, the lime shall be added in such a manner that the lime will not become entrained into the air stream of the dryer-drum and that thorough dry mixing shall occur prior to the injection point of the liquid asphalt.

When a batch plant is used, the hydrated lime shall be added to the mixture in the weigh hopper or as approved by the Engineer. The feeder system shall be controlled by a proportioning device which shall provide accuracy to within  $\pm 10\%$  of the specified amount of hydrated lime solids. The proportioning device shall have a convenient and accurate means of calibration and shall be interlocked with the aggregate feed or weight system so as to maintain the required proportion. A flow indicator or sensor shall be provided and interlocked with the plant controls such that the production of the mixture will be interrupted if there is a stoppage of the hydrated lime feed. The stockpiling of hydrated lime treated aggregate will not be permitted. The methods of introducing and mixing the anti-stripping additive and aggregate shall be subject to approval by the Engineer prior to beginning production.

(h) **Stabilizing additive.** When a stabilizing additive such as a cellulose or mineral fiber is required to prevent asphalt binder drain down, adequate dry storage shall be provided for the stabilizing fiber additive. A separate feed system shall be provided to proportion the fiber into the mixture uniformly and in desired quantities. The feed system shall be interlocked with the aggregate feed or weigh system to maintain the correct proportions for all rates of production and batch sizes. The proportion of fibers shall be controlled at all times within  $\pm 10\%$  of the amount of fibers required. The fiber system shall provide in-process monitoring consisting of either a digital display of output or a printout of the feed-rate, in pounds per minute. Flow indicators or sensing devices for the fiber system shall be provided and interlocked with plant controls so mix production shall be interrupted if fiber introduction fails, or if the output rate is not within the specified tolerances.

1. **Batch plant.** Stabilizing additive shall be pneumatically added through a separate inlet directly into the weigh hopper above the pugmill. The addition of fibers shall be timed to occur during the hot aggregate charging of the hopper. Adequate mixing time will be required to ensure proper blending of the aggregate and fiber additive. Both the wet and dry mixing times shall each be increased a minimum of five (5) seconds beyond the standard mixing time. The actual mixing time increase shall be determined by the Engineer based on individual plant characteristics. If concentrations of mastic (fiber, asphalt binder, and fines) are visible behind the paver, the batch size shall be reduced in 10% increments until the problem is alleviated.
2. **Drum mix plant.** Stabilizing additive shall be introduced using specialized equipment to mix the asphalt binder with loose fibers at the time of introduction into the drum mixer. This equipment shall be approved by the Engineer. Care shall be taken to ensure the loose fibers do not become entrained in the exhaust system of the plant.

(2) **Batching plants.** Batch plants shall be according to the following.

- (a) **Dryers.** The plant shall be equipped with a revolving cylindrical dryer or dryers capable of heating and drying all of the fine and coarse aggregates to a temperature of 250°F to 350°F.
- (b) **Equipment for weighing or measuring aggregate.** The equipment shall include a means for accurately weighing each size of aggregate in a weigh hopper suspended on scales and of ample size to hold a full batch without hand raking or running over. The gate shall close tightly so that no material is allowed to leak into the pugmill mixer while a batch is being weighed.

The scale shall be the springless dial type, shall be designed as an integral unit of the batching equipment, and shall be constructed to withstand the usage for which they are intended. Load cells with digital readouts may be used if approved by the

Engineer. The scale shall have a capacity of not more than twice the weight of the approved capacity of the mixer.

Except for permanently located plants, springless dial scales shall be provided with suitable markers inside the glass cover and in front of the dial which may be set to show the position of the dial indicator for the required load or the various accumulative loads when more than one (1) aggregate is weighed in the same hopper. Markers shall have distinctive colors for the various materials to be weighed. Dials shall be placed so that they can be viewed without parallax by the operator.

The value of the minimum graduation interval of any scale used for weighing materials shall be not more than 0.2% of the batch weight and not more than 0.1% of the capacity of the scale, except that graduation intervals less than 5 pounds when weighing aggregates and less than two (2) pounds when weighing cement and finely divided minerals will not be required. In the case of beam scales, the same requirement shall also apply to the graduation of each individual beam with respect to the weight of material normally weighed on it. The value of the minimum graduation interval of any scale used for weighing mixing water shall be not less than two (2) pounds. All scales shall be designed and built to a maximum tolerance of 0.4% of the net load in the hopper.

Scales shall be housed or otherwise protected against the effect of wind in a manner meeting the approval of the Engineer.

The scales shall be calibrated by an independent company. The independent company shall have scale testing equipment and standard weights meeting the requirements of NIST. The scale calibration will be observed by the Engineer. Scales shall be calibrated at the beginning of each construction season or each 12-month period, and each time the scales are moved, or when scale components are repaired or replaced.

Once a scale is calibrated, the settings shall not be altered. The concrete producer shall submit for approval by the Engineer, a method to verify the settings have not been altered. If at any time the Engineer determines the settings have been altered, a new calibration will be required.

Means of access for inspection purposes shall be safe and shall meet the approval of the Engineer. In the case of permanently located plants, the means of access shall be an inclined stairway with the handrail located so that its upward flight will end on the scale operator's platform. It shall be firmly attached to the supporting members of the bin. The weigh platform shall have an approved floor of metal grid or two (2) inch plank.

- (c) **Dust collection.** Material collected from the primary collector shall be discharged into a hopper which is equipped with the means of either wasting stored dust or metering and conveying its contents into the boot of the hot elevator. Metering of dust from the hopper shall be accomplished by either an adjustable variable speed vane or auger feeder. Feed shall be actuated by a control located in the discharge chute between the dryer and the hot elevator and shall only occur when aggregate is being discharged from the dryer. In all cases, the hopper used for storing the primary material shall be equipped with a low-bin indicator.

Material collected in the secondary collector (baghouse) shall not be stored internally but shall be discharged directly into a silo. Feed of the material from the silo to the mix shall be accomplished only by weight. In no case shall the collected secondary material be returned to the hot elevator. To meet job mix formula criteria, it may be necessary to waste some or all of the collected secondary material.



- (d) **Mineral filler system.** The mineral filler shall be weighed in the aggregate weigh hopper. It shall be conveyed to the weigh hopper by approved means. The feeding method shall operate in such manner as will enable small fractions of the material to be weighed. The chute used to introduce the mineral filler into the weigh hopper shall be so constructed that none of the material is retained in it after the required amount has been deposited in the weigh hopper.
- (e) **Equipment for weighing or measuring asphalt binder.** The equipment used for weighing or measuring the asphalt binder shall consist either of an approved weigh bucket or metering device. If a weigh bucket is used, it shall be a non-tilting type and shall be completely suspended from a springless dial scale. Load cells with digital readouts may be used if approved by the Engineer. The weigh bucket, its discharge valve or valves and spray bar shall be adequately heated and shall have a capacity of at least 15% in excess of the weight of asphalt binder required in any batch. Adequately heated, quick-acting, non-drip valves shall be used in charging the bucket.
- (f) If a metering device is used, it shall be of an approved design and have a capacity of at least 15% in excess of the quantity of asphalt binder used in a batch. The controls shall be constructed so that they may be locked at any dial setting and will automatically reset to that reading after the addition of asphalt binder to the mix. The dial shall be in full view of the mixer operator. The flow of asphalt binder shall be automatically controlled so that it will begin when the dry mixing period is over. The section of the asphalt line between the charging valve and the spray bar shall be provided with a valve and outlet for calibrating-verifying the meter.
- (g) Either the weigh bucket or the meter device shall discharge all the asphalt binder required for one (1) batch in not more than 15 seconds after the flow has started. The size and spacing of the spray bar openings shall provide a uniform application of asphalt binder the full length of the mixer.
- (h) **Accuracy of scales.** The scales shall meet the requirements of *225 ILCS 470/Weights and Measures Act* of the State of Illinois. The scales shall be calibrated at the beginning of each construction season and as often as the Engineer may deem necessary to assure their continued accuracy. Ten (10) standard 50-pound weights meeting the requirements of NIST shall be available at the asphalt plant for use in calibrating and testing the weighing equipment. The scales shall be inspected frequently for sensitivity, sluggishness or damage. They shall be checked for accuracy at intervals of not more than one (1) week by obtaining the net weight, on truck scales, of a truck load of asphalt.
- (i) **Pugmill mixer.** The batch mixer shall have a rating plate attached showing the manufacturer's rated capacity and shall be an approved type capable of producing a uniform mixture within the job tolerances. If not enclosed, the mixer box shall be equipped with a dust hood to prevent loss of dust. The clearance of the blades from all fixed and moving parts shall not exceed three-quarters (3/4) inch.

The capacity of the pugmill mixer will be determined by the Engineer based on 115% of the calculated net volume of the mixer below the center of the mixer shafts and 100 pounds per cubic foot material. If the mixer will not operate efficiently at the approved capacity, or if its production does not coordinate with other plant units, the right is reserved to reduce the size of the batch until the desired efficiency is obtained. The Engineer's decision as to the permissible capacity of the pugmill mixer will be final.

The mixer shall be heated by an approved method and shall have a capacity of not less than 2,000 pounds for any composition required under these specifications. The amount of material which the Contractor will be permitted to mix per batch shall be determined by the Engineer. The mixer shall be of the twin-shaft type.

- (j) **Time lock.** The mixer shall be equipped with an accurate time lock to control the operations of a complete mixing cycle. It shall lock the weigh hopper gate after the charging of the mixer until the closing of the mixer gate at the completion of the cycle. It shall lock the asphalt binder bucket or meter throughout the dry mixing period and shall lock the mixer gate throughout the dry and wet mixing periods. The dry mixing period is defined as the interval of time between the opening of the weigh hopper gate and the start of introduction of asphalt binder. The wet mixing period is the interval of time between the start of introduction of asphalt binder and the opening of the mixer gate.

The heated aggregates and mineral filler shall be mixed in the pugmill mixer for a period of not less than ten (10) seconds. The asphalt binder shall then be added, and the mixing continued. The time required to add the asphalt binder shall be not more than 15 seconds. The total time required for adding the asphalt binder and completing the wet mixing period shall be not less than 35 seconds, or longer if necessary, to produce a homogeneous mixture in which all particles of aggregate are coated uniformly. If a question as to the degree of coating should arise, AASHTO T 195 shall be used. The total mixing time shall be a minimum of 45 seconds consisting of dry and wet mixing. The times of dry and wet mixing shall be set by the Engineer. The same size batch weights shall be used in the production of asphalt, unless permission to change is granted in writing by the Engineer.

The control of the timing shall be flexible and capable of being set at intervals of five (5) seconds or less throughout a total cycle. The setting of time intervals shall be at the direction of the Engineer.

- (k) **Batch counter.** An approved mechanical batch and/or tonnage counter shall be installed as part of the time lock device. It shall register only upon the actuation of the asphalt weigh bucket or valve release. It shall not register any dry batches, or any material released during the operation of pulling the bins.
- (l) **Screens.** The screens used in separating the aggregates shall be of the vibrating types, and when operated at normal speeds shall separate the aggregates satisfactorily. The screening system shall be equipped with a scalping screen having openings not more than one-half (1/2) inch larger than the largest size aggregate used in preparing the asphalt. The screening system shall have a tailing pipe for the removal of oversized aggregate. The discharge point of the tailing pipe shall be located so that it will not create a hazard or nuisance. The screens shall produce aggregate in the proper bins, as required.

Efficiency of separation based on laboratory sieves, shall be such that no more than 20% of the material in the bin is smaller than neither the nominal size nor more than 10% over size for that bin.

- (m) **Hot aggregate bin.** The plant shall be equipped with a minimum of four (4) aggregate storage bins of sufficient capacity to supply the mixer when it is operating at full capacity. Bins shall be arranged to assure separate and adequate storage of appropriate fractions of the mineral aggregates. Separate dry storage shall be provided for mineral filler, and the plant shall be equipped to feed the material into the aggregate weigh hopper. Each bin shall be provided with overflow pipes, of such size and at such locations as to prevent backing up of material into other compartments or bins. Material from the overflow pipe shall not be returned to the hot elevator. Each compartment shall be provided with its individual outlet gate, constructed so that when the gate is closed, there shall be no leakage. Gates shall cut off quickly and completely. Bins shall be so constructed that samples can be readily obtained. A sampling device having the same width as the hot aggregate bin outlet gates shall be provided for this purpose. Hot aggregate bins shall not be modified in any manner nor shall divider plates be removed.

(n) **Temperature recording instrument.** The plant shall be equipped with either a recording pyrometer or a recording thermometer having at least two (2) terminals when a single dryer is used, and at least three (3) terminals when a dual dryer is used. The type and accuracy of the recording instrument shall be approved by the Engineer. Unless otherwise approved, one (1) terminal shall be installed at a suitable location at the discharge of each dryer and the others near the discharge gate in each bin compartment used for fine aggregate. The temperature recording instrument shall be capable of making accurate charts of the temperatures during the day's run. The recording instrument shall be installed at a point free from the dust and vibration of the plant. If this instrument is not located as to indicate clearly to the plant operator the temperature of the mineral aggregates at the discharge of each dryer, a non-recording pyrometer shall also be installed in view of the plant operator. At the end of each days run, the record sheet of the recording instrument shall be submitted to the Engineer.

(3) **Dryer drum plants.** Dryer drum plants shall be according to the following.

(a) **General.** General requirements shall be according to paragraph 404-4.2 a. (1) titled GENERAL, except a surge bin meeting the requirements of paragraph 404-4.2 a.(1)(d) titled SURGE BINS shall be utilized.

The heated aggregates, mineral filler, and asphalt binder shall be proportioned by electronic proportioning equipment and mixed to produce a homogenous mixture in which all particles of aggregate are coated uniformly. If a question as to the degree of coating should arise, AASHTO T 195 shall be used. If the Engineer ascertains that proper mixing is not being obtained, adjustments shall be made in the plant operation (production rate, dryer drum slope, etc.) to assure that these conditions are met.

(b) **Vibrating scalping screen.** The combined aggregates shall pass over a vibrating scalper that will remove all material and aggregate greater than the nominal top size gradation permitted by the specification for the mixture being produced, or as set by the Engineer, prior to the aggregates being placed on the weigh belt. The scalper shall be independent of other proportioning or weighing equipment.

(c) **Aggregate weighing equipment.** The combined aggregates shall be weighed on continuous belt weighing devices meeting the requirements of the NIST Handbook #44. The weigh belts shall be self-aligning with a gravity belt takeup and rigid wind guards at the weighing section. Sun screens may be required by the Engineer at the weighing section. Means shall be provided to divert the aggregate into a truck, after passing over the weigh belt scales.

(d) **Mineral filler system.** Mineral filler shall be proportioned to the mixing zone of the asphalt plant by a variable speed vane feeder and storage system or other systems approved by the Engineer. Means must be provided to divert material from the proportioning unit for purposes of calibration. The feeder shall be provided with an automatic cutoff system in the event the feeder is blocked or is devoid of material.

(e) **Asphalt binder system.** The asphalt binder system shall consist of a temperature compensating meter and pump. Other asphalt binder systems may be used if approved by the Engineer. The pump and meter shall be installed as close to the asphalt binder storage tanks as possible using rigid pipe with a minimum of piping length and bends. The diameter of the pipe shall be consistent throughout the system. Means shall be provided to automatically stop the plant in the event asphalt binder ceases to flow through the meter.

(f) **Dryer drum mixer.** Dryer drum mixer components shall have a minimum capacity of 60 tons per hour of asphalt. The units shall have a recording pyrometer or thermometer that records the discharge temperature of the mixture.

1. **Single unit dryer drum mixers.** The single unit dryer drum mixer shall be a revolving cylindrical drum capable of heating, drying, and mixing the combined aggregates, mineral filler when required, and asphalt binder to produce a uniformly coated, homogenous asphalt meeting all applicable specifications. The dryer burner shall be equipped with automatic controls.
  2. **Dual unit dryer drum mixers.** The dryer portion of the dual unit dryer drum mixer shall be a revolving cylindrical drum capable of heating and drying the combined aggregates to the required specifications. The mixer portion of the dual unit dryer drum mixer shall be either a revolving cylindrical drum or a continuous twin shaft pugmill with a compatible mixing capacity to the dryer production rating. The unit shall be capable of mixing the heated and dried combined aggregates, mineral filler when required, and asphalt binder to produce a uniformly coated, homogenous asphalt meeting all applicable specifications.
- (g) **Secondary dust collector.** The collected baghouse dust shall be returned to the dryer at a uniform rate at a point where the asphalt binder is added to the mixing zone of the asphalt plant.

If positive dust control equipment (PDCE) is required, it shall consist of a system that is an integral part of the production process. The system shall accurately weigh all of the secondary dust collected in the baghouse, transfer the material to a storage silo, accurately weigh the required amount of fines to be returned from the storage silo, and transfer them back to the mixture. The PDCE weighing devices shall have an accuracy of 0.5% of the actual weight of the material. The system shall be capable of automatically monitoring the dust collection process and adjusting the amount of asphalt binder added to the mixture. The entire system shall be interlocked with the plant controls to respond to production rate changes, start up, and shut down situations. The weighing process shall be displayed and recorded in 0.1 units. The PDCE shall be capable of accurately wasting dust without having any adverse effects on the mixture.

(h) **Proportioning control systems.**

1. **Aggregate feed control.** Each feeder shall have an adjustable feed control, which can be locked, with a master control that will automatically increase or decrease the production rate of each feeder proportionately when the total rate of production is changed. The revolutions per minute, tons per hour, etc. of all feeders shall be measured at the tail shaft of the feeder. The aggregate feeders shall have an accuracy of  $\pm 1.0\%$  of the actual quantity of material incorporated.
2. **Aggregate weighing.** The main proportioning weigh belt shall be electronically interfaced with the asphalt binder and mineral filler system to proportion the required amount of each material simultaneously to the mixer. The aggregate weighing systems shall have an accuracy of  $\pm 0.5\%$  of the actual material weighed by the belts. The weighing system shall also have a high-low adjustable tolerance indicator that will signal the operator audibly when the actual production rate differs from the preset rate by more than 3.0%.
3. **Mineral filler control.** Mineral filler shall be added to the mixer by a variable speed proportioning system interfaced with the aggregate weigh belt that will indicate total dry aggregate combined (aggregates + mineral filler) weight to the asphalt proportioning system. The mineral filler system shall have an accuracy of  $\pm 0.5\%$  if the mineral filler is measured by weight, or  $\pm 8.0\%$  if the mineral filler is measured solely by volume of the actual material measured by the system. The mineral filler shall be added in the mixer at the same point the asphalt binder is added such that no mineral filler is lost as fugitive dust. Other systems will be permitted if approved by the Engineer.

4. **Asphalt binder control.** The required quantity of asphalt binder shall be proportioned to the mixer via a temperature compensating meter that will correct the quantity of asphalt binder to 60°F, or a system approved by the Engineer. This system shall be electronically interfaced with the combined dry aggregates and mineral filler. The meter shall have an accuracy of  $\pm 0.4\%$  of the actual material metered.
  5. **Aggregate moisture compensators.** The moisture compensation devices shall be capable of electronically converting the wet aggregate weight to dry aggregate weight. Other systems will be permitted if approved by the Engineer.
- (i) **Control console.** The following items shall be part of the operator's control console.
1. **Aggregate feed controls.** The variable speed controls, both total and proportional for each feeder and combined aggregates shall be indexed in units with a minimum unit of 0.1. The rate in revolutions per minute, tons per hour, etc. shall be displayed by a digital readout for each feeder with a minimum unit of 0.1 revolutions per minute or one (1) ton per hour, etc.
  2. **Aggregate weight indicator.** The accumulated wet weight of material in tons that passes over each weigh belt shall be available at the control console with a minimum unit of 0.1 ton. The dry weight of material, in tons per hour, passing over each weigh belt shall be displayed by digital readouts with a minimum unit of one (1) ton per hour.
  3. **Mineral filler control.** Mineral filler shall be controlled by a variable speed control with a minimum unit of 0.1 and shall be displayed in revolutions per minute, tons per hour, etc. with a minimum unit of 0.1 revolutions per minute or 0.1 tons per hour, etc.
  4. **Asphalt binder control.** The asphalt binder control shall be capable of presetting the actual asphalt binder content directly as a percent of the total weight of mixture with a minimum unit of 0.1%. The asphalt binder rate shall be displayed to a minimum unit of 0.1. A control shall be provided to set the specific gravity or weight per gallon of the asphalt binder. The temperature of the asphalt binder shall be recorded by a recording pyrometer or thermometer at the console.
  5. **Aggregate moisture compensators.** The compensators shall be part of the operator's console and shall have a minimum unit of 0.1%. The control shall be lockable if the moisture setting is not printed as part of the record.
  6. **Asphalt temperature.** The temperature of the mixture shall be recorded in degrees Fahrenheit by a recording pyrometer or thermometer at the console.
- (j) **Recording of proportions.** The plant shall be equipped with a digital printer that will automatically print the following data at six (6) minute intervals during production time and on demand. All readings shall show the date, month and year, and time to the nearest minute for each print.
1. Accumulated dry aggregate in tons to the nearest 0.1 ton.
  2. Accumulated mineral filler in revolutions, tons, etc., to the nearest 0.1 unit.
  3. Accumulated asphalt binder in gallons, tons, etc., to the nearest 0.1 unit.
  4. Aggregate moisture compensators in percent as set at the panel. Required when accumulated dry aggregate is printed in wet aggregate weight.

Another system approved by the Engineer, such as a fully computerized system, that will provide the control and documentation of the above equipment, will be permitted.

- b. Hauling equipment.** Trucks used for hauling asphalt mixtures shall have tight, clean, and smooth metal beds. To prevent the mixture from adhering to them, the truck beds shall be lightly coated with a minimum amount of paraffin oil, lime solution, or other material approved by the Engineer. Petroleum products shall not be used for coating truck beds. Each truck shall have a suitable cover to protect the mixture from adverse weather. When necessary, to ensure that the mixture will be delivered to the site at the specified temperature, truck beds shall be insulated or heated, and covers shall be securely fastened.
- c. Material transfer vehicle (MTV).** Material transfer vehicles used to transfer the material from the hauling equipment to the paver shall be self-propelled with a swing conveyor that can deliver material to the paver without making contact with the paver. The MTV shall be able to move back and forth between the hauling equipment and the paver providing material transfer to the paver, while allowing the paver to operate at a constant speed. The MTV will have remixing and storage capability to prevent physical and thermal segregation.

An MTV is required for runway and taxiway construction on pavements designed for aircraft weighing 100,000 pounds or more. The MTV is recommended for all pavements where the weight of the MTV will not damage the pavement structure.

- d. Asphalts pavers.** Asphalt pavers shall be self-contained, power-propelled units equipped with augers, activated screed or a strike off assembly and be capable of being heated. The augers, activated screed or strike off assembly shall be adjustable either automatically or by adding additional sections so the paver will place, compact or strike off the asphalt to the full width being placed. All width extensions shall have the same placement features and equipment functions as provided on the main body of the paver. Pavers with extendible type screeds shall have a minimum ten (10) foot basic screed, except on projects with 7,500 square yards or less of asphalt. For these smaller projects, a minimum eight (8) foot basic screed will be permitted. Augers shall be extended as additional sections of screed are bolted on or automatically adjustable screeds are extended. The augers need not be extended when the screed extensions on each side of the machine are one (1) foot or less if the finished surface of the mat is uniform. Pavers used for shoulders and similar construction shall be capable of spreading and finishing asphalt in widths shown on the plans. The use of any machine obsolete in design or in poor mechanical condition will not be permitted.

The asphalt paver shall be equipped with a control system capable of automatically maintaining the specified screed grade and elevation. The device shall be effective in leveling depressions in the surface of the existing pavement, the leveling course and the binder course.

The automatic electronic grade control device shall be capable of controlling the elevation of the screed relative to either a preset grade control stringline or a grade reference device traveling on the adjacent pavement surface. The traveling grade reference device shall be not less than 30 feet in length.

The paver shall be equipped with a receiving hopper having sufficient capacity for a uniform spreading operation. The hopper shall be equipped with a distribution system to uniformly place a non-segregated mixture in front of the screed. The distribution system shall have chain curtains, deflector plates, and/or other devices designed and built by the paver manufacturer to prevent segregation during distribution of the mixture from the hopper to the paver screed. The Contractor shall submit a written certification that the devices recommended by the paver manufacturer to prevent segregation have been installed and are operational. Prior to paving, the Contractor, in the presence of the Engineer, shall visually inspect paver parts specifically identified by the manufacturer's check list for excessive wear and the need for replacement. The Contractor shall supply the completed check list to the Engineer noting the condition of the parts. Worn parts shall be replaced. The Engineer may require an additional inspection prior to placement of the surface course or at other times throughout the work.

The screed or strike off assembly shall effectively produce a finished surface of the required smoothness and texture without tearing, shoving or gouging the mixture. If the spreading and finishing equipment in use leaves tracks or indented areas or produces other blemishes in the pavement that are not satisfactorily corrected by the scheduled operations, the use of such equipment shall be discontinued.

The paver shall be capable of paving to a minimum width specified in the contract documents.

The paver shall be capable of being operated at forward speeds consistent with satisfactory placement of the mixture.

A straightedge at least four (4) feet in length and equipped with a carpenter's level shall be available at the spreading and finishing machine to check the surface of the asphalt for transverse slope and longitudinal surface variations.

- e. **Rollers.** The number, type, and weight of rollers shall be sufficient to compact the asphalt to the required density while it is still in a workable condition without crushing of the aggregate, depressions or other damage to the pavement surface. Rollers shall be in good condition, clean, capable of reversing without backlash, and of operating at slow speeds to avoid displacement of the asphalt. All rollers shall be specifically designed and suitable for compacting asphalt concrete and shall be properly used. Rollers that impair the stability of any layer of a pavement structure or underlying soils shall not be used.

No roller shall be used that has in any way been thrown out of its original balance by the application of attachments not approved by the Engineer. All bearings shall be tight.

- (1) **Self-propelled pneumatic-tired roller.** The roller shall be of the oscillating wheel type consisting of not less than seven (7) pneumatic-tired wheels revolving on two (2) axles, and capable of being ballasted to the weight required. The tires on the front and rear wheels shall be staggered so that the tire sidewalls will have a minimum overlap of one-half (1/2) inch. The roller shall provide for a smooth operation when starting, stopping or reversing direction.

The tires shall withstand inflation pressures between 60 and 120 pounds per square inch. The roller shall be equipped with an adequate scraping or cleaning device on each tire to prevent the accumulation of material on the tires. The roller shall be equipped with a water system which will keep all tires uniformly wet to prevent material pickup.

The Contractor shall provide means for determining the weight of the roller as distributed on each wheel. Ballast shall be included in determining the weight.

- (2) **Steel wheel rollers.** The roller shall be self-propelled and provide a smooth operation when starting, stopping, or reversing directions. The steering mechanism shall provide for positive control of the roller. Roller wheels shall be smooth and free from openings or projections which will mar the surface on which the roller is operated. Motor rollers shall be equipped with drip pans to contain oil, grease, or gasoline drips generated by the roller operation. The roller shall be provided with adjustable scrapers which shall be used when necessary to keep the surface of the wheels clean.

When used on a hot-mix asphalt surface, the roller shall be equipped with water tanks and sprinkling devices which shall be used to wet the wheels and prevent material pickup.

- (a) **Tandem rollers.** The Contractor shall provide means for determining the weight of the roller as distributed on each axle. Ballast shall be included in determining the weight.

The rear wheel may be crowned at the rate of not more than 3/16 inch in 4-1/2 feet. The front wheel shall be divided into at least two (2) sections and shall show no

noticeable crown. The weight of the roller shall meet requirements of the specific item of work being constructed.

**(b) Three-wheel rollers.** The rear wheels of three-wheel rollers may be crowned at the rate of not more than 1/16 inch in 20 inches and shall be propelled with a differential gear. The front wheel shall be divided into at least two (2) sections, shall show no noticeable crown, and shall overlap the compression area of each rear wheel by not less than 1-1/2 inch. The weight of the roller shall meet requirements of the specific item of work being constructed.

**(3) Vibratory roller.** The vibratory roller shall be self-propelled and provide a smooth operation when starting, stopping or reversing directions. The vibrating drums amplitude and frequency shall be approximately the same in each direction and meet the following minimum requirements: drum diameter 48 inches, length of drum 66 inches, vibrators 1,600 vibrations per minute, unit static force on vibrating drums 125 pounds per inch, total applied force 325 pounds per inch, adjustable eccentrics, and reversible eccentrics on nondriven drums. The total applied force for various combinations of vibrations per minute and eccentric positions shall be shown on decals on the vibrating roller or on a chart maintained with the roller. The vibratory roller shall be equipped with water tanks and sprinkling devices, or other approved methods, which shall be used to wet the wheels to prevent material pickup.

A vibrating reed tachometer (hand type) shall be furnished with each vibratory roller. The vibrating reed tachometer shall have a range of 1,000 to 4,000 vibrations per minute. The vibrating reed tachometer shall have two (2) rows of reeds, one (1) ranging from 1,000 to 2,000 vibrations per minute and the other from 2,000 to 4,000 vibrations per minute.

**(4) Oscillatory roller.** The oscillatory roller shall be self-propelled and provide a smooth operation when starting, stopping, or reversing directions. The oscillatory roller shall be able to operate in a mode that will provide tangential impact force with or without vertical impact force by using at least one drum. The oscillatory roller shall be equipped with water tanks and sprinkling devices, or other approved methods, which shall be used to wet the drums to prevent material pickup. The drum(s) amplitude and frequency of the tangential and vertical impact force shall be approximately the same in each direction and meet the following requirements:

- (a)** The minimum diameter of the drum(s) shall be 48 inches;
- (b)** The minimum length of the drum(s) shall be 66 inches;
- (c)** The minimum unit static force on the drum(s) shall be 125 lb/in;
- (d)** The minimum force on the oscillatory drum shall be 18,000 lb; and
- (e)** Self-adjusting eccentrics, and reversible eccentrics on non-driven drum(s).

**f. Density device.** The Contractor shall have on site a density gauge during all paving operations in order to assist in the determination of the optimum rolling pattern, type of roller and frequencies, as well as to monitor the effect of the rolling operations during production paving. The Contractor shall supply a qualified technician during all paving operations to calibrate the gauge and obtain accurate density readings for all new asphalt. These densities shall be supplied to the Resident Engineer upon request at any time during construction. No separate payment will be made for supplying the density gauge and technician.

**g. Pavement surface test equipment.** Required surface testing and analysis equipment and their jobsite transportation shall be provided by the Contractor.

**(1) Straightedge.** The 16-foot or 12-foot straightedge shall consist of a metal I-beam mounted between two (2) wheels spaced 16 feet between the axles. Scratcher bolts,



which can be easily and accurately adjusted, shall be set at the 1/4, 1/2, and 3/4 points between the axles. A handle suitable for pushing and guiding shall be attached to the straightedge.

**(2) Profile testing device.** The profile testing device shall have a decal displayed to indicate it has been tested through the Profile Equipment Verification (PEV) Program administered by the Department.

**(a) California profilograph.** The California Profilograph shall be either computerized or manual and have a frame 25 feet in length supported upon multiple wheels at either end. The profile shall be recorded from the vertical movement of a wheel attached to the frame at midpoint.

The California Profilograph shall be calibrated according to the manufacturer's recommendations and California Test 526. All calibration traces and calculations shall be submitted to the Engineer for the project file.

**(b) Inertial profiler.** The inertial profiler shall be either an independent device or a system that can be attached to another vehicle using one (1) or two (2) non-contact sensors to measure the pavement profile. The inertial profiler shall be capable of performing a simulation of the California Profilograph to provide results in the Profile Index format.

The inertial profiler shall be calibrated according to the manufacturer's recommendations. All calibration traces and calculations shall be submitted to the Engineer for the project file.

**(c) Trace analysis.** The Contractor shall reduce/evaluate these traces using a 0.00-inch blanking band and determine a Profile Index in inches per mile for each section of finished pavement surface. Traces produced using a computerized profile testing device will be evaluated without further reduction. When using a manual profile testing device, the Contractor shall provide an electronic scanner, a computer, and software to reduce the trace. All analysis equipment (electronic scanner, computerized recorder, etc.) shall be able to accept 0.00 inches for the blanking band.

All traces from pavement sections tested with the profile testing device shall be recorded on paper with scales of 300-to-1 longitudinally and 1-to-1 vertically. Equipment and software settings of the profile testing device and analysis equipment shall be set to those values approved through the PEV Program.

The Engineer may retest the pavement at any time to verify the accuracy of the equipment.

**404-4.3 Aggregate stockpile management.** Aggregate stockpiles shall be constructed in such a manner that prevents segregation and intermixing of deleterious materials. Aggregates from different sources shall be stockpiled, weighed and batched separately at the asphalt batch plant. Aggregates that have become segregated or mixed with earth or foreign material shall not be used.

A continuous supply of materials shall be provided to the work to ensure continuous placement.

**404-4.4 Preparation of asphalt binder.** The asphalt binder shall be heated in a manner that will avoid local overheating and provide a continuous supply of the asphalt binder to the mixer at a uniform temperature. The temperature of the asphalt binder delivered to the mixer shall be sufficient to provide a suitable viscosity for adequate coating of the aggregate particles, but shall not exceed 350°F, unless otherwise required by the manufacturer.

**404-4.5 Preparation of mineral aggregate.** The aggregate for the mixture shall be heated and dried prior to introduction into the mixer. The maximum temperature and rate of heating shall be such that no damage occurs to the aggregates. The temperature of the aggregate and mineral filler

shall not exceed 350°F when the asphalt is added. Particular care shall be taken that aggregates high in calcium or magnesium content are not damaged by overheating. The temperature shall not be lower than is required to obtain complete coating and uniform distribution on the aggregate particles and to provide a mixture of satisfactory workability.

**404-4.6 Preparation of asphalt mixture.** The aggregates and the asphalt binder shall be weighed or metered and introduced into the mixer in the amount specified by the job mix formula. The combined materials shall be mixed until the aggregate obtains a uniform coating of bitumen and is thoroughly distributed throughout the mixture. Wet mixing time shall be the shortest time that will produce a satisfactory mixture, but not less than 25 seconds for batch plants. The wet mixing time for all plants shall be established by the Contractor, based on the procedure for determining the percentage of coated particles described in AASHTO T 195, for each individual plant and for each type of aggregate used. The wet mixing time will be set to achieve 95% of coated particles. For continuous mix plants, the minimum mixing time shall be determined by dividing the weight of its contents at operating level by the weight of the mixture delivered per second by the mixer. The moisture content of all asphalt mixtures upon discharge shall not exceed 0.5%.

For batch plants, wet mixing time begins with the introduction of asphalt binder into the mixer and ends with the opening of the mixer discharge gate. Mixing time should be the shortest time required to obtain uniform distribution of aggregate sizes and thorough coating of aggregate particles with asphalt binder.

**404-4.7 Application of tack coat.** Immediately before placing the asphalt mixture, the underlying course shall be cleaned of all dust and debris. A tack coat shall be applied in accordance with Item 603 titled EMULSIFIED ASPHALT TACK COAT to all vertical and horizontal asphalt and concrete surfaces prior to placement of the first and each subsequent lift of asphalt mixture.

**404-4.8 Laydown plan, transporting, placing, and finishing.** Prior to the placement of the asphalt, the Contractor shall prepare a laydown plan with the sequence of paving lanes and width to minimize the number of cold joints; the location of any temporary ramps; laydown temperature; and estimated time of completion for each portion of the work (milling, paving, rolling, cooling, etc.). The laydown plan and any modifications shall be approved by the Engineer.

Deliveries shall be scheduled so that placing and compacting of mixture is uniform with minimum stopping and starting of the paver. Hauling over freshly placed material shall not be permitted until the material has been compacted, as specified, and allowed to cool to atmospheric temperature. The Contractor, at their expense, shall be responsible for repair of any damage to the pavement caused by hauling operations.

Edges of existing asphalt pavement abutting the new work shall be saw cut and the cut off material and laitance removed. Apply a tack coat in accordance with Item 603 titled EMULSIFIED ASPHALT TACK COAT before new asphalt material is placed against it.

The speed of the paver shall be regulated to eliminate pulling and tearing of the asphalt mat. The paver speed shall be mated with the required roller speed and shall not exceed that which coincides with the average rate of delivery of asphalt to the paver to provide, as nearly as possible, continuous operation of the paver. In no case shall the speed of the paver exceed 50 feet per minute

Placement of the asphalt mix shall begin along the centerline of a crowned section or on the high side of areas with a one-way slope unless shown otherwise on the laydown plan as accepted by the Engineer. The asphalt mix shall be placed in consecutive adjacent lanes having a minimum width as specified in the contract documents. Additional screed sections attached to widen the paver to meet the minimum lane width requirements must include additional auger sections to move the asphalt mixture uniformly along the screed extension.

The longitudinal joint in one (1) course shall offset the longitudinal joint in the course immediately below by at least one (1) foot; however, the joint in the surface top course shall be at the centerline of crowned pavements. Transverse joints in one (1) course shall be offset by at least ten (10) feet from transverse joints in the previous course. Transverse joints in adjacent lanes

shall be offset a minimum of ten (10) feet. On areas where irregularities or unavoidable obstacles make the use of mechanical spreading and finishing equipment impractical, the mixture may be spread and luted by hand tools.

The Resident Engineer may at any time, notwithstanding previous plant acceptance, reject and require the Contractor to dispose of any batch of asphalt mixture which is rendered unfit for use due to contamination, segregation, incomplete coating of aggregate, or improper mix temperature. Such rejection may be based on only visual inspection or temperature measurements. In the event of such rejection, the Contractor may take a representative sample of the rejected material in the presence of the Resident Engineer and, if it can be demonstrated in the laboratory, in the presence of the Resident Engineer, that such material was erroneously rejected, payment will be made for the material at the contract unit price.

Paving operations shall be conducted in a manner to prevent medium or high segregation. Plant operations, hauling of the mix, paver operations, and the compacted mat shall be continually monitored for segregation. Areas of segregation in the surface course, as determined by the Resident Engineer, shall be removed and replaced at the Contractor's expense. The area shall be removed by saw cutting and milling a minimum of the construction lift thickness as specified for the approved mix design. The area to be removed and replaced shall be a minimum width of the paver and a minimum of ten (10) feet long.

**404-4.9 Compaction of asphalt mixture.** Immediately after each lift of asphalt course mixture is placed, each lift shall be compacted with equipment meeting the following requirements.

- a. **Breakdown roller.** The break down roller shall be a vibratory roller, pneumatic-tired roller, oscillatory roller, steel-wheeled tandem roller or steel wheeled three-wheel roller.
- b. **Intermediate roller.** The intermediate roller shall be a pneumatic-tired roller or oscillatory roller. A vibratory roller may be used on mixtures containing polymer modified asphalt binder.
- c. **Final roller.** The final roller shall be a vibratory roller operated in static mode, an oscillatory roller operated in tangential impact mode only, or steel-wheeled tandem roller.

Rolling of the first lane of asphalt shall start longitudinally at the edge having the lower elevation and progress to the other edge, overlapping on successive trips to obtain uniform coverage. The roller shall not pass over an unprotected edge of the freshly laid asphalt, unless directed by the Resident Engineer. When directed by the Resident Engineer, the edge shall be rolled with a pneumatic-tired roller.

When laying the asphalt adjacent to a previously placed lane, the first pass of the roller shall be along the longitudinal joint on the fresh mixture with the compression wheel not more than six (6) inches from the joint. The second pass of the roller shall overlap the longitudinal joint not more than 12 inches on the previously placed lane, after which the rolling shall proceed from the low side of the transverse slope to the high side, overlapping uniformly. Each stop shall be regulated to prevent trapping of water on the rolled surface. The steel-wheeled rollers shall be operated with the compression wheels toward the direction of paving.

The speed of the roller at all times shall be slow enough to avoid displacement of the asphalt. If displacement occurs, it shall be corrected at once by raking and applying fresh asphalt where required. To prevent adhesion of the asphalt to the roller, the wheels shall be kept properly moistened without an excess of water.

Rolling of the asphalt shall be continued until all roller marks are eliminated and the asphalt is satisfactorily compacted. When required by the Resident Engineer, the surface course shall be rolled diagonally in two (2) directions with a tandem roller, the second rolling crossing the lines of the first, and, if the width of the pavement permits, it shall also be rolled at right angles to the centerline.

In all places inaccessible to the rollers, such as locations adjacent to curbs, gutters, headers, manholes, and similar structures, the required compaction shall be secured with tampers. Any

mixture that becomes loose and broken, mixed with dirt, contains check-cracking, or in any way defective shall be removed and replaced with fresh hot mixture and immediately compacted to conform to the surrounding area. This work shall be done at the Contractor's expense. Skin patching shall not be allowed.

**404-4.10 Joints.** The formation of all joints shall be made in such a manner as to ensure a continuous bond between the courses and obtain the required density. All joints shall have the same texture as other sections of the course and meet the requirements for smoothness and grade.

The roller shall not pass over the unprotected end of the freshly laid mixture except when necessary to form a transverse joint. When necessary to form a transverse joint, it shall be made by means of placing a bulkhead or by tapering the course. The tapered edge shall be cut back to its full depth and width on a straight line to expose a vertical face prior to placing the adjacent lane. In both methods, all contact surfaces shall be given a tack coat of asphalt material before placing any fresh mixture against the joint.

Longitudinal joints which have been left exposed for more than four (4) hours; the surface temperature has cooled to less than 175°F or are irregular, damaged, uncompacted or otherwise defective shall be cut back with a cutting wheel or pavement saw a maximum of three (3) inches to expose a clean, sound, uniform vertical surface for the full depth of the course. All cutback material and any laitance produced from cutting joints shall be removed from the project. Asphalt tack coat in accordance with Item 603 titled EMULSIFIED ASPHALT TACK COAT shall be applied to the clean, dry joint, prior to placing any additional fresh asphalt against the joint. The cost of this work shall be considered incidental to the cost of the asphalt.

**404-4.11 Saw-cut grooving.** Saw-cut grooves shall be provided as specified in Item 621 titled SAW-CUT GROOVES.

**404-4.12 Diamond grinding.** Diamond grinding shall be completed prior to pavement grooving. Diamond grinding shall be accomplished by sawing with saw blades impregnated with industrial diamond abrasive.

Diamond grinding shall be performed with a machine designed specifically for diamond grinding capable of cutting a path at least three (3) feet wide. The saw blades shall be one-eighth (1/8) inch wide with a sufficient number of blades to create grooves between 0.090 and 0.130 inches wide; and peaks and ridges approximately 1/32 inch higher than the bottom of the grinding cut. The actual number of blades will be determined by the Contractor and depend on the hardness of the aggregate. Equipment or grinding procedures that causes ravels, aggregate fractures, spalls or disturbance to the pavement will not be permitted. The Contractor shall demonstrate to the Resident Engineer that the grinding equipment will produce satisfactory results prior to making corrections to surfaces. Grinding will be tapered in all directions to provide smooth transitions to areas not requiring grinding. The slurry resulting from the grinding operation shall be continuously removed and the pavement left in a clean condition. The Contractor shall apply a surface treatment per Item 608 titled EMULSIFIED ASPHALT SEAL COAT to all areas that have been subject to grinding.

**404-4.13 Nighttime paving requirements.** The Contractor shall provide adequate lighting during any nighttime construction. A lighting plan must be submitted by the Contractor and approved by the Engineer prior to the start of any nighttime work. All work shall be in accordance with the approved construction safety and phasing plan and lighting plan.

**404-4.14 Protection of pavement.** After final rolling, no vehicular traffic of any kind shall be permitted on the pavement until it has cured at least 12 hours or unless otherwise authorized by the Engineer. Newly constructed pavement areas shall not be opened to aircraft traffic until 24 hours after completion or unless otherwise authorized by the Engineer.

**CONTRACTOR QUALITY CONTROL (QC)**

**404-5.1 General.** The Contractor shall develop a Contractor Quality Control Program (CQCP) in accordance with Item 100 titled CONTRACTOR QUALITY CONTROL PROGRAM (CQCP). No partial payment will be made for materials that are subject to specific QC requirements without an approved CQCP.

**404-5.2 Contractor quality control (QC) facilities.** The Contractor shall provide or contract for testing facilities in accordance with Item 100 titled CONTRACTOR QUALITY CONTROL PROGRAM (CQCP). The Engineer shall be permitted unrestricted access to inspect the Contractor's QC facilities and witness QC activities. The Engineer will advise the Contractor in writing of any noted deficiencies concerning the QC facility, equipment, supplies, or testing personnel and procedures. When the deficiencies are serious enough to be adversely affecting the test results, the incorporation of the materials into the work shall be suspended immediately and will not be permitted to resume until the deficiencies are satisfactorily corrected.

**404-5.3 Contractor QC testing.** The Contractor shall perform all QC tests necessary to control the production and construction processes applicable to these specifications and as set forth in the approved CQCP. The testing program shall include, but not necessarily be limited to, tests for the control of asphalt content, aggregate gradation, temperatures, aggregate moisture, field compaction, and surface smoothness. A QC Testing Plan shall be developed as part of the CQCP.

- a. **Asphalt content.** A minimum of two (2) tests shall be performed per day in accordance with AASHTO T 308 for determination of asphalt content. The correction factor shall be determined as part of the first test performed at the beginning of plant production; and as part of every tenth test performed thereafter. The asphalt content for the day will be determined by averaging the test results.
- b. **Gradation.** Aggregate gradations shall be determined a minimum of twice per day from mechanical analysis of extracted aggregate in accordance with the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 11-08, *Aggregate Gradation Control System (AGCS)*.
- c. **Moisture content of aggregate.** The moisture content of aggregate used for production shall be determined a minimum of once per day in accordance with AASHTO T 255.
- d. **Moisture content of asphalt.** The moisture content of the mixture shall be determined once per day in accordance with AASHTO T 329.
- e. **Temperatures.** Temperatures shall be checked, at least four (4) times per day, at necessary locations to determine the temperatures of the dryer, the asphalt binder in the storage tank, the mixture at the plant, and the asphalt at the job site.
- f. **In-place density monitoring.** The Contractor shall conduct any necessary testing to ensure that the specified density is being achieved. A nuclear gauge may be used to monitor the pavement density in accordance with ASTM D2950.
- g. **Smoothness for contractor quality control.**

The Contractor shall perform smoothness testing in transverse and longitudinal directions daily to verify that the construction processes are producing pavement with variances less than one-quarter (1/4) inch in 16 feet, identifying areas that may pond water which could lead to hydroplaning of aircraft. If the smoothness criterion is not met, appropriate changes and corrections to the construction process shall be made by the Contractor before construction continues

The Contractor may use a 12 or 16-foot straightedge or a profile testing device approved by the Engineer. Straight-edge testing shall start with one-half (1/2) the length of the straightedge at the edge of pavement section being tested and then moved ahead one-half (1/2) the length of the straightedge for each successive measurement. Testing shall be

continuous across all joints. The surface irregularity shall be determined by placing the freestanding (unleveled) straightedge on the pavement surface and allowing it to rest upon the two (2) highest spots covered by its length, and measuring the maximum gap between the straightedge and the pavement surface in the area between the two (2) high points. If an external reference device is used, the data may be evaluated using the FAA profile program, ProFAA, or FHWA ProVal, using the 12-foot straightedge simulation function.

Smoothness readings shall not be made across grade changes or cross slope transitions. The transition between new and existing pavement shall be evaluated separately for conformance with the contract documents.

**(1) Transverse measurements.** Transverse measurements shall be taken for each day's production placed. Transverse measurements shall be taken perpendicular to the pavement centerline each 50 feet or more often as determined by the Resident Engineer. The joint between lanes shall be tested separately to facilitate smoothness between lanes.

**(2) Longitudinal measurements.** Longitudinal measurements shall be taken for each day's production placed. Longitudinal tests shall be parallel to the centerline of paving; at the center of paving lanes when widths of paving lanes are less than 20 feet; and at the third points of paving lanes when widths of paving lanes are 20 feet or greater.

Deviations on the final surface course in either the transverse or longitudinal direction that will trap water greater than one-quarter (1/4) inch shall be corrected with diamond grinding or by removing and replacing the surface course to full depth. Grinding shall be tapered in all directions to provide smooth transitions to areas not requiring grinding. All areas in which diamond grinding has been performed shall be subject to the final pavement thickness tolerances specified herein. Areas that have been ground shall be sealed with a surface treatment in accordance with Item 608 titled Emulsified Asphalt Seal Coat. To avoid the surface treatment creating any conflict with runway or taxiway markings, it may be necessary to seal a larger area.

Control charts shall be kept to show area of each day's placement and the percentage of corrective grinding required. Corrections to production and placement shall be initiated when corrective grinding is required. If the Contractor's machines and/or methods produce significant areas that need corrective actions in excess of 10% of a day's production, production shall be stopped until corrective measures are implemented by the Contractor.

**h. Grade.** Grade shall be evaluated daily to allow adjustments to paving operations when grade measurements do not meet specifications. As a minimum, grade shall be evaluated prior and after the placement of the first lift and then after placement of the surface lift.

Measurements will be taken at appropriate grade lines (as a minimum at center and edges of paving lane) and longitudinal spacing as shown on cross-sections and plans. The final surface of the pavement will not vary from the grade line elevations and cross-sections specified in the contract documents by more than 0.05 feet vertically and 0.1 feet laterally. The documentation will be provided by the Contractor to the Resident Engineer by the end of the following working day.

Areas of surface course that exceed grade or smoothness criteria and that retain water on the surface must be ground off provided the course thickness after grinding is not more than one-half (1/2) inch less than the thickness specified in the contract documents.

The Contractor shall repair low areas or areas that cannot be corrected by grinding by removal of deficient areas to the depth of the final course plus one-half (1/2) inch and replacing with new material. Skin patching is not allowed.

**404-5.4 Sampling.** When directed by the Resident Engineer, the Contractor shall sample and test any material that appears inconsistent with similar material being sampled, unless such material is

voluntarily removed and replaced, or deficiencies corrected by the Contractor. All sampling shall be in accordance with standard procedures specified.

**404-5.5 Control charts.** The Contractor shall maintain linear control charts for both individual measurements and moving average of the last four (4) tests for aggregate gradation, asphalt content, and voids.

Control charts shall be posted in a location satisfactory to the Resident Engineer and kept current. As a minimum, the control charts shall identify the project number, the contract item number, the test number, each test parameter, the limits applicable to each test parameter, and the Contractor's test results. The Contractor shall use the control charts as part of a process control system for identifying potential problems and assignable causes before they occur. If the Contractor's projected data during production indicates a problem and the Contractor is not taking satisfactory corrective action, the Engineer may halt production or acceptance of the material.

**a. Individual measurements and moving average.** Control charts for individual measurements and moving average of the last four (4) tests shall be established to maintain process control within tolerance for aggregate gradation, asphalt content, and voids. The control charts shall use the job mix formula target values as indicators of central tendency for the following test parameters with associated limits.

#### Control Chart Limits for Individual Measurements

Sieve	Individual Test	Moving Average of 4
3/8 inch	±6%	±4%
No. 4	±6%	±4%
No. 8	±5%	±3%
No. 30	±3%	±2.5%
No. 200	±2%	±1%
Asphalt Content	±0.45%	±0.2%
Voids	±1.2%	±1%

**b. Corrective action.** The CQCP shall indicate that appropriate action shall be taken when the process is believed to be out of tolerance. The plan shall contain sets of rules to gauge when a process is out of control and detail what action will be taken to bring the process into control. As a minimum, a process shall be deemed out of control and production stopped and corrective action taken, if:

**(1) Corrective action for required plant tests.**

**(a) Individual test results.** When an individual test result exceeds its control limit, the Contractor shall immediately resample and retest. If at the end of the day no material remains from which to resample, the first sample taken the following day shall serve as the resample as well as the first sample of the day. This result shall be recorded as a retest. If the retest passes, the Contractor may continue the required plant test frequency. Additional check samples should be taken to verify mix compliance.

**1. Voids and asphalt binder content.** If the retest for voids or asphalt binder content exceeds control limits, asphalt production shall cease, and immediate corrective action shall be instituted by the Contractor. After corrective action, asphalt production shall be restarted, the asphalt production shall be stabilized, and the Contractor shall immediately resample and retest. asphalt production

may continue when approved by the Engineer. The corrective action shall be documented.

**2. Gradation.** For gradation retest failures, immediate corrective action shall be instituted by the Contractor. After corrective action, the Contractor shall immediately resample and retest. The corrective action shall be documented.

**(b) Moving average.** When the moving average values trend toward the moving average control limits, the Contractor shall take corrective action and increase the sampling and testing frequency. The corrective action shall be documented.

The Contractor shall notify the Engineer whenever the moving average values exceed the moving average control limits. If two (2) consecutive moving average values fall outside the moving average control limits, the Contractor shall cease operations. Corrective action shall be immediately instituted by the Contractor. Operations shall not be reinstated without the approval of the Engineer. Failure to cease operations shall subject all subsequently produced material to be considered unacceptable.

**(c) Asphalt production control.** If the Contractor is not controlling the production process and is making no effort to take corrective action, the operation shall stop.

**(2) Corrective action for required field tests (density).** When an individual density test exceeds the control limits, the Contractor shall immediately retest in a location that is halfway between the failed test site and the finish roller. If the retest passes, the Contractor shall continue the normal density test frequency. An additional density check test should be performed to verify the mix compaction.

If the retest fails, the Contractor shall immediately conduct one (1) of the following procedures.

**(a) Low density.** If the failing density retest indicates low densities, the Contractor shall immediately increase the compaction effort, review all mixture test results representing the asphalt being produced, and make corrective action as needed. The Contractor shall immediately perform a second density retest within the area representing the increased compaction effort and mixture adjustments.

**(b) High density.** If the failing density retest indicates high densities, the Contractor shall cease production and placement until all mixture test results are reviewed and corrective action is taken. If the high-density failure is a result of a change in the mixture, any existing material in the surge bin may be subject to rejection by the Engineer. After restart of asphalt production, a second density retest shall then be performed in the area representing the mixture adjustments.

If the second retest from either procedure passes, production and placement of the asphalt may continue. The increased compaction effort for low density failures shall not be reduced to that originally being used unless it is determined by investigation that the cause of the low density was unrelated to compaction effort, the cause was corrected, and tests show the corrective action has increased the density within the required limits.

If the second retest fails, production and placement of the asphalt shall cease until the Contractor has completed an investigation and the problem causing the failing densities has been determined. If the Contractor's corrective action is approved by the Engineer, production and placement of the asphalt may then be resumed. The Contractor shall increase the frequency of density testing to show, to the satisfaction of the Engineer, that the corrective action taken has corrected the density problem.

**404-5.6 QC reports.** The Contractor shall maintain records and shall submit reports of QC activities daily in accordance with the CQCP described in Item 100 titled CONTRACTOR QUALITY CONTROL PLAN (CQCP).



## MATERIAL ACCEPTANCE

**404-6.1 Acceptance sampling and testing.** Unless otherwise specified, all acceptance sampling and testing necessary to determine conformance with the requirements specified in this section will be performed by the Resident Engineer at no cost to the Contractor except that coring as required in this section shall be completed and paid for by the Contractor. Refer to Illinois Department of Transportation, Aeronautics Policy Memorandum (PM) 96-3, *Requirements for Quality Assurance on Projects With Bituminous Concrete Paving*.

**(For Method I only: Under 2,000 tons/pay item)** After the completion of compaction, the pavement will be tested for acceptance by the Resident Engineer and accepted on the basis of percent air voids in the final compacted mat. The HMA surface course shall be compacted to a minimum density of 94 percent (6 percent air voids) and a maximum of 98 percent (2 percent air voids) of the Theoretical Maximum Specific Gravity (AASHTO T 209). If during construction, the density test fails below 94 percent, additional approved rollers shall be required. Failure to achieve density within these limits shall be cause for rejection of the material, as determined by the Department.

Two random nuclear density tests shall be taken for each 500 tons of mix placed. Each nuclear density test shall be the average of five (5) nuclear tests taken as a cross-section of the pavement. The Resident Engineer shall have a nuclear gauge and qualified operator on the project when constructing this item. One random mix sample shall be taken from each 1,000 tons of mix laid, for Extraction, Maximum Specific Gravity, and Air Void tests.

A minimum of one core set (2 cores, results averaged) shall be collected from a location centered on a longitudinal construction joint. The minimum density of the joint shall be 91 percent of the Theoretical Maximum Specific Gravity. When a longitudinal joint sealant is applied, longitudinal joint density testing will not be required on the joint(s) sealed.

Joint density results below an average of 91% shall result in the immediate suspension of paving operations until sufficient investigation and solution to the density problem is agreed to by the Engineer. The result of this deficiency will be a 5% penalty on all production done on the day the core represents.

**(For Method II only: 2,000 tons/pay item and Over)** After the completion of compaction, the pavement will be tested and accepted on the basis of Percentage of material Within specification Limits (PWL).

The HMA surface course shall be compacted to a minimum density of 94 percent (6 percent air voids) and a maximum of 98 percent (2 percent air voids) of the Theoretical Maximum Specific Gravity (AASHTO T 209) and accepted by the following statistical procedure. When more than one surface course mix design is used on the same project, each mix will be evaluated separately under the statistical acceptance procedure specified herein.

- a. **Quality assurance (QA) testing laboratory.** The QA testing laboratory performing these acceptance tests will be accredited in accordance the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 6-08, *Minimum Private Laboratory Requirements for Construction Materials Testing or Mix Design*.
- b. **Lot size.** A standard lot will consist of to one (1) day's production not to exceed 2,000 tons. Each lot will be divided into approximately equal sublots equivalent to 500 tons of asphalt. When only one (1) or two (2) sublots are produced in a day's production, the sublots will be combined with the production lot from the previous or next day. A lot shall consist of the average of four (4) sublot samples, but shall not exceed six (6) sublots. The minimum number of sublots per lot shall be three (3). Where three (3) sublots are produced, they will constitute a lot. Where one (1) or two (2) sublots are produced, they will be incorporated into the previous or next lot. Where more than one (1) plant is simultaneously producing asphalt for the job, the lot sizes will apply separately for each plant.

- c. **Partial lots.** When operational conditions cause a lot to be terminated before the specified number of tests have been made for the lot or for overages or minor placements to be considered as partial lots, the following procedure will be used to adjust the lot size and the number of tests for the lot.

Where three (3) sublots have been produced, they will constitute a lot. The final lot may thus contain up to six (6) sublots. Where one (1) or two (2) sublots have been produced, they will be incorporated into the next lot or the previous lot and the total number of sublots will be used in the acceptance criteria calculation, that is,  $n=5$  or  $n=6$ .

- d. **Asphalt air voids.** Plant-produced asphalt will be tested for air voids on a subplot basis.
- (1) **Sampling.** Random sampling locations will be determined by the Resident Engineer. Samples shall be taken from material deposited into trucks at the plant or at the job site in accordance with ASTM D979. The sample of asphalt may be put in a covered metal tin and placed in an oven for not less than 30 minutes nor more than 60 minutes to maintain the material at or above the compaction temperature as specified in the JMF.
  - (2) **Testing.** Air voids will be determined for each subplot in accordance with AASHTO T 269 for a set of compacted specimens prepared in accordance with ASTM D6926.
- e. **In-place asphalt mat and joint density.** Each subplot will be tested for in-place mat and joint density as a percentage of the theoretical maximum density (TMD).
- (1) **Sampling.** The Contractor will cut minimum five (5) inch diameter samples in accordance with AASHTO R 67. The Contractor shall furnish all tools, labor, and materials for cleaning, and filling the cored pavement. Laitance produced by the coring operation shall be removed immediately after coring, and core holes shall be filled within one (1) day after sampling in a manner acceptable to the Resident Engineer.
  - (2) **Bond.** Each lift of asphalt shall be bonded to the underlying layer. If cores reveal that the surface is not bonded, additional cores shall be taken as directed by the Resident Engineer to determine the extent of unbonded areas. Unbonded areas shall be removed by milling and replaced at the Contractor's expense as directed by the Engineer.
  - (3) **Thickness.** Thickness of each lift of surface course will be evaluated by the Resident Engineer for compliance to the requirements specified in the contract documents after any necessary corrections for grade. Measurements of thickness will be made using the cores extracted for each subplot for density measurement. The maximum allowable deficiency at any point will not be more than one-quarter (1/4) inch less than the thickness indicated for the lift. Average thickness of lift, or combined lifts, will not be less than the indicated thickness. Where the thickness tolerances are not met, the lot or subplot shall be corrected by the Contractor at his expense by removing the deficient area and replacing with new pavement. The Contractor, at his expense, may take additional cores as approved by the Engineer to circumscribe the deficient area.
  - (4) **Mat density.** One (1) core shall be taken from each subplot. Random sampling locations will be determined by the Resident Engineer. Cores for mat density shall not be taken closer than one (1) foot from a transverse or longitudinal joint. The bulk specific gravity of each cored sample will be determined in accordance with AASHTO T 166. The percent compaction (density) of each sample will be determined by dividing the bulk specific gravity of each subplot sample by the TMD for that subplot.
  - (5) **Joint density.** One (1) core centered over the longitudinal joint shall be taken for each subplot which contains a longitudinal joint. Random sampling locations will be determined by the Resident Engineer. The bulk specific gravity of each core sample will be determined in accordance with AASHTO T 166. The percent compaction (density) of each sample will be determined by dividing the bulk specific gravity of each joint density sample by the average TMD for the lot. The TMD used to determine the joint density at

joints formed between lots will be the lower of the average TMD values from the adjacent lots. The minimum joint density shall be 91% of the TMD.

When a longitudinal joint sealant is applied, longitudinal joint density testing will not be required on the joint(s) sealed

#### 404-6.2 Acceptance criteria.

a. **General.** Acceptance will be based on the implementation of the Contractor Quality Control Program (CQCP) and the following characteristics of the completed pavements:

- (1) Air voids
- (2) Mat density
- (3) Joint density
- (4) Grade
- (5) Profilograph smoothness

(a) Profilograph smoothness and acceptance only apply when the overall project is a new or reconstructed runway or taxiway greater than 500 feet in length. Profilograph roughness is not applicable to aprons and should be used with caution on projects to rehabilitate runways and/or taxiways unless the project includes provisions to correct existing deficiencies.

b. **Air voids and mat density.** Acceptance of each lot of plant produced material for air voids and mat density will be based on the percentage of material within specification limits (PWL). If the PWL of the lot equals or exceeds 90%, the lot will be acceptable.

c. **Joint density.** Acceptance of each lot of plant produced asphalt for joint density will be based on the PWL. If the PWL of the lot is equal to or exceeds 90%, the lot will be considered acceptable. If the PWL is less than 90%, the Contractor shall evaluate the reason and act accordingly. If the PWL is less than 80%, the Contractor shall cease operations. Production may resume once the reason for poor compaction has been determined and appropriate measures have been taken to ensure proper compaction. If the PWL is less than 71%, the pay factor for the lot used to complete the joint will be reduced by 5%.

d. **Grade.** The final finished surface of the pavement of the completed project shall be surveyed to verify that the grade elevations and cross-sections specified in the contract documents do not deviate more than 0.05 feet vertically or 0.1 feet laterally.

Cross-sections of the pavement shall be taken at a minimum 50-foot longitudinal spacing and at all longitudinal grade breaks. Minimum cross-section grade points shall include grade at centerline,  $\pm 10$  feet of centerline, and edge of pavement.

The survey and documentation shall be stamped and signed by a professional licensed surveyor. Payment for sublots that do not meet grade for over 25% of the sublot shall be reduced by 5% and not be more than 95%.

e. **Profilograph smoothness for QA acceptance.** The final profilograph shall be the full length of the project to facilitate testing of roughness between lots. The Contractor, in the presence of the Resident Engineer shall perform a profilograph smoothness test on the completed project with a profilograph as specified in paragraph 404-4.2 titled EQUIPMENT. Data and results shall be provided within 48 hours of profilograph smoothness tests.

The pavement shall have an average profile index less than 15 inches per mile per one-tenth (1/10) mile. The equipment shall utilize electronic recording and automatic computerized reduction of data to indicate "must grind" bumps and the Profile Index for the pavement using a 0.2-inch blanking band. The bump template must span one (1) inch with an offset of 0.4 inches. The profilograph must be calibrated prior to use certified through the Profile Equipment Verification (PEV) Program administered by the Department.

Profilograms shall be recorded on a longitudinal scale of one (1) inch equals 25 feet and a vertical scale of one (1) inch equals one (1) inch. Profilograph shall be performed one (1) foot right and left of project centerline and 15 feet right and left of project centerline. Any areas that indicate "must grind" shall be corrected with diamond grinding or by removing and replacing full depth of surface course, as directed by the Engineer. Where corrections are necessary, a second profilograph run shall be performed to verify that the corrections produced an average profile index of 15 inches per mile per one-tenth (1/10) mile or less.

- 404-6.3. Percentage of material within specification limits (PWL).** The PWL will be determined in accordance with procedures specified in Item 110 titled METHOD OF ESTIMATING PERCENTAGE OF MATERIAL WITHIN SPECIFICATION LIMITS (PWL). The specification tolerance limits (L) for lower and (U) for upper are contained in table below.

**Acceptance Limits for Stability, Air Voids, and Density**

Test Property	Specification tolerance limits	
	L	U
Stability (lb)	2150	-
Air Voids (%)	Design Voids – 1.35	Design Voids + 1.35
Mat Density (%)	94.0	-
Joint Density (%)	91.0	-

- a. **Outliers.** All individual tests for mat density and air voids will be checked for outliers (test criterion) in accordance with ASTM E178, at a significance level of 5%. Outliers will be discarded, and the PWL will be determined using the remaining test values.

**404-6.4 Resampling pavement for mat density.**

- a. **General.** Resampling of a lot of pavement will only be allowed for mat density, and then, only if the Contractor requests same, in writing, within 48 hours after receiving the written test results from the Resident Engineer. Only one (1) resampling per lot will be permitted. Results of the resampling and retesting shall be final.
- (1) A redefined PWL will be calculated for the resampled lot. The number of tests used to calculate the redefined PWL will include the initial tests made for that lot plus the retests.
- (2) The cost for resampling and retesting shall be borne by the Contractor.
- b. **Payment for resampled lots.** The redefined PWL for a resampled lot will be used to calculate the payment for that lot.
- c. **Outliers.** Check for outliers in accordance with ASTM E178, at a significance level of 5%.

**METHOD OF MEASUREMENT**

- 404-7.1** The quantity of asphalt shall be measured for payment by the number of tons of asphalt used for pavement as specified, completed and accepted by the Resident Engineer.

Recorded batch weights or truck scale weights will be used to determine the basis for the tonnage.

### BASIS OF PAYMENT

**404-8.1 (For Method I only: Under 2,000 tons/pay item).** Payment for accepted quantities of work performed by the Contractor and measured by the Resident Engineer shall be made at the contract unit as specified in paragraph 404-7.1 of this section. Acceptance shall be based upon the acceptance test results for density. Acceptance test results that do not meet the limits set forth in paragraph 404-6.1, QUALITY ASSURANCE ACCEPTANCE SAMPLING AND TESTING, Method I, shall be cause for a payment adjustment, or removal and replacement, of the material placed in the failed subplot(s), as determined by the Department.

The total project payment for asphalt shall not exceed 103% of the product of the contract plan quantity of asphalt used in the accepted work.

**(For Method II only: 2,000 tons/pay item and Over).** Payment for accepted quantities of work performed by the Contractor and measured by the Resident Engineer shall be made at the contract unit as specified in paragraph 404-7.1 of this section adjusted based on results for air voids and mat density, joint density, and smoothness. This price shall be full compensation for furnishing all materials, for all preparation, mixing, and placing of these materials, and for all labor, equipment, tools, and incidentals necessary to complete the items.

The total project payment for asphalt shall not exceed 103% of the product of the contract plan quantity of asphalt used in the accepted work.

**a. Adjusted payment.** The pay factor for each individual lot shall be calculated in accordance with the Pay Adjustment Schedule table below. A pay factor shall be calculated for both mat density and air voids. The lot pay factor shall be the higher of the two values when calculations for both mat density and air voids are 100% or higher. The lot pay factor shall be the product of the two values when only one of the calculations for either mat density or air voids is 100% or higher. The lot pay factor shall be the lower of the two values when calculations for both mat density and air voids are less than 100%. If PWL for joint density is less than 71% then the lot pay factor shall be reduced by 5% but be no higher than 95%.

For each lot accepted, the adjusted contract unit price shall be the product of the lot pay factor for the lot and the contract unit price. Payment shall be subject to the total project limitations specified in paragraph 404-8.1. Payment in excess of 100% for accepted lots of asphalt shall be used to offset payment for accepted lots of asphalt pavement that achieve a lot pay factor less than 100%.

Payment for sublots which do not meet grade in accordance with paragraph 404-6.2d after correction for over 25% of the subplot shall be reduced by 5%.

**Pay Adjustment Schedule<sup>1</sup>**

Percentage of Material Within Specification Limits (PWL)	Lot Pay Factor (percent of contract unit price)
96 – 100	106
90 – 95	PWL + 10
75 – 89	0.5 PWL + 55
55 – 74	1.4 PWL - 12
Below 55	Reject

1. Although it is theoretically possible to achieve a pay factor of 106% for each lot, actual payment above 100% shall be subject to the total project limitation specified in paragraph 401-8.1.

- b. Profilograph smoothness.** The Contractor will receive full payment when the profilograph average profile index is in accordance with the contract documents. When the final average profile index for the entire length of pavement does not exceed 15 inches per mile per one-tenth (1/10) mile, payment will be made at the contract unit price for the completed pavement.

### REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

#### ASTM International (ASTM)

ASTM D 36	Standard Test Method for Softening Point of Bitumen (Ring-and-Ball Apparatus)
ASTM D 2950	Standard Test Method for Density of Bituminous Concrete in Place by Nuclear Methods
ASTM D 3203	Standard Test Method for Percent Air Voids in Compacted Dense and Open Bituminous Paving Mixtures
ASTM D 3699	Standard Specification for Kerosene
ASTM D 4867	Standard Test Method for Effect of Moisture on Asphalt Concrete Paving Mixtures
ASTM D 6084	Standard Test Method for Elastic Recovery of Bituminous Materials by Ductilometer
ASTM D 6926	Standard Practice for Preparation of Bituminous Specimens Using Marshall Apparatus
ASTM D 6927	Standard Test Method for Marshall Stability and Flow of Bituminous Mixtures
ASTM E 178	Standard Practice for Dealing with Outlying Observations

#### Asphalt Institute (AI)

MS-2	Mix Design Manual, 7th Edition
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#### American Association of State Highway and Transportation Officials (AASHTO)

AASHTO R 67	Standard Practice for Sampling Asphalt Mixtures after Compaction (Obtaining Cores)
AASHTO T 88	Standard Method of Test for Particle Size Analysis of Soils
AASHTO T 90	Standard Method of Test for Determining the Plastic Limit and Plasticity Index of Soils
AASHTO T 166	Standard Method of Test for Bulk Specific Gravity ( $G_{mb}$ ) of Compacted Hot Mix Asphalt (HMA) Using Saturated Surface-Dry Specimens
AASHTO T 195	Standard Method of Test for Determining Degree of Particle Coating of Bituminous-Aggregate Mixtures
AASHTO T 209	Standard Method of Test for Theoretical Maximum Specific Gravity ( $G_{mm}$ ) and Density of Hot-Mix Asphalt (HMA)

AASHTO T 255	Standard Method of Test for Total Evaporable Moisture Content of Aggregate by Drying
AASHTO T 269	Standard Method of Test for Percent Air Voids in Compacted Dense and Open Asphalt Mixtures
AASHTO T 308	Standard Method of Test for Determining the Asphalt Binder Content of Hot Mix Asphalt (HMA) by the Ignition Method
AASHTO T 324	Standard Method of Test for Hamburg Wheel-Track Testing of Compacted Hot Mix Asphalt (HMA)
AASHTO T 329	Standard Method of Test for Moisture Content of Asphalt Mixtures by Oven Method

**Illinois Department of Transportation, Bureau of Materials Illinois Laboratory Test Procedure (ITP)**

*Manual of Test Procedures for Materials*

AASHTO T 11	Illinois Modified, Standard Method of Test for Materials Finer Than 75- $\mu$ m (No. 200) Sieve in Mineral Aggregates by Washing
ITP 19	Bulk Density ("Unit Weight") and Voids in Aggregate

*Manual of Aggregate Quality Test Procedures*

AASHTO T 21	Illinois Modified, Standard Method of Test for Organic Impurities in Fine Aggregates for Concrete
ITP 71	Effect of Organic Impurities in Fine Aggregate on Strength of Mortar
AASHTO T 96	Illinois Modified, Standard Method of Test for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
AASHTO T 104	Illinois Modified, Standard Method of Test for Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate
AASHTO T 113	Illinois Modified, Standard Method of Test for Lightweight Pieces in Aggregate
ITP 203	Deleterious Particles in Coarse Aggregate
ITP 204	Deleterious Particles in Fine Aggregate

**Illinois Department of Transportation, Bureau of Materials Policy Memoranda (PM)**

PM 1-08	Performance Graded Asphalt Binder Acceptance Procedure
PM 4-08	Approval of Hot-Mix Asphalt Plants and Equipment
PM 6-08	Minimum Private Laboratory Requirement for Construction Materials Testing or Mix Design
PM 11-08	Aggregate Gradation Control System (AGCS)
PM 12-08	Crushed Gravel Producer Self-Testing Program
PM 13-08	Slag Producer Self-Testing Program

**Illinois Department of Transportation, Bureau of Materials Qualified Product List**

Certified Sources for Performance Graded Asphalt Binder

**Illinois Department of Transportation, Aeronautics Policy Memoranda (PM)**

PM 96-3                      Requirements for Quality Assurance on Projects With Bituminous  
Concrete Paving

PM                              HMA Comparison Samples

**END OF ITEM 404**



## Part 7 – Rigid Pavement

### Item 501 Cement Concrete Pavement

#### DESCRIPTION

- 501-1.1** This work shall consist of pavement composed of cement concrete with reinforcement or without reinforcement constructed on a prepared underlying surface as specified in the contract documents. The terms cement concrete, hydraulic cement concrete, and concrete are interchangeable in this specification.

Concrete provided under this item shall be a Class PV concrete meeting the requirements of the current Illinois Department of Transportation *Standard Specifications for Road and Bridge Construction*. The mix design shall be pre-approved by the Department prior to use. The Contractor shall be responsible for obtaining the job mix formula meeting the requirements of this item.

#### MATERIALS

- 501-2.1 Alkali-silica reaction (ASR).** Fine and Coarse aggregates to be used in Item 501 PCC shall be tested and evaluated by the Contractor for alkali-aggregate reactivity in accordance with ASTM C1260. Coarse and fine aggregates shall be tested separately. Tests must be representative of aggregate sources which will be providing material for production.
- a. Aggregate groups.** Each combination of aggregates used in a mixture will be assigned to an aggregate group. The point at which the coarse aggregate and fine aggregate expansion values intersect in the following table will determine the group.

#### Aggregate Groups

Coarse Aggregate Or Coarse Aggregate Blend  ASTM C1260 Expansion	Fine Aggregate Or Fine Aggregate Blend  ASTM C1260 Expansion		
	≤ 0.16%	0.16% - 0.27%	> 0.27%
≤ 0.16%	Group I	Group II	Group III
0.16% - 0.27%	Group II	Group II	Group III
> 0.27%	Group III	Group III	Group IV

- b. Mixture option.** All PCC mixes developed under Item 501 shall use Mixture Option 5 for reduction of ASR risk.

### Reduction of Risk for Deleterious Alkali-Silica Reaction

Aggregate Group	Mixture Options				
	Option 1	Option 2	Option 3	Option 4	Option 5
Group I	Not Available for Aeronautics Mixes				X <sup>1</sup>
Group II					X
Group III					X
Group IV					X

1. "X" denotes valid option for aggregate group.

- (1) **Mixture option 5 (modified for FAA).** The combined coarse and fine aggregate shall be tested in accordance with ASTM C1567, modified for combined aggregates, using the proposed mixture design proportions of aggregates, cementitious materials, and/or specific reactivity reducing chemicals. If the expansion does not exceed 0.10%, the proposed combined materials will be accepted. If the expansion is greater than 0.10%, the aggregates will not be accepted unless adjustments to the combined materials mixture can reduce the expansion to less than or equal to 0.10%, or new aggregates shall be evaluated and tested. The laboratory performing the ASTM C1567 test shall be approved by the Department according to the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 29-11 *Minimum Laboratory Requirements for Alkali-Silica Reactivity (ASR) Testing*. The Engineer reserves the right to verify a Contractor's ASTM C1567 test result. When the Contractor performs the test, a split sample may be requested by the Engineer.

**501-2.2 Fine aggregate.** The fine aggregate shall consist of washed sand, washed stone sand, or a blend of washed sand and washed stone sand approved by the Engineer. Stone sand produced through an air separation system approved by the Engineer may be used in place of washed stone sand.

- a. **Description.** The natural and manufactured materials used as fine aggregate are defined as follows.
- (1) **Sand.** Sand shall be the fine granular material resulting from the natural disintegration of rock. Sand produced from deposits simultaneously with, and by the same operations as, gravel coarse aggregate may contain crushed particles in the quantity resulting normally from the crushing and screening of oversize particles.
- (2) **Stone sand.** Stone sand shall be produced by washing, or processing by air separation, the fine material resulting from crushing rock quarried from undisturbed, consolidated deposits, or crushing gravel. The acceptance and use of crushed gravel stone sand shall be according to the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 12-08 *Crushed Gravel Producer Self-Testing Program*.
- b. **Quality.** The fine aggregate shall be Class A Quality, except that the minus No. 200 sieve ITP 11 requirement in the Fine Aggregate Quality Table shall not apply to washed stone sand or any blend of washed stone sand and washed sand approved by the Engineer.

### Fine Aggregate Quality

Quality Test	Class
	A
Na <sub>2</sub> SO <sub>4</sub> Soundness 5 Cycle, Illinois Modified AASHTO T 104, % Loss max.	10
Organic Impurities Check, Illinois Modified AASHTO T 21	Yes <sup>1</sup>
Deleterious Materials <sup>2, 3</sup>	
Shale, % max.	3.0
Clay Lumps, % max.	1.0
Coal & Lignite, & Shells, % max.	1.0
Conglomerate, % max.	3.0
Other Deleterious, % max.	3.0
Total Deleterious, % max.	3.0

1. Applies only to sand. Sand exceeding the colorimetric test standard of 11 (Illinois Modified AASHTO T 21) will be checked for mortar making properties according to Illinois Modified ASTM C 87 and shall develop a compressive strength at the age of 14 days when using Type I or II Cement of not less than 95% of the comparable standard.
2. Applies only to sand.
3. Tests shall be run according to ITP 204.

- c. **Gradation requirements.** The washed sand shall be Gradation FA 1 or FA 2. Washed stone sand, which includes any blend with washed sand, shall be Gradation FA 1, FA 2, or FA 20.

### Gradation Requirements

Sieve Size	Gradation Percent Passing		
	FA 1	FA 2	FA 20
3/8 inch	100	100	100
No. 4	97±3	97±3	97±3
No. 8			80±20
No. 16	65±20	65±20	50±15
No. 50	16±13	20±10	19±11
No. 100	5±5	5±5	10±7
No. 200			4±4

The blending, alternate use, and/or substitution of fine aggregates from different sources will not be permitted without the approval of the Engineer. Any blending shall be by interlocked mechanical feeders at the aggregate source or concrete plant. The blending shall be uniform, and the equipment shall be approved by the Engineer.

- d. **Alkali reaction.**

- (1) Each fine aggregate will be tested for alkali reaction according to ASTM C1260. These values will be made available on the Department's Alkali-Silica Potential Reactivity Rating List. The Engineer may differentiate aggregate based on ledge, production

method, gradation number, or other factors. An expansion value of 0.03% will be assigned to limestone or dolomite fine aggregates (manufactured stone sand). However, the Department reserves the right to perform the ASTM C1260 test.

- (2) Alkali reaction potential in Item 501 PCC mixes shall be tested under the procedures in paragraph 501-2.1 Alkali-Silica Reaction (ASR).

**501-2.3 Coarse aggregate.** Aggregates delivered to the mixer shall be clean, hard, uncoated aggregates consisting of gravel, crushed stone, crushed gravel, crushed slag, crushed sandstone, or crushed concrete meeting the following requirements.

- a. **Description.** The natural and manufactured materials used as coarse aggregate are defined as follows.
  - (1) **Gravel.** Gravel shall be the coarse granular material resulting from the reduction of rock by the action of the elements and having subangular to rounded surfaces. It may be partially crushed.
  - (2) **Crushed stone.** Crushed stone shall be the angular fragments resulting from crushing undisturbed, consolidated deposits of rock by mechanical means. Crushed stone shall be divided into the following, when specified.
    - (a) **Carbonate crushed stone.** Carbonate crushed stone shall be either dolomite or limestone. Dolomite shall contain 11.0% or more magnesium oxide (MgO). Limestone shall contain less than 11.0% magnesium oxide (MgO).
    - (b) **Crystalline crushed stone.** Crystalline crushed stone shall be either metamorphic or igneous stone, including but is not limited to, quartzite, granite, rhyolite and diabase.
  - (3) **Crushed gravel.** Crushed gravel shall be the product resulting from crushing, by mechanical means, and shall consist entirely of particles obtained by crushing gravel. The acceptance and use of crushed gravel shall be according to the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 12-08 *Crushed Gravel Producer Self-Testing Program*.
  - (4) **Crushed slag.** Crushed slag shall be the graded product resulting from the processing of air-cooled blast furnace slag. Air-cooled blast furnace slag shall be the nonmetallic product, consisting essentially of silicates and aluminosilicates of lime and other bases, which is developed in a molten condition simultaneously with iron in a blast furnace. It shall be air-cooled and shall have a compact weight (ITP 19) of not less than 70 pounds per cubic foot. The acceptance and use of air-cooled blast furnace slag shall be according to the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 13-08, *Slag Producer Self-Testing Program*.
  - (5) **Crushed sandstone.** Crushed sandstone shall be the angular fragments resulting from crushing, by mechanical means, a cemented sand composed predominantly of quartz grains. Sandstone shall have an Insoluble Residue of 50.0% or higher.
  - (6) **Crushed concrete.** Crushed concrete shall be the angular fragments resulting from crushing Portland cement concrete by mechanical means. The acceptance and use of crushed concrete shall be according to Item 219 titled RECYCLED CONCRETE AGGREGATE BASE COURSE.

- b. **Quality.** The coarse aggregate shall be Class A Quality as modified in table below.

### Coarse Aggregate Quality

Quality Test	Class
	A
Na <sub>2</sub> SO <sub>4</sub> Soundness 5 Cycle, Illinois Modified AASHTO T 104 <sup>1</sup> , % Loss max.	15
Los Angeles Abrasion, Illinois Modified AASHTO T 96, % Loss max.	45
Minus No. 200 Sieve Material, Illinois Modified AASHTO T 11	1.0 <sup>2</sup>
Deleterious Materials <sup>3</sup>	
Shale, % max.	1.0
Clay Lumps, % max.	0.25
Coal & Lignite, % max.	0.25
Soft & Unsound Fragments, % max.	2.0 <sup>4</sup>
Other Deleterious, % max.	2.0 <sup>4,5</sup>
Total Deleterious, % max.	2.6 <sup>4</sup>

1. Does not apply to crushed concrete.
2. The limit for material finer than the No. 200 sieve is allowed to be increased to 1.5% for crushed aggregates consisting of dust of fracture that is essentially free from clay or shale. Test results supporting acceptance of increasing limit to 1.5% with statement indicating material is dust of fracture must be submitted with Concrete mix. Acceptable techniques to characterizing these fines include methylene blue adsorption or X-ray diffraction analysis.
3. Test shall be run according to ITP 203.
4. IDOT A Quality Deleterious Materials modified for FAA requirements.
5. Includes deleterious chert. The maximum allowable percentage by mass of chert is 0.1% (less than 2.40 specific gravity). This can be extrapolated from the lightweight fraction separated in 2.35 heavy media suspension and the lightweight media separated in a 2.55 heavy media separation. Tests shall be run according to Illinois Modified AASHTO T 113.

- c. **Gradation requirements.** The coarse aggregate gradation shall be as follows.

### Gradation Requirements

Sieve Size	Gradation Percent Passing			
	CA 7	CA 11	CA 14	CA 16
1-1/2 inch	100			
1 inch	95±5	100		
3/4 inch		92±8		
1/2 inch	45±15	45±15	90±10	100
3/8 inch			45±20	97±3
No. 4	5±5	6±6	3±3	30±15
No. 16		3±3		2±2

- (1) **Combining sizes.** Each size shall be stored separately, and care shall be taken to prevent them from being mixed until they are ready to be proportioned. Separate compartments shall be provided to proportion each size.

If the coarse aggregate is furnished in separate sizes, they shall be combined in proportions to provide a uniformly graded coarse aggregate grading within the following limits.

### Gradation Requirements

Sieve Size	Gradation Percent Passing	
	CA 5 & CA 7	CA 5 & CA 11
1-3/4 inch	100	100
1-1/2 inch	98±2	98±2
1 inch	72±22	72±22
1/2 inch	22±12	22±12
No. 4	3±3	3±3

**d. Alkali reaction.**

- (1) Each coarse aggregate will be tested for alkali reaction according to ASTM C1260. These values will be made available on the Department's Alkali-Silica Potential Reactivity Rating List. The Engineer may differentiate aggregate based on ledge, production method, gradation number, or other factors. An expansion value of 0.05% will be assigned to limestone or dolomite coarse aggregates. However, the Department reserves the right to perform the ASTM C1260 test.
- (2) Alkali reaction potential in PCC mixes shall be tested under the procedures in paragraph 501-2.1 Alkali-Silica Reaction (ASR).

**501-2.4 Cement.** Cement shall conform to the requirements of ASTM C150 Type I. Other cement types may be allowed by Special Provision.

**501-2.5 Water.** Water used in mixing or curing shall be potable. If water is taken from other sources considered non-potable, it shall meet the requirements of AASHTO T 26.

**501-2.6 Cementitious materials.**

- a. **Fly ash.** Fly ash shall consist of the finely divided residue that results from the combustion of ground or powdered coal, transported from the combustion chamber by exhaust gas, collected by mechanical or electrical means, and stored in stockpiles or bins. Fly ash shall be according to AASHTO M 295, Type C (with less than or equal to 18.0% CaO), or F and shall meet the requirements of the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 18-08, *Acceptance Procedure for Finely Divided Minerals Used in Concrete and Other Applications*. The source of the fly ash shall be identified by the Contractor and approved by the Resident Engineer in advance of modification operations so laboratory tests can be completed prior to beginning work.

Fly ash may be used in concrete mixtures when the air temperature is below 40 °F, but the Engineer may request a trial batch of the concrete mixture to show the mix design strength requirement will be met.

For cement-fly ash mixes, the ratio of water to cementitious material will be based on the total cementitious material contained in the mix. Measurements of fly ash and cement shall be rounded up to the nearest five (5) pounds in the mix design.

- b. **Slag cement (ground granulated blast furnace (GGBF)).** Ground granulated blast-furnace slag shall consist of the glassy granular material formed when molten blast-furnace slag is rapidly chilled and then finely ground. Slag cement shall conform to AASHTO M 302, Grade 100 or Grade 120. GGBF shall be listed on the current Illinois Department of Transportation's published Qualified Producer List of *Finely Divided Materials*.

GGBF slag may be used in concrete mixtures when the air temperature is below 40 °F, but the Engineer may request a trial batch of the concrete mixture to show the mix design strength requirement will be met.

For cement-GGBF slag mixes, the ratio of water to cementitious material will be based on the total cementitious material contained in the mix. Measurements of GGBF slag and cement shall be rounded up to the nearest five (5) pounds in the mix design.

- c. **Microsilica (silica fume).** Microsilica is an amorphous silica of high silica content and purity possessing high pozzolanic activity.

The microsilica used in Portland cement concrete shall be according to AASHTO M 307.

The microsilica shall be supplied either in a dry, densified form or as a water-based slurry.

- d. **High-reactivity metakaolin (HRM).** High-reactivity metakaolin (HRM) is a reactive aluminosilicate pozzolan formed by calcining purified kaolinite at a specific temperature range.

The HRM used in Portland cement concrete shall be according to AASHTO M 321, except the fineness shall be a maximum 15% retained on the No. 325 sieve.

The HRM shall be supplied in a dry, undensified form.

- 501-2.7 Admixtures.** Admixtures shall be furnished in liquid form ready for use. The admixtures shall be delivered in the manufacturer's original containers, bulk tank trucks or such containers or tanks as are acceptable to the Engineer. Delivery shall be accompanied by a ticket which clearly identifies the manufacturer and trade name of the material. Containers shall be readily identifiable as to manufacturer and trade name of the material they contain.

Concrete admixtures shall be listed on the current Illinois Department of Transportation's published Qualified Product List of *Concrete Admixtures*. For the admixture submittal, a report prepared by an independent laboratory accredited by the AASHTO Materials Reference Laboratory (AMRL) for Portland cement concrete shall be provided. The report shall show the

results of physical tests conducted no more than five (5) years prior to the time of submittal, according to applicable specifications.

Tests shall be conducted using materials and methods specified on a "test" concrete and a "reference" concrete, together with a certification that no changes have been made in the formulation of the material since the performance of the tests. Per the manufacturer's option, the cement content for all required tests shall either be according to applicable specifications or 565 pounds of cementitious material per cubic yard. Compressive strength test results for six (6) months and one (1) year will not be required.

Prior to the approval of an admixture, the Engineer reserves the right to request a sample for testing. The test and reference concrete mixtures tested by the Engineer will contain a cement content of 565 pounds of cementitious material per cubic yard. For freeze thaw testing, the Department will perform the test according to ITP 161. The flexural strength test will be performed according to AASHTO T 177. If the Engineer decides to test the admixture, the manufacturer shall submit AASHTO T 197 water content and set time test results on the standard cement used by the Department. The test and reference concrete mixture shall contain a cement content of 565 pounds of cementitious material per cubic yard. The manufacturer may select their lab or an independent lab to perform this testing. The laboratory is not required to be accredited by AASHTO.

The manufacturer shall include in the submittal the following information: the manufacturing range for specific gravity, the midpoint and manufacturing range for residue by oven drying, and manufacturing range of pH. The submittal shall also include an infrared spectrophotometer trace no more than five (5) years old. If an accelerating admixture contains calcium salts, the midpoint and manufacturing range for residue by oven drying will not be required.

For air-entraining admixtures, the specific gravity allowable manufacturing range shall be established by the manufacturer and the test method shall be according to ASTM C494. For residue by oven drying and pH, the allowable manufacturing range and test methods shall be according to ASTM C260.

For air entraining, water-reducing and accelerating admixtures, the pH allowable manufacturing range shall be established by the manufacturer and the test method shall be according to ASTM E 70. For specific gravity and residue by oven drying, the allowable manufacturing range and test methods shall be according to ASTM C494.

When test results are more than seven (7) years old, the manufacturer shall resubmit the infrared spectrophotometer trace and the report prepared by an independent laboratory accredited by AASHTO.

All admixtures, except chloride-based accelerators, shall contain a maximum of 0.3% chloride by weight as determined by an appropriate test method selected by the manufacturer. To verify the manufacturer test result, the Department will use AASHTO T 260, Procedure A, Method 1.

Random field samples may be taken by the Department to verify an admixture meets specification. A split sample will be provided to the manufacturer if requested. Admixtures that do not meet specification requirements or an allowable manufacturing range established by the manufacturer shall be replaced with new material.

Admixtures shall conform to the following.

- a. **Air-entraining admixtures.** Air-entraining admixtures shall be according to AASHTO M 154. The specific gravity allowable manufacturing range shall be established by the manufacturer and the test method shall be according to ASTM C494. For residue by oven drying and pH, the allowable manufacturing range and test methods shall be according to ASTM C260 and shall consistently entrain the air content in the specified ranges under field conditions. The air-entraining agent and any water reducer admixture shall be compatible.



- b. **Water-reducing admixtures.** Water-reducing admixture shall meet the requirements of AASHTO M 194, Type A, B, or D.
- c. **Other admixtures.** The use of set retarding and set-accelerating admixtures shall be approved by the Engineer prior to developing the concrete mix. Retarding admixtures shall meet the requirements of AASHTO M 194, Type A, B, or D and set-accelerating admixtures shall meet the requirements of AASHTO M 194, Type C.

**501-2.8 Joint seal.** The sealant for the joints in the concrete pavement shall meet the requirements of Item 604 titled COMPRESSION JOINT SEALS FOR CONCRETE PAVEMENTS or Item 605 titled JOINT SEALANTS FOR PAVEMENTS and shall be of the type specified in the contract documents.

**501-2.9 Premolded joint material.** Premolded joint material for isolation and expansion joints shall conform to the requirements of AASHTO M 213 or ASTM D1752 and shall be where specified in the contract documents. The filler for each joint shall be furnished in a single piece for the full depth and width required for the joint, unless otherwise specified by the Resident Engineer. When the use of more than one (1) piece is required for a joint, the abutting ends shall be fastened securely and held accurately to shape by stapling or other positive fastening means satisfactory to the Resident Engineer.

**501-2.10 Steel reinforcement.** All fabrication shall be done at the mill or shop prior to shipment.

At the time of shipment, the surface of all reinforcement bars and welded wire reinforcement shall be free from loose mill scale, dirt, oil, grease, or other foreign substances. A light coating of rust, which may form during storage under acceptable conditions at the mill or warehouse, will not be deemed cause for rejection. Stocks of reinforcement bars or welded wire reinforcement either at the mill or warehouse, which have not been protected in an adequate manner during storage, will not be accepted.

At the time the bars or welded wire reinforcement are placed in the work, they shall be free from rust which pits the surface or scales off, dirt, oil, grease, or other foreign substances. A light coating of rust, which may form during storage on the work under acceptable conditions, will not be deemed cause to require cleaning. Thin powdery rust and tight rust is not considered detrimental and need not be removed.

Reinforcing shall consist of steel conforming to the requirements below.

a. **Reinforcement bars.** Reinforcement bars will be accepted according to the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 26-08, *Reinforcement Bar and/or Dowel Bar Plant Certification Procedure* and/or be on the current Illinois Department of Transportation's published Qualified Producer List of *Certified ASTM A706 Reinforcing Bar and/or Dowel Bar*.

(1) **Reinforcement Bars (Non-Coated).** Reinforcement bars shall be according to ASTM A706 Grade 60 for deformed bars and the following.

- (a) For straight bars furnished in cut lengths and with a well-defined yield point, the yield point shall be determined as the elastic peak load, identified by a halt or arrest of the load indicator before plastic flow is sustained by the bar and dividing it by the nominal cross-sectional area of the bar.
- (b) Tensile strength shall be a minimum of 1.20 times the yield strength.
- (c) For bars straightened from coils or bars bent from fabrication, there shall be no upper limit on yield strength; and for bar designation No. 3 – No. 6, the elongation after rupture shall be at least 9%.
- (d) **Heat numbers.** Bundles or bars at the construction site shall be marked or tagged with heat identification numbers of the bar producer.

- (e) **Guided bend test.** Bars may be subject to a guided bend test across two (2) pins which are free to rotate, where the bending force shall be centrally applied with a fixed or rotating pin of a certain diameter as specified in ASTM A706. The dimensions and clearances of this guided bend test shall be according to ASTM E190.
- (f) **Spiral reinforcement.** Spiral reinforcement shall be deformed or plain bars conforming to the above requirements or cold-drawn steel wire conforming to AASHTO M 32.
- (g) **Splicing.** Splicing of bars shall use a bar splicer assembly or mechanical splicer as specified in the contract documents.

The splicer shall be listed on the current Illinois Department of Transportation's published Qualified Product List of *Reinforcing Bar Splicer Assemblies and Mechanical Splicers* and shall develop, in tension, at least 125% of the specified yield strength of the bars to be spliced. When two (2) different diameter bars are being spliced, the minimum tension shall be at least 125% of the smaller bar yield strength.

When both reinforcement bars to be spliced are epoxy coated, the splicer shall also be epoxy coated according to ASTM A775.

For applications requiring a mechanical splicer, the Contractor shall supply the manufacturer's installation instructions to the Engineer prior to installing the mechanical splicers.

- (2) **Epoxy coated reinforcement bars.** Epoxy coated reinforcement bars shall be according to paragraph 501-2.10 a. (1) titled REINFORCEMENT BARS and shall be epoxy coated according to ASTM A775 and the following.
  - (a) **Certification.** The epoxy coating applicator shall be certified according to the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 24-08, *Epoxy Coating Plant Certification Procedure* and/or be on the current Illinois Department of Transportation's published Qualified Producer List of *Certified Epoxy Coating Plants*.
  - (b) **Coating thickness.** When spiral reinforcement is coated after fabrication, the thickness of the epoxy coating shall be seven (7) to 20 mils.
  - (c) **Cutting reinforcement.** Reinforcement bars may be sheared or sawn to length after coating, providing the end damage to the coating does not extend more than 0.5 inches back and the cut is patched before any visible rusting appears. Flame cutting will not be permitted.

- b. **Welded reinforcement.** Welded reinforcement shall be according to the following.

All welded wire reinforcement and bar mat will be accepted according to the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 23-08, *Welded Wire Reinforcement/Bar Mat Plant Certification Procedure*. and/or be on the current Illinois Department of Transportation's published Qualified Producer List of *Certified Welded Wire Reinforcement*.

- (1) **Welded wire reinforcement.** Welded wire reinforcement shall be according to the following.
  - (a) **Welded wire reinforcement (non-coated).** Welded wire reinforcement shall be according to AASHTO M 55 or AASHTO M 221. Welded wire reinforcement for concrete pavement may be furnished in either flat sheets or hinged sheets. The method of hinging the sheets shall meet the approval of the Engineer.

- (b) **Epoxy coated welded wire reinforcement.** Epoxy coated welded wire reinforcement shall be according to paragraph 501-2.1 b.(1)(b) and shall be epoxy coated according to ASTM A884 and the following.

The epoxy coating applicator shall be certified according to the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 24-08, *Epoxy Coating Plant Certification Procedure* and/or be on the current Illinois Department of Transportation's published Qualified Producer List of *Certified Epoxy Coating Plants*.

- (2) **Bar mat.** Bar mat shall be according to the following.

- (a) **Bar mat (non-coated).** Bar mat shall be according to AASHTO M 54. Longitudinal bars shall be Grade 60. The mat shall be furnished either in flat sheets or hinged flat sheets. The method of hinging the sheets shall meet the approval of the Engineer.

- (b) **Epoxy coated bar mat.** Epoxy coated bar mat shall be according to paragraph 501-2.1 a. (2).

**501-2.11 Dowel and tie bars.** Dowel and tie bars shall consist of steel conforming to the requirements below.

- a. **Dowel bars.** Dowel bars shall be plain, round bars according to the requirements of AASHTO M 227 Grades 70 through 80 and shall be free from burring or other deformation restricting slippage in the concrete. The finished bars shall be saw cut and free from burrs or out-of-round ends which will prevent their slipping easily in the concrete. All dowel bars will be accepted according to the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 26-08, *Reinforcement Bar and/or Dowel Bar Plant Certification Procedure* and/or be on the current Illinois Department of Transportation's published Qualified Producer List of *Certified ASTM A706 Reinforcing Bar and/or Dowel Bar*. The bars shall be epoxy coated according to ASTM A 775, except patching of the ends will not be required. The epoxy coating applicator shall be certified according to the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 24-08, *Epoxy Coating Plant Certification Procedure* and/or be on the current Illinois Department of Transportation's published Qualified Producer List of *Certified Epoxy Coating Plants*.
- b. **Dowel bar assembly.** The dowel bar assembly shall be an approved welded assembly possessing the rigidity to hold the dowel bars during the placing and compacting of the concrete to the degree of alignment specified. The assembly shall have two (2) parallel spacer bars and two (2) subgrade bearing members. An upright bar support of each end of each dowel bar shall be welded to both the spacer bar and the bearing member at appropriate points to hold the bars at the design height.

The dowel bars shall be spaced as specified in the contract documents. The alternate ends of dowel bars shall be welded to the spacer bars or the upright bar, without repair to the epoxy. One (1) weld is permitted per dowel bar. The opposite end of each dowel shall be held securely in place by means of wire loops or metal tubes welded to the spacer bar. Suitable ties shall be provided to hold the contraction joint assembly in normal position during shipping, handling and installation. Wire sizes shall be at least W7 for the outside spacer bars, bearing member, and upright supports. The tie wires used for securing the spacer bars shall be at least W3 wires.

- c. **Tie bars.** Tie bars shall be deformed steel bars and conform to the requirements of ASTM A706. Tie bars designated as Grade 60 in ASTM A706 shall be used for construction requiring bent bars.

**501-2.12 Material for curing concrete.** Curing materials shall conform to one (1) of the following specifications below.

- a. Membrane curing compounds.** Liquid membrane-forming compounds for curing concrete shall conform to the requirements of ASTM C309, Type 2, Class A and the following.

The manufacturer shall provide the membrane curing compound manufacturing range for specific gravity and non-volatile content.

The material will be sampled at the manufacturer's plant by an authorized representative of the Department. The Engineer will test the sampled material and no material shall be used until it has been approved.

Each container shall be legibly marked with the name of the manufacturer, the type (Department designation) or type/class (ASTM designation), the manufacturer's batch or lot number, date of manufacture, and the Department's test identification number.

Approved material shall not be used after nine (9) months from the date of manufacture, unless sampled and tested for re-approval by the Engineer. Material more than 18 months old from the date of manufacture shall not be used.

Based on information provided in the safety data sheet (SDS), the Engineer reserves the right to reject the material due to health or safety concerns.

Specimens used for determining moisture loss will be made and tested according to AASHTO T 155.

It shall be white pigmented and there are no restrictions on dissolved solids.

- b. Burlap curing blankets and cotton mats.** These materials shall be according to AASHTO M 182 and shall be free from substances which may be deleterious to freshly placed concrete. Burlap shall meet the requirements for Class 3.

Blankets and mats shall be in a condition satisfactory to the Engineer. Any tears or holes shall be repaired.

- c. Waterproof paper blankets, white polyethylene sheeting, and burlap-polyethylene blankets.** These materials shall be white and according to ASTM C171, except moisture loss test specimens shall be made according to AASHTO T 155.

Blankets and sheeting shall be in a condition satisfactory to the Engineer. Any tears or holes shall be repaired.

**501-2.13 Epoxy-resin.** The chemical adhesive resin system shall consist of a two (2) part, fast-setting resin and filler/hardener. The system shall meet the requirements of the ITP for Chemical Adhesives and be listed on the current Illinois Department of Transportation's published Qualified Producer List of *Finely Divided Materials*.

## CONCRETE MIX

**501-3.1 General.** No concrete shall be placed until an acceptable concrete mix has been submitted to the Engineer for review and the Engineer has taken appropriate action. The Engineer's review shall not relieve the Contractor of the responsibility to select and proportion the materials to comply with this section.

**501-3.2 Concrete mix laboratory.** The laboratory used to develop the concrete mix shall be accredited in accordance with AASHTO Materials Reference Laboratory (AMRL). The laboratory accreditation must be current and listed on the accrediting authority's website. All test methods required for developing the concrete mix must be included in the lab accreditation. A copy of

the laboratory's current accreditation and accredited test methods shall be submitted to the Engineer prior to start of construction.

**501-3.3 Concrete mix proportions.** Prior to the start of paving operations and after approval of all materials to be used in the manufacture of the concrete, the Contractor shall provide a preliminary mix design for evaluation at the test batch. The mix design shall indicate saturated surface dry batch weights per cubic yard for each material component. In addition, each material component, including chemical admixtures, shall be identified by the Illinois Department of Transportation material and producer code number and the producer name and location. Saturated surface dry and oven dry specific gravities for each proposed aggregate to be used in the mix shall be indicated on the mix design. Absorption for each proposed aggregate to be used in the mix shall be indicated on the mix design. When requested in writing by the Contractor, the Engineer will recommend a preliminary mix design for evaluation at the test batch. Upon completion of a successful test batch as specified herein, the Department will issue a mix design approval letter with the Contractor's selected mix design attached.

Regardless of the mix design chosen, the Contractor is responsible for the mix design, as well as the manufacture and placement of the mix. For pavements designed to accommodate aircraft gross weights greater than 60,000 pounds, concrete shall be proportioned to achieve a 28-day flexural strength that meets or exceeds the acceptance criteria for a flexural strength of 650 pounds per square inch per AASHTO T 177. For pavements designed to accommodate aircraft gross weights of 60,000 pounds or less, concrete shall be designed to achieve a 28-day compressive strength that meets or exceeds the acceptance criteria for a compressive strength of 4,400 pounds per square inch per AASHTO T 22. The mix design shall exceed the acceptance criteria by at least 100 pounds per square inch for flexural strength or by at least 400 pounds per square inch compressive strength. Due to variations in materials, operations, and testing, the average strength of concrete furnished by a supplier should be higher than the specified strength to ensure a good statistical chance of meeting the acceptance criteria throughout the duration of the job. The strength necessary to meet specification requirements depends on the producer's standard deviation of flexural test results and the accuracy that the value can be estimated from historic data for the same or similar materials.

The minimum cementitious material shall be adequate to ensure a workable, durable mix. The minimum cementitious material (cement plus fly ash, or slag cement) shall be not less than 564 pounds per cubic yard. The actual ratio of water to cementitious material established at the time of the test batch shall be the maximum permitted for concrete production.

The Engineer will verify the mix design submitted by the Contractor. Verification of a mix design shall in no manner be construed as acceptance of any mixture produced. Once a mix design has been verified, the Engineer shall be notified if a change in source is made, or admixtures added or deleted from the mix and a new concrete mix must be submitted to the Engineer for approval.

Tests performed at the jobsite will determine if a mix design can meet specifications. If the tests indicate it cannot, the Contractor shall make adjustments to a mix design, or submit a new mix design if necessary, to comply with the specifications.

The Engineer may request samples at any time for testing, prior to and during production, to verify the quality of the materials and to ensure conformance with the applicable specifications.

**501-3.4 Concrete mix design submittal.** The concrete mix design shall be submitted to the Engineer at least 45 days prior to the start of operations in accordance with Illinois Department of Transportation, Aeronautics Policy Memorandum (PM) 87-3, *Mix Design, Test Batch, Quality Control, and Acceptance Testing of PCC Pavement Mixture*. The submitted concrete mix shall not be more than 180 days old and must use the materials to be used for production for the project. Production shall not begin until the concrete mix is approved in writing by the Engineer.

**501-3.5 Cementitious materials.**

- a. **Fly ash.** Class C fly ash shall not have greater than 18.0% calcium oxide (CaO). When Class C fly ash is used, the amount of Portland cement replaced shall not exceed 30% by weight, at a replacement ratio of 1-to-1. When Class F fly ash is used, the amount of Portland cement replaced shall not exceed 25% by weight, at a minimum replacement ratio of 1-to-1 (fly ash-to-cement replaced).
- b. **Slag cement (ground granulated blast furnace (GGBF)).** When GGBF slag is used, the amount of Portland cement replaced shall not exceed 35% by weight, at a replacement ratio of 1-to-1 (GGBF slag-to-cement replaced).
- c. **Mixtures with multiple finely divided minerals.** The mixture shall contain a maximum of two finely divided minerals. The finely divided minerals shall constitute a maximum of 35% by weight of the total cement plus finely divided minerals. The fly ash portion shall not exceed 30% for Class C fly ash or 25% for Class F fly ash. The Class C and F fly ash combination shall not exceed 30%. The ground granulated blast furnace slag portion shall not exceed 35%.

**501-3.6 Admixtures.**

- a. **Air-entraining admixtures.** Air-entraining admixture are to be added in such a manner that will ensure uniform distribution of the agent throughout the batch. The air content of freshly mixed air-entrained concrete shall be based upon trial mixes with the materials to be used in the work adjusted to produce concrete of the required plasticity and workability. The percentage of air in the mix shall be  $6.0\% \pm 1.5\%$ . Air content shall be determined by testing in accordance with AASHTO T 152 for gravel and stone coarse aggregate and AASHTO T 196 for slag and other highly porous coarse aggregate.
- b. **Water-reducing admixtures.** Water-reducing admixtures shall be added to the mix in the manner recommended by the manufacturer and in the amount necessary to comply with the specification requirements. Tests shall be conducted with the materials to be used in the work, in accordance with AASHTO M 194.
- c. **Other admixtures.** Set controlling, and other approved admixtures shall be added to the mix in the manner recommended by the manufacturer and in the amount necessary to comply with the specification requirements. Tests shall be conducted with the materials to be used in the work, in accordance with AASHTO M 194.

**CONSTRUCTION METHODS**

- 501-4.1 Test batch.** The Contractor shall demonstrate, in the presence of the Engineer, that the materials, concrete mix, equipment, construction processes, and quality control processes meet the requirements of the specifications. At least 28 days prior to the start of production the Contractor shall prepare a test batch under the direction of the Engineer. The test batch shall be prepared at the concrete plant proposed for use in the production of the concrete mix for the project and shall be in accordance with the approved Job Mix Formula (JMF). When approved by the Engineer, the test batch may be prepared at a different plant provided that the same materials specified in the JMF are used. In addition, the proposed test batch plant must meet the plant requirements specified herein. If more than one (1) JMF is required as a result of different sources of materials, additional test batches shall be conducted for each JMF as outlined herein. The cost for each additional test batch shall be borne by the Contractor. The plant shall have been surveyed and approved by the Engineer prior to preparation of the test

batch. The Contractor shall provide all Quality Control for production of the concrete. The test batch shall be prepared as outlined below.

**a. Proportioning.** Prior to preparation of the mix, the Proportioning Technician shall perform a minimum of two (2) gradation analyses and two (2) moisture tests on each aggregate used. In order to obtain representative aggregate moisture, the Contractor shall construct a small stockpile for both the coarse and fine aggregates. The small stockpiles shall contain enough material to manufacture as many test batches as the Contractor decides to make. An aggregate sample shall be obtained from each small stockpile using proper aggregate sampling techniques for obtaining a representative sample. The free moisture for each aggregate shall be determined. From this data, the JMF shall be adjusted for moisture, as outlined in Illinois Department of Transportation's, Bureau of Materials Portland Cement Concrete Level II Technician Course, *Manual of Instructions for Concrete Proportioning and Testing*.

**b. Preparation of the mix.**

(1) Prepare a test batch that is at least one-half (1/2) the manufacturer's rated capacity of the mixing drum in cubic yards. The test batch shall be prepared in accordance with the approved JMF, adjusted for moisture.

(2) Mixing requirements shall be:

(a) **Central mix plant.** Minimum of 90 seconds. If transit mixer trucks are used to transport the mix, the mix shall be agitated, after mixing, at two (2) to five (5) revolutions per minute for the approximate travel time anticipated between batching at the plant and deposit of the concrete in the forms.

If non-mixing trucks are used to transport the mix, the mix shall remain in the central mixer with no mixing or agitation for the approximate time anticipated from when mixing is complete to deposit of the concrete in the forms.

(b) **Transit mix plant.** Seventy (70) to 100 revolutions at five (5) to 16 revolutions per minute. After initial mixing, agitate mix at two (2) to five (5) revolutions per minute for the approximate time anticipated from when mixing is complete to deposit of the concrete in the forms. This plant option is not allowed for projects with more than 5,000 cubic yards of concrete.

(3) The ratio of water to cementitious material, including free surface moisture on the aggregates but not including moisture absorbed by the aggregates, shall be between 0.38 – 0.45 by weight. A water/cementitious ratio of less than 0.38 shall be subject to approval by the Engineer. The actual ratio of water to cementitious material established at the time of the test batch shall be the maximum permitted for production concrete.

At the test batch, the Contractor shall determine an allowable slump as determined by ASTM C143 not to exceed 2 inches for slip-form placement. For fixed-form placement, the slump shall not exceed 3 inches. For hand placement, the slump shall not exceed 4 inches. For pavements designed to accommodate aircraft gross weights greater than 60,000 pounds, beams shall be required for testing flexural strength. For pavements designed to accommodate aircraft gross weights of 60,000 pounds or less, cylinders shall be required for testing compressive strength.

Beams/cylinders shall be made for testing at three (3), seven (7), 14, and 28 days. With permission from the Engineer at the time of the test batch, the maximum slump may be exceeded provided the maximum allowable water-cementitious ratio is not exceeded.

If the test batch concrete does not obtain a flexural strength of 750 pounds per square inch or a compressive strength of 4,800 pounds per square inch at 28 days, a new test batch shall be required at the Contractor's expense.

- (4) The Proportioning Technician shall complete form AER 15, *PCC Testing Summary* and form AER 6, *Concrete Moisture Determination (Adjusted Oven Dry Method)*, to be given to the Resident Engineer after completion of the test batch.
- (5) The Resident Engineer shall complete form AER 4, *Concrete Plant Production, Mix Verification*.
- (6) The concrete test beams/cylinders shall be tested at three (3), seven (7), 14 and 28 days to establish a growth curve of concrete strength vs. age. The flexural strength shall be at least 100 pounds per square inch over the specified strength or the compressive strength shall be at least 400 pounds per square inch over the specified strength, at 28 days.

Only one (1) test batch will be paid for per project. Any additional test batches shall be paid for by the Contractor.

The Contractor shall provide complete facilities for the curing of the beams/cylinders on the job site. Curing facilities shall include, but not be limited to, furnishing and operating water tanks equipped with temperature control devices that will automatically maintain the temperature of the water as specified in AASHTO T 23. Submersible heaters are acceptable provided the above-mentioned criteria are achieved.

Upon acceptance of the test batch by the Engineer, the Contractor must use the same equipment, materials, and construction methods for the remainder of concrete paving. Any adjustments to processes or materials must be approved in advance by the Engineer.

**501-4.2 Equipment.** The Contractor is responsible for the proper operation and maintenance of all equipment necessary for handling materials and performing all parts of the work to meet this specification. For projects with more than 15,000 cubic yards of concrete, an onsite central mix plant shall be required for manufacturing the concrete and shall be used exclusively for this project during any and all paving operations.

a. **Concrete mixers.** Concrete may be mixed at a central plant, or wholly or in part in truck mixers for projects with less than 1,500 cubic yards of concrete. Each truck mixer shall have attached in a prominent place a manufacturer's nameplate showing the capacity of the drum in terms of volume of mixed concrete and the speed of rotation of the mixing drum or blades.

- (1) **Central plant mixer.** The mixer shall be the batch type. The mixer used for paving shall have a rated capacity of not less than 28 cubic feet of mixed concrete. The mixer shall be capable of discharging the concrete directly into truck agitators, truck mixers operating at agitating speed, or non-agitating trucks for transport to the jobsite. The mixer for structures and incidental construction shall have a rated capacity of not less than ten (10) cubic feet for structures involving the placement of 30 cubic yards or more, and not less than seven (7) cubic feet of mixed concrete for placements less than 30 cubic feet.

The mixer shall be equipped with a batch meter for counting the batches, and an approved timing device which will automatically lock the discharge lever during the full time of mixing and release it at the end of the mixing period. The timing device shall be equipped with a bell, adjusted to ring each time the lock is released. If the timing device becomes broken or out of order, the Contractor will be permitted to operate while it is being repaired, provided the Contractor furnishes an approved timepiece equipped with minutes and seconds, and provided that each batch is mixed 1-1/2 minutes. If the timing device is not repaired within 72 hours, further use of the mixer will be prohibited until repairs are made.

When measuring water by volume, the mixer shall be equipped with a water measuring device which shall be capable of measuring and discharging the specified amount of water within a limit of accuracy of 1%, except a limit of accuracy closer than one (1)



quart will not be required, and shall be so arranged that the accuracy of measurement will not be affected by variations in pressure in the water supply line. A water glass placed vertically on the water tank shall not be used as a water measuring device. The water measuring equipment shall include an auxiliary tank of approved design from which the water measuring tank shall be filled. The volume of the auxiliary tank shall be not less than the volume of the measuring tank. The equipment shall be so arranged that the water pressure in the measuring tank cannot exceed that due to the difference in elevation between the two (2) tanks. The measuring tank shall be equipped with an outside tap and valve to provide for checking the graduation on the indicator, unless other means are provided for readily and accurately determining the amount of water

discharged. Means shall be provided to automatically stop the flow of water from the measuring tank when the desired quantity has been delivered. If the specified amount of water can be provided without the auxiliary tank, the auxiliary tank will not be required.

When measuring water by weight, means shall be provided for automatically stopping the flow of water into the weighing container at the moment the correct amount has been delivered. A water meter may be used for measuring water provided it meets the requirements for automatic stop of the flow of water and accuracy of measurement.

The truck mixers shall be examined daily for changes in condition due to accumulation of hard concrete or mortar or wear of blades. The pickup and throw-over blades shall be replaced when they have worn down three-quarters (3/4) inch or more. The Contractor shall have a copy of the manufacturer's design on hand showing dimensions and arrangement of blades in reference to original height and depth.

- (2) **Truck mixer.** Truck mixers shall be either the type having a watertight revolving drum, suitably mounted and fitted with adequate blades attached to the drum, or the type having an open-top, watertight, trough-like container, suitably mounted and fitted with adequate blades revolving about an axis parallel to the axis of the trough. Truck mixers shall be capable of combining materials into a uniform mixture, and of discharging the mixture without segregation.

Truck mixer blades at the point of maximum drum diameter, nearest to the drum head, shall not be worn more than 10% of the original radial height. The radial height shall be determined according to the National Ready Mixed Concrete Association's Certification of Ready Mixed Concrete Production Facilities/Plant Certification Check List document, the blade dimensions provided by the manufacturer, or other available information.

Truck mixers, except when used exclusively for agitating premixed concrete, shall be provided with a batch meter and locking device capable of preventing the discharge of the concrete before the required number of revolutions has been obtained, or with an approved revolution counter, suitably mounted, to provide a means of verifying the amount of mixing obtained.

The water measuring device shall be capable of measuring and discharging the specified amount of water within a limit of accuracy of 1%, except a limit of accuracy closer than one (1) quart will not be required. If the water is added during transit, the measuring device may be mounted upon the truck mixer, and an outside tap or valve shall be provided for checking the graduations on the indicator, unless other means are provided for readily and accurately determining the amount of mixing water discharged. Provisions shall be made to automatically stop the flow of water when the desired amount has been delivered. If not mounted on the truck mixer, the water measuring device shall be located at the site selected for adding the water and shall be according to the requirements of paragraph 501-4.2 a (1) titled CENTRAL PLANT MIXER. A water glass placed vertically on the water tank shall not be used as a water measuring device, except for final slump adjustment at the job site.

The truck mixer shall be approved before use according to the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 16-08, *Approval of Concrete Plants and Delivery Trucks*.

- (3) **Truck agitator.** Truck agitators shall be either the type having a watertight revolving drum, suitably mounted and fitted with adequate blades attached to the drum, or the type having an open-top, watertight, trough-like container, suitably mounted and fitted with adequate blades revolving about an axis parallel to the axis of the trough. The truck agitator, when fully loaded, shall be capable of maintaining the mixed concrete in a thoroughly mixed and uniform mass, and of discharging the concrete without segregation. For the open-top truck agitator, a watertight cover shall be used to protect the concrete when it is raining.

The truck agitator shall be approved before use according to the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 16-08, *Approval of Concrete Plants and Delivery Trucks*.

- (4) **Nonagitator trucks.** Nonagitator trucks shall have a metal container that is smooth, watertight, and non-reactive to concrete. Nonagitator trucks shall be capable of discharging the concrete at a satisfactorily controlled rate and without segregation. A watertight cover shall be used to protect the concrete when it is raining.

The nonagitator truck shall be approved before use according to the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 16-08, *Approval of Concrete Plants and Delivery Trucks*.

- b. **Batching and weighing equipment.** The plant and mixing equipment shall conform to the requirements of the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 16-08, *Approval of Concrete Plants and Delivery Trucks*.

The bins, weighing hoppers and scales shall be arranged to the satisfaction of the Engineer so that the weigh beam "telltale" dial, or the dial scale, or the digital readout is in full view of the operator controlling the gates, valves or belts that feed the material into the weighing hopper. The equipment used for batching and weighing the materials shall comply with the following requirements.

Equipment for transferring and spreading concrete from the transporting equipment to the paving lane in front of the finishing equipment shall be provided. The equipment shall be specially manufactured, self-propelled transfer equipment which will accept the concrete outside the paving lane and will spread it evenly across the paving lane in front of the paver and strike off the surface evenly to a depth which permits the paver to operate efficiently.

- (1) **Bins and silos.** Bins and silos shall have sufficient capacity for adequate supply of materials to the weighing hoppers. They shall be supported by rigid frame-work on a safe foundation. Portable type bins and silos shall be fully loaded and permitted to stand for at least 12 hours before operations start. Bins and silos shall have separate compartments for each aggregate, cement, and finely divided mineral used. Except for permanently located plants, the top of the fine aggregate compartment shall be equipped with a tilted screening device which shall reject all material coarser than one (1) inch and through which all fine aggregate must pass upon entering that compartment. Each compartment shall be designed to discharge material efficiently and freely into the measuring hopper.

Means of control shall be provided so that when the quantity to be obtained is being approached, the flow of the material can be gradually retarded and completely shut off, without leakage, at the moment the desired amount has been discharged.

- (2) **Weighing hoppers.** The hoppers shall be completely suspended from the scales and shall otherwise hang free and, except as further provided, shall have sufficient capacity

to contain the material or materials to be weighed for one (1) batch without shoveling and without jiggling the hopper to keep bin gates and chute openings free of material during the weighing. Cement shall be weighed in a hopper entirely free and independent of the hopper or hoppers used for weighing the aggregate. When manually batching, finely divided minerals shall be weighed in a separate hopper. Finely divided minerals may be weighed into the cement weigh hopper for automatic or semi-automatic batching.

Batching equipment, insufficient in capacity to weigh the materials required for a full batch, will be permitted for stationary mixers and truck mixers provided that the capacity of the hopper or hoppers is sufficient to weigh all the materials for at least one (1) cubic yard of concrete for any mixer of rated capacity of one (1) cubic yard or larger. The batching equipment shall be limited to a maximum of three (3) weighings of each material for charging the mixer.

All hoppers, except cement, shall have a port or other opening for removal of overload of any one (1) of the materials unless sufficient clearance for this purpose exists between the bottom of the bin gate and the top of the hopper. The top of the cement hopper shall be closed to prevent the escape of cement while it is being weighed. Hoppers shall be constructed in a manner that will eliminate the accumulation of tare material and leakage through the discharge gates during weighing. They shall be capable of discharging the material efficiently and completely into the batch trucks or mixer without the necessity of beating or jiggling. If any hopper, in the opinion of the Resident Engineer, does not discharge the material satisfactorily, it shall be provided with a vibrator of sufficient frequency and power to assure complete discharge. For cement and finely divided minerals, a device shall indicate the complete discharge of materials. All weighing hoppers shall be enclosed or otherwise protected against wind.

- (3) **Scales.** The scales may be of either the horizontal beam or the springless dial type, shall be designed as an integral unit of the batching equipment, and shall be constructed to withstand the usage for which they are intended. Load cells with digital readouts may also be used.

Beam type scales shall have as many beams and of such capacities as will permit the required weight of each aggregate to be set off on a single beam, except that when one (1) aggregate is required, two (2) weigh beams will be permitted. The scale shall be provided with suitable lockouts so that the weigh beams may be engaged to weigh in the desired order. Each weigh beam shall have some means or device to indicate when the beam is in the proper balance position. Poises shall be constructed so that they will be held firmly in position. Beam scales shall have provisions such as a "telltale" dial for indicating to the operator that the required load in the hopper is being approached. Such device shall indicate at least the last 200 pounds of load in the case of scales used for weighing aggregate, and at least the last 100 pounds of load in the case of scales used for weighing cement and finely divided minerals, and shall be placed in a position from which it can be viewed without parallax by the operator while charging the hopper.

Except for permanently located plants, springless dial scales shall be provided with suitable markers inside the glass cover and in front of the dial which may be set to show the position of the dial indicator for the required load or the various accumulative loads when more than one (1) aggregate is weighed in the same hopper. Markers shall have distinctive colors for the various materials to be weighed. Dials shall be placed so that they can be viewed without parallax by the operator.

The value of the minimum graduation interval of any scale used for weighing materials shall be not more than 0.2% of the batch weight and not more than 0.1% of the capacity of the scale, except that graduation intervals less than five (5) pounds when weighing aggregates and less than two (2) pounds when weighing cement and finely divided

minerals will not be required. In the case of beam scales, the same requirement shall also apply to the graduation of each individual beam with respect to the weight of material normally weighed on it. The value of the minimum graduation interval of any scale used for weighing mixing water shall be not less than two (2) pounds. All scales shall be designed and built to a maximum tolerance of 0.4% of the net load in the hopper.

Cement shall be weighed on a scale separate and distinct from the scale or scales used for weighing other materials. Mixing water, when weighed, shall be subject to the same requirement as cement. Finely divided minerals shall be weighed on a separate scale unless the batching equipment is automatic or semi-automatic. When a beam scale is used for weighing cement, a tare beam shall be provided and the weigh beam or beams shall be capable of being lifted out of weighing position so that the tare weight of the hopper can be checked after each weighing operation to determine if all of the cement or finely divided minerals has been discharged into the batch.

Scales shall be housed or otherwise protected against the effect of wind in a manner meeting the approval of the Engineer.

The scales shall be calibrated by an independent company. The independent company shall have scale testing equipment and standard weights meeting the requirements of NIST. The scale calibration will be observed by the Engineer. Scales shall be calibrated at the beginning of each construction season or each 12-month period, and each time the scales are moved, or when scale components are repaired or replaced.

Once a scale is calibrated, the settings shall not be altered. The concrete producer shall submit for approval by the Engineer, a method to verify the settings have not been altered. If at any time the Engineer determines the settings have been altered, a new calibration will be required.

Means of access for inspection purposes shall be safe and shall meet the approval of the Engineer. In the case of permanently located plants, the means of access shall be an inclined stairway with the handrail located so that its upward flight will end on the scale operator's platform. It shall be firmly attached to the supporting members of the bin. The weigh platform shall have an approved floor of metal grid or two (2) inch plank.

- (4) **Slurry mixer.** A slurry mixer may be used to premix cement, finely divided minerals, water, and admixtures before discharge into a stationary mixer or truck mixer. The equipment shall be a vortex type, paddle type, or other type approved by the Engineer. The vortex type shall have an impeller for mixing. The paddle type shall have mixing blades and paddles for mixing.

The batching equipment shall have a moisture sensor to measure the fine aggregate moisture, when the slurry mixer is operated. The cement, finely divided minerals, and water shall be measured in the slurry mixer. The mixing of materials in the slurry mixer shall result in a uniform mix, which shall flow into the stationary mixer or truck mixer.

The batching equipment shall have the ability to batch cement and finely divided minerals with or without the use of the slurry mixer.

- c. **Automatic and semi-Automatic batching equipment.** Automatic equipment for weighing, measuring, batching and mixing materials shall be according to paragraph 501-4.2 a titled CONCRETE MIXERS and 501-4.2 b titled BATCHING AND WEIGHING EQUIPMENT, except as follows.

- (1) **General requirements.** It is the purpose of the requirements set forth herein that automatic and semi-automatic batching equipment shall render impossible the omission of any one (1) of the required materials from any batch, and that duplications of measurement of any one (1) material into any batch shall not occur. Further, it is the

intent that the amounts of materials entering into any batch shall be accurately measured within the specific tolerances set forth herein. In the case of stationary mixers, it is intended that each batch shall be mixed during the full period required after all the materials have entered the mixer, and that recharging the mixer shall not occur before the previous batch has been discharged. Certain requirements to further the objects stated are as follows.

- (a) **Allowable tolerances.** Aggregates measured individually or cumulatively, shall have a tolerance within  $\pm 1.5\%$  of the required quantity. Cement and cementitious materials measured individually or cumulatively, shall have a tolerance within  $\pm 1\%$  of the required quantity. Water shall be measured to a tolerance within  $\pm 1\%$  of the required quantity. Admixtures shall be measured to a tolerance within  $\pm 3\%$  of the required quantity. The interlock control shall be set to the required tolerance.
- (b) **Weighing control.** Arrangement shall be such that any scale of the system can be conveniently checked for accuracy at any time that this should be considered desirable. All scales shall be designed and built so that, when any drag due to weighing control devices is included, an accuracy within the maximum tolerance of 0.4% of the net load in the hopper will be maintained.
- (c) **Water measuring control.** When the mixing water is measured volumetrically, provisions shall be made for bypassing the measured water into a container for checking the accuracy of delivery. If the water is measured during the course of its flow into the batch, means shall be provided to show, at any time during the flow, the amount that has entered. Devices for volumetric measurement of mixing water, in the case of automatic systems, shall automatically reset at the initial position immediately after delivery of the measured amount, ready for the next succeeding batch cycle.
- (d) **Admixture control.** The dispenser for an admixture shall meet the requirements for automatic or semi-automatic batching. Liquid admixtures shall be protected from freezing and contamination. Agitation shall be provided for liquid admixtures which are not stable solutions.

To provide a visual indication the liquid admixture is actually entering the batch, the tube conducting the admixture into the stream of mixing water or directly on the aggregate shall be transparent or translucent, or shall have a transparent or translucent section. If approved by the Engineer, an alternate indicator may be used for high range water reducing admixtures and corrosion inhibitor admixtures.

The dispenser's visual indicator shall be easily viewed by the plant operator when batching. Televised images may be used.

- (e) **Control of mixing time.** When automatic or semi-automatic batching equipment, in connection with stationary mixers, are used for successive batches of the same size, the mixing time adjusting control shall be capable of being locked with a key. As an alternative to a locking key, the start and finish time for mixing may be automatically printed on the batch ticket. The start and finish time shall be reported to the nearest second.
- (2) **Automatic batching equipment.** Automatic batching equipment shall be provided with gates, valves, or other suitable devices, which, when activated by a single starting mechanism, shall set in motion the charging of weigh hoppers or other containers, and which, in weighing or measuring any given material, shall automatically stop the flow of that material when the desired amount, within the allowable tolerance, has been attained. Automatic batching equipment shall be capable of having quantities preset on a central control panel that will result in correct measurement of each material for each batch, and control adjustments shall be capable of being performed on that panel.

For any material measured by weight, a suitable "over" and "under" indicating device shall be provided, showing whether the amount of material weighed is within the allowable tolerance. Interlock shall be provided (1) so that the charging device can open or start only when the scale indicates zero load and when the weigh hopper or container discharging gate or valve is closed, and (2) so that the discharging gate or valve can open only when the desired weight within the allowable tolerance is in the weigh hopper or container and when the charging device is closed or stopped. If more than one (1) aggregate is weighed cumulatively into the same hopper, control and interlock shall be provided with respect to each increment of weighing, as required for a material weighed into an individual hopper. It shall not be mandatory that the mixing water and air-entraining admixture be measured by weighing. These materials may be measured volumetrically, if the specified controls, or other equally effective means are provided, and if the measurements are within the specified tolerance.

Automatic batching equipment for weighing or measuring batch quantities in increments shall be provided with an automatic repeater having a counter that can be set for the number of increments required, and which shall ensure that the required number of increments are accurately delivered and discharged into each batch.

An automatic batching system shall consist of the combination of automatic batchers necessary for batching the materials required. All shall be activated by a single starting mechanism and the system shall be completely interlocked. In the case of stationary mixers, interlock shall be provided so that the discharging gates or valves can open only when the mixer is in the proper position for receiving the materials. The interlock of the system, with respect to sequence of discharge of the materials into the mixer, shall be such that the mixing water and air-entraining admixture are discharged according to the requirements of paragraph 501-4.6 titled MIXING CONCRETE.

Means shall be provided for convenient adjustment, from preset quantities, of the amounts of the aggregates, the mixing water and the air-entraining admixture, as based on tests of the aggregates and observations and tests of the mixture being produced. Suitable equipment indicating the amount of free water in the fine aggregate, as it is being batched, shall be provided, and the quantities of fine aggregate and mixing water shall be adjusted currently, as concrete is being produced, so that the desired amounts of these materials enter into each batch. Other adjustments of the quantities, as preset for automatic control, shall be made only at the direction of the Resident Engineer.

The operator shall not interfere with the operation of any part of the scale mechanism during the weighing process for the purpose of circumventing the interlock or malfunction of the equipment. Failure to comply with this requirement shall be cause for the Engineer to require that the equipment be provided with a positive means for preventing such interference.

A batching system consisting of a combination of semi-automatic batchers, as described below, and automatic batchers may be approved, provided that control and interlock shall be as prescribed for automatic batchers.

- (3) **Semi-automatic batching equipment.** Batching equipment which does not substantially comply with all the requirements prescribed for automatic batching equipment, but which meets at least the following described minimum conditions, will be considered as semi-automatic batching equipment.

As a minimum requirement, semi-automatic batching equipment shall be provided with gates, valves or other suitable devices, which open or start separately, when actuated by individual starting mechanisms, to permit the material to be weighed or measured, and close or stop automatically when the desired amount, within the allowable tolerance, has been attained. Interlock with respect to individual units and "over" and

"under" indicating devices shall be provided as prescribed for automatic batching equipment.

Other features prescribed for automatic batching equipment may be incorporated and approved.

A semi-automatic batching system shall consist of the combination of semiautomatic batchers necessary for batching the materials required. The system may be partially or completely interlocked.

For semi-automatic batching systems constructed so that materials are batched at more than one (1) stop or location, a separate control panel shall be furnished at each location, unless the operations can be controlled from a central location in a manner that will ensure that the correct amount of material is included in each batch. In the event that movement of trucks receiving the batches is necessary during the operations at any location, a separate control panel shall be provided at that location, and an operator shall be present to ensure that the batches are discharged correctly into their respective compartments. However, if effective interlock is provided between the movement of trucks and the batching mechanism so that batches can be discharged only as required without omission or duplication, and as each batch compartment is brought into correct position, then the operations may be conducted from a centrally located control panel.

The operator shall not interfere with the operation of any part of the scale mechanism during the weighing process for the purpose of circumventing the interlock or malfunction of the equipment. Failure to comply with this requirement shall be cause for the Engineer to require that the equipment be provided with a positive means for preventing such interference.

A batching system consisting of a combination of semi-automatic and manual batchers may be approved, provided that satisfactory control of the batching is attained.

- (4) Manual operation.** Automatic and semi-automatic batching equipment may be constructed so that they can be switched to manual control. When switching to manual control is necessary, the batching operations shall continue only until repairs can be made, but not for a period exceeding 72 hours, unless otherwise approved by the Engineer.

If provision is made for switching to manual operation, then the scale, or a scale follower approved by the Engineer, shall be placed within easy view of the operator, but not farther than 20 feet from the location from which the manual batching is being performed. Dial scales shall be placed so that they can be viewed without parallax.

- d. Mechanical concrete spreader.** The mechanical concrete spreader shall be approved by the Engineer. The spreader shall run on forms when forms are used or on wheels or tracks when slip forming. The mechanical concrete spreader shall be self-propelled and shall be capable of spreading the concrete mix to the desired cross sections. The spreader shall be easily adjustable to spread different elevations of concrete. Vibrators may be attached to the spreader, finishing machine or may be mounted on a separate carriage and shall avoid contact with the joints, load transfer devices, reinforcement, subgrade, subbase, or side forms.

The vibrating impulses shall be applied through an apparatus especially designed for this purpose and so constructed as to operate satisfactorily ahead of the finishing machine in such a manner that the vibratory impulses are transmitted through the concrete mass with sufficient intensity to consolidate it throughout its entire depth and width. Vibrators shall be used only for purposes of consolidation.

Surface pan type vibrators shall be so designed that the vibrating impulses will be applied directly to the surface of the concrete. The surface pan type vibrator shall be equipped with

a minimum of two (2) vibrating elements for each lane width of pavement vibrated. The operating frequency shall be 3,500 vibrations per minute or greater.

Vibrators of the internal type shall be especially designed for this purpose and so constructed as to operate satisfactorily. The operating frequency of the internal type shall be  $7,000 \pm 2,000$  vibrations per minute. The vibrating elements shall be so spaced that the concrete mass shall be consolidated throughout its entire depth and width, but the spacing of the vibrating elements shall be 24 inches or less.

A vibrating reed tachometer, hand type, shall be provided with each paver. The vibrating reed tachometer shall have a range from at least 4,000 to 10,000 vibrations per minute.

For a contract which has a minimum of 10,000 square yards of pavement that is 12 feet or wider, an electronic internal vibrator monitoring device shall be provided. The device shall be capable of displaying the operating frequency of each internal vibrator and shall be visible to the paving operator. The vibrator monitoring device shall have a range from at least 4,000 to 10,000 vibrations per minute.

- e. **Fixed forms.** Flexible or curved forms of proper radius, made of either metal or wood, shall be supplied for use on curves of 100-foot radius or less.

At all other locations, unless approved by the Engineer, straight side fixed forms shall be made of steel, they shall be of an approved cross section, and shall be furnished in sections not less than ten (10) feet in length. They shall have a height not less than the edge thickness of the pavement to be constructed, a base width equal to or greater than the height and shall be made of metal not less than one-quarter (1/4) inch in thickness, except that a minimum thickness of 3/16 inches will be permitted if the form is of trapezoidal cross section. They shall have flange braces extending outward on the base not less than two-thirds (2/3) the height of the form and spaced not more than five (5) feet apart.

Forms shall be provided with adequate devices for secure settings so that when in place they will withstand, without visible spring or settlement, the impact and vibration of the consolidating and finishing equipment. Each section shall have a steel pin at each end and at least one (1) intermediate pin, and provision shall be made to lock all pins to a true grade. Locked joints shall be provided between form sections to maintain the alignment and elevation of the form line. Metal forms shall withstand loading imparted by the paving train without distortion or settlement of the form line. They shall be straight and free from warp. Forms with battered top surfaces and bent, twisted or broken forms shall not be used. Built-up forms shall not be used, except as approved by the Engineer. The top face of the form shall not vary from a true plane more than 1/16 inch in ten (10) feet, and the upstanding leg shall not vary more than one-quarter (1/4) inch.

Wood forms may be used under special conditions, when approved by the Engineer. When used, the wood forms shall be well seasoned surfaced plank, shall be not less than two (2) inches thick (commercial dimensions), with the exception of curved or flexible sections, and shall extend the full depth of the pavement section; shall be straight and free from warp; shall provide for rigid, smooth connections; and shall provide ways and means to be securely fastened in place to the lines and grades given.

Metal forms that will be used to support a vibrating screed shall be made of no less than 10 gauge steel with a minimum four (4) inch wide base and have a minimum of two (2) flange braces with provisions for pin locking in each ten (10) foot section.

Metal pins shall be of proper size and length to hold the forms rigidly and securely in place.

Metal forms may be built-up with a single layer of wood plank, two (2) inches thick or less when the specified pavement thickness differs from standard manufactured form sizes. The wood plank shall be well seasoned surfaced hardwood free from warp and twist. The plank shall be attached to the bottom of the metal form with two (2) lines of bolts at not more than



two (2) foot centers on each line. The width of the plank shall equal or exceed the pavement thickness.

**f. Finishing equipment.**

**(1) Slip-form.** The standard method of constructing concrete pavements shall be with an approved slip-form paving equipment designed and operated to spread, consolidate, screed, and finish the freshly placed concrete in one (1) complete pass of the machine so that the end result is a dense and homogeneous pavement which is achieved with a minimum of hand finishing. The paver-finisher shall be a heavy duty, self-propelled machine designed specifically for paving and finishing high quality concrete pavements. The tracks shall be of sufficient length and width to properly support the machine and its load without causing excessive depressions. The formless paver shall be equipped with strike off screed, and internal vibrators of sufficient quantity to provide complete consolidation regardless of the depth of concrete placed. The paver shall be capable of constructing pavement to line and grade specified. The method of placing the concrete in front of the formless paver shall be a separate operation without being attached to the formless paver.

The formless paver shall be approved by the Engineer prior to starting the paving operations.

The finishing machine shall be equipped with a mechanical strike off device and either a rotating cylinder or a longitudinal oscillating screed which transversely finishes the surface of the concrete. The Contractor may attach other equipment to the finishing machine to enhance the final finish when approved by the Engineer. The finishing machine shall produce a floor surface of uniform texture, free from porous areas, and with the required surface smoothness.

The finishing machine shall be operated on rails or other supports that will not deflect under the applied loads. The supports shall be adjustable for elevation and shall be completely in place for the full length of the area to be finished. The supports shall be approved by the Engineer before placing of the concrete is started.

The finishing machine shall be designed for concrete paving and meet the approval of the Engineer. The finishing machine shall be power driven with at least two (2) oscillating screeds or a pan type screed which shall be capable of placing, spreading, consolidating, screeding, and finishing the concrete to the proper pavement elevation and cross section within the specified tolerance.

The pan type paver shall be equipped with augers, strike off and tamper bars ahead of the pan screed with at least one (1) trailing oscillating screed or belt finisher. The pan shall be sufficiently braced and stiffened to ensure no deflection. Internal vibrators with pressure compensating controls meeting the requirements of paragraph 501-4.2 d titled MECHANICAL CONCRETE SPREADER shall be attached to the paver. If the paver is powered by cable and motor, a steering sensor shall be required, and the motor shall be hydraulically operated. One (1) switch or control, which stops or starts all paver functions simultaneously, shall be provided.

**(2) Fixed-form.** On projects requiring less than 500 square yards of concrete pavement or irregular areas at locations inaccessible to slip-form paving equipment, concrete pavement may be placed with equipment specifically designed for placement and finishing using stationary side forms. Methods and equipment shall be reviewed and accepted by the Engineer. Hand screeding and float finishing may only be used on small irregular areas as allowed by the Engineer.

**g. Vibrators.** Vibrator shall be the internal type. The rate of vibration of each vibrating unit shall be sufficient to consolidate the pavement without segregation or voids. The operating

frequency of the internal type shall be  $7,000 \pm 2,000$  vibrations per minute. The vibrating elements shall be so spaced that the concrete mass shall be consolidated throughout its entire depth and width, but the spacing of the vibrating elements shall be 24 inches or less. A vibrating reed tachometer, hand type, shall be provided with each paver. The vibrating reed tachometer shall have a range from at least 4,000 to 10,000 vibrations per minute. Adequate power to operate all vibrators shall be available on the paver. The vibrators shall be automatically controlled so that they shall be stopped as forward motion ceases. The Contractor shall provide an electronic or mechanical means to monitor vibrator status. The checks on vibrator status shall occur a minimum of two (2) times per day or when requested by the Resident Engineer.

Hand-held vibrators may only be used in irregular areas and shall be the internal type. It shall be adequately powered to operate under full load at a frequency of 4,500 vibrations per minute or greater; and shall have an intensity and period of vibration sufficient to obtain thorough consolidation of the concrete.

The vibrator shall have a non-metallic head for areas containing epoxy coated reinforcement. The head shall be coated by the manufacturer. The hardness of the non-metallic head shall be less than the epoxy coated reinforcement, resulting in no damage to the epoxy coating. Slip-on covers will not be allowed.

- h. Vibrating screed.** The screed used to strike off and consolidate the concrete by the hand method shall be durably constructed, equipped with a vibrator, and shall be shaped to provide the cross section as shown on the plans. The screed shall be at least two (2) feet longer than the maximum width of the slab to be struck off. It shall be an approved design and be constructed either of metal or of other suitable material shod with metal.
- i. Concrete finisher float.** The concrete finisher float shall be either self-propelled or attached to a finishing machine. The float shall be easily adjustable from crown to flat. The float shall be a minimum of 30 inches in length with a minimum of 24 inches in contact with the concrete. It shall be so designed to prevent tearing of the concrete surface or rolling of aggregate under the float. The float pan shall be suspended from the frame, float freely on the concrete, and shall be capable of being adjusted in both height and width. The float pan, once adjusted, shall be equipped hydraulically or by other suitable means that it may be raised from the operator's platform and when lowered shall automatically return to its pre-set position. If self-propelled, it shall also be equipped with four (4) or more wheels which ride on the forms and it shall be of sufficient weight as to resist flexing under the pressure of the concrete.
- j. Mechanical longitudinal float.** The machine shall be so constructed that the travel of the floating mechanism can be adjusted to conform to the pavement cross section, elevation, and surface smoothness shown on the plans. The float shall be a minimum of ten (10) feet in length and one (1) foot in width. It shall be equipped with a power-driven floating screed and shall oscillate longitudinally with respect to the pavement during its transverse travel across the pavement. It may be either attached to the finishing machine or formless paver, self-propelled on rollers operating on forms or self-propelled operating on tracks. If attached to a finishing machine or formless paver, it shall be rigidly supported by a frame at the rear in a manner approved by the Resident Engineer. If self-propelled, the tracks or rollers from which the float operates shall be in good working condition. The tracks or rollers from which the float operates shall be accurately adjusted and coordinated with the adjustments of the finishing machine or formless paver so that a small amount of mortar is carried ahead of the float at all times.
- k. Hand-operated longitudinal float.** The hand-operated longitudinal float shall be at least ten (10) foot in length and properly stiffened to prevent flexibility and warping during the finishing operation. The handle shall be at least three (3) feet longer than one-half (1/2) the width of the slab.

- l. Long-handled float.** The long-handled float shall have a blade at least three (3) feet in length and six (6) inches in width. The handle shall be of such length as will permit the operation of the float from the shoulder. Two (2) or more such floats shall be provided.
- m. Ten (10) foot straightedge.** The ten (10) foot straightedge shall be made of suitable material, and shall be maintained in accurate alignment at all times. It shall be equipped with a handle at least three (3) feet longer than one-half (1/2) the width of the slab. Two (2) or more ten (10) foot straightedges shall be provided.
- n. Broom.** Brooms shall be of push broom type, at least 18 inches in width. They shall contain a maximum of three (3) rows of good quality bass or bassine fiber 4-1/2 inches or less in length. The handle shall be at least one (1) foot longer than one-half (1/2) the width of the slab and shall be readily adjustable. Two (2) or more brooms shall be provided.
- o. Edging tool.** The edging tools shall have a radius of one-quarter (1/4) inch, and shall be approved by the Engineer. Two (2) or more edging tools shall be provided.
- p. Concrete saws.** Only self-propelled, water cooled and lubricated saws with diamond blades shall be used on this project. The Contractor shall provide sawing equipment adequate in number of units and power to complete the sawing to the required dimensions. The concrete saw shall be equipped with a diamond blade of sufficient size to saw pavements full-depth and be capable of accurately maintaining cutting depth and alignment. The Contractor shall provide at least one (1) standby saw in good working order and a supply of saw blades at the site of the work at all times during sawing operations.
- q. Drilling machine.** The machine used for drilling the holes for dowel bars in the face of the pavement shall be capable of drilling the size and depth of holes as specified in the contract documents. A drill support system using the pavement surface as a reference shall be required to assure hole alignment at the specified depth of the PCC pavement. Hand-held tools will not be allowed.
- r. Coring machine.** Pavement thickness cores shall be taken utilizing an approved coring machine. The cores shall have a diameter of four (4) inches. The cores will be measured with a device approved by the Department.
- s. Pavement surface test equipment.** Required surface testing and analysis equipment and their jobsite transportation shall be provided by the Contractor.
  - (1) Straightedge.** The 16 foot or 12-foot straightedge shall consist of a metal I-beam mounted between two (2) wheels spaced 16 feet or 12 feet between the axles. Scratcher bolts, which can be easily and accurately adjusted, shall be set at the 1/4, 1/2, and 3/4 points between the axles. A handle suitable for pushing and guiding shall be attached to the straightedge.
  - (2) Profile testing device.** The profile testing device shall have a decal displayed to indicate it has been tested through the Profile Equipment Verification (PEV) Program administered by the Department.
    - (a) California profilograph.** The California Profilograph shall be either computerized or manual and have a frame 25 feet in length supported upon multiple wheels at either end. The profile shall be recorded from the vertical movement of a wheel attached to the frame at midpoint.

The California Profilograph shall be calibrated according to the manufacturer's recommendations and California Test 526. All calibration traces and calculations shall be submitted to the Engineer for the project file.
    - (b) Inertial profiler.** The inertial profiler shall be either an independent device or a system that can be attached to another vehicle using one (1) or two (2) non-contact sensors to measure the pavement profile. The inertial profiler shall be capable of

performing a simulation of the California Profilograph to provide results in the Profile Index format.

The inertial profiler shall be calibrated according to the manufacturer's recommendations. All calibration traces and calculations shall be submitted to the Engineer for the project file.

- (c) **Trace analysis.** The Contractor shall reduce/evaluate these traces using a 0.00-inch blanking band and determine a Profile Index in inches per mile for each section of finished pavement surface. Traces produced using a computerized profile testing device will be evaluated without further reduction. When using a manual profile testing device, the Contractor shall provide an electronic scanner, a computer, and software to reduce the trace. All analysis equipment (electronic scanner, computerized recorder, etc.) shall be able to accept 0.00 inches for the blanking band.

All traces from pavement sections tested with the profile testing device shall be recorded on paper with scales of 300-to-1 longitudinally and 1-to-1 vertically. Equipment and software settings of the profile testing device and analysis equipment shall be set to those values approved through the PEV Program.

The Engineer may retest the pavement at any time to verify the accuracy of the equipment.

- 501-4.3 Form setting.** Prior to the start of paving, forms shall be in place to accommodate at least one (1) day's paving to ensure continuous paving operation. The forms shall be supported for the full length and width of the form line by either the subgrade or subbase. If required by the Resident Engineer, the subbase or subgrade shall be tamped under the form line. The alignment of the form line shall be within a tolerance of  $\pm 1/4$  inch with the plan edge of pavement. The elevation of the form shall be the plan elevation of the edge of pavement. Minor intermittent deviations in the subgrade or subbase elevation may be corrected, without the use of shims or wedges, by placing compacted granular or subbase material in one-half (1/2) inch lifts or less for low areas. High areas may be corrected by tamping or trimming as required. The minimum form height shall equal the plan pavement thickness. Form heights exceeding the pavement thickness may be used provided the forms are set and maintained at the plan elevation. Forms shall be set to withstand, without visible spring or settlement, the impact and vibration of the consolidating and finishing equipment. Forms shall be cleaned and oiled prior to the concrete placement.
- 501-4.4 Base surface preparation prior to placement.** The work shall be extended to at least 18 inches beyond each edge of the proposed base course or pavement. When a subbase is being placed under the base course or pavement, the work shall be extended to include the area being covered by the subbase material. Any damage to the prepared base, subbase, and subgrade shall be corrected full depth by the Contractor prior to concrete placement. The underlying surface shall be entirely free of frost when concrete is placed. The prepared grade shall be moistened with water, without saturating, immediately ahead of concrete placement to prevent rapid loss of moisture from concrete.
- 501-4.5 Handling, measuring, and batching material.** Aggregate stockpiles shall be constructed and managed in such a manner that prevents segregation and intermixing of deleterious materials. Aggregates from different sources shall be stockpiled, weighed and batched separately at the concrete batch plant. Aggregates that have become segregated or mixed with earth or foreign material shall not be used. All aggregates produced or handled by hydraulic methods, and washed aggregates, shall be stockpiled or binned for draining at least 12 hours before being batched. Store and maintain all aggregates at a uniform moisture content prior to use. A continuous supply of materials shall be provided to the work to ensure continuous placement.

**501-4.6 Mixing concrete.** The concrete may be mixed at the work site, in a central mix plant or in truck mixers. The mixer shall be of an approved type and capacity. Mixing time shall be measured from the time all materials are placed into the drum until the drum is emptied into the truck.

The required mixing time for stationary mixers with a capacity greater than two (2) cubic yards may be less than 75 seconds upon satisfactory completion of a mixer performance test. Mixer performance tests may be requested by the Contractor when the quantity of concrete to be placed exceeds 50,000 square yards. The testing shall be conducted according to the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 20-08, *Field Test Procedures for Mixer Performance and Concrete Uniformity Tests*.

The Contractor will be allowed to test two (2) mixing times within a range of 50 to 75 seconds. If satisfactory results are not obtained from the required tests, the mixing time shall continue to be 75 seconds for the remainder of the contract. If satisfactory results are obtained, the mixing time may be reduced. In no event will mixing time be less than 50 seconds.

The Contractor shall furnish the labor, equipment, and material required to perform the testing according to the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 20-08, *Field Test Procedures for Mixer Performance and Concrete Uniformity Tests*.

**a. Ready-mixed concrete.** Ready-mixed concrete is central-mixed, truck-mixed, or shrink-mixed concrete transported and delivered in a plastic state ready for placement in the work and shall be according to the following.

**(1) Central-mixed concrete.** Central-mixed concrete is concrete which has been completely mixed in a stationary mixer and delivered in a truck agitator, a truck mixer operating at agitating speed, or a nonagitator truck.

The stationary mixer shall operate at the drum speed for which it was designed. The batch shall be charged into the drum so that some of the water shall enter in advance of the cement, finely divided minerals, and aggregates. The flow of the water shall be uniform and all water shall be in the drum by the end of the first 15 seconds of the mixing period. Water shall begin to enter the drum from zero to two (2) seconds in advance of solid material and shall stop flowing within two (2) seconds of the beginning of mixing time.

Some coarse aggregate shall enter in advance of other solid materials. For the balance of the charging time for solid materials, the aggregates, finely divided minerals, and cement (to assure thorough blending) shall each flow at acceptably uniform rates, as determined by visual observation. Coarse aggregate shall enter two (2) seconds in advance of other solid materials and a uniform rate of flow shall continue to within two (2) seconds of the completion of charging time.

The entire contents of the drum, or of each single compartment of a multiple-drum mixer, shall be discharged before the succeeding batch is introduced.

The volume of concrete mixed per batch shall not exceed the mixer's rated capacity, as shown on the standard rating plate on the mixer, by more than 10%.

The minimum mixing time shall be 75 seconds for a stationary mixer having a capacity greater than two (2) cubic yards. For a mixer with a capacity equal to or less than two (2) cubic yards, the mixing time shall be 60 seconds. Transfer time in multiple drum mixers is included in the mixing time. Mixing time shall begin when all materials are in the mixing compartment and shall end when the discharge of any part of the batch is started. The required mixing times will be established by the Engineer for all types of stationary mixers.

When central-mixed concrete is to be transported in a truck agitator or a truck mixer, the stationary-mixed batch shall be transferred to the agitating unit without delay and without loss of any portion of the batch. Agitating shall start immediately thereafter and shall continue without interruption until the batch is discharged from the agitator. The ingredients of the batch shall be completely discharged from the agitator before the succeeding batch is introduced. Drums and auxiliary parts of the equipment shall be kept free from accumulations of materials.

The vehicles used for transporting the mixed concrete shall be of such capacity, or the batches shall be so proportioned, that the entire contents of the mixer drum can be discharged into each vehicle load.

- (2) **Truck-mixed concrete.** Truck-mixed concrete is completely mixed and delivered in a truck mixer. When the mixer is charged with fine and coarse aggregates simultaneously, not less than 60 nor more than 100 revolutions of the drum or blades at mixing speed shall be required, after all of the ingredients including water are in the drum. When fine and coarse aggregates are charged separately, not less than 70 revolutions will be required. For self-consolidating concrete, a minimum of 100 revolutions is required in all cases. Additional mixing beyond 100 revolutions shall be at agitating speed unless additions of water, admixtures, or other materials are made at the jobsite. The mixing operation shall begin immediately after the cement and water, or the cement and wet aggregates, come in contact. The ingredients of the batch shall be completely discharged from the drum before the succeeding batch is introduced. The drum and auxiliary parts of the equipment shall be kept free from accumulations of materials. If additional water or an admixture is added at the jobsite, the concrete batch shall be mixed a minimum of 40 additional revolutions after each addition.
- (3) **Mixing water.** Wash water shall be completely discharged from the drum or container before a batch is introduced. All mixing water shall be added at the plant and any adjustment of water at the jobsite by the Contractor shall not exceed the specified maximum water/cement ratio or slump. If strength specimens have been made for a batch of concrete, and subsequently during discharge there is more water added, additional strength specimens shall be made for the batch of concrete. No additional water may be added at the jobsite to central mixed concrete if the mix design has less than 565 pounds per cubic yard of cement and finely divided minerals summed together.
- (4) **Mixing and agitating speeds.** The mixing or agitating speeds used for truck mixers or truck agitators shall be per the manufacturer's rating plate.
- (5) **Capacities.** The volume of plastic concrete in a given batch will be determined according to AASHTO T 121, based on the total weight of the batch, determined either from the weight of all materials, including water, entering the batch or directly from the net weight of the concrete in the batch as delivered.

The volume of mixed concrete in truck mixers or truck agitators shall in no case be greater than the rated capacity determined according to the Truck Mixer, Agitator, and Front Discharge Concrete Carrier Standards of the Truck Mixer Manufacturer's Bureau, as shown by the rating plate attached to the truck. If the truck mixer does not have a rating plate, the volume of mixed concrete shall not exceed 63% of the gross volume of the drum or container, disregarding the blades. For truck agitators, the value is 80%.

- (6) **Time of haul.** Haul time shall begin when the delivery ticket is stamped. The delivery ticket shall be stamped no later than five (5) minutes after the addition of the mixing water to the cement, or after the addition of the cement to the aggregate when the combined aggregates contain free moisture in excess of 2% by weight. If more than one (1) batch is required for charging a truck using a stationary mixer, the time of haul shall

start with mixing of the first batch. Haul time shall end when the truck is emptied for incorporation of the concrete into the work.

Mixed concrete from the central mixing plant shall be transported in truck mixers, truck agitators, or non-agitating trucks. The elapsed time from the addition of cementitious material to the mix until the concrete is discharged from the truck should not exceed 30 minutes when the concrete is hauled in non-agitating trucks, nor 90 minutes when the concrete is hauled in truck mixers or truck agitators. The maximum haul time for concrete transported in truck mixers or truck agitators shall be according to the following.

Concrete Temperature at Point of Discharge	Haul Time	
	Hours	Minutes
50°-64°F	1	30
>64°F – without retarder	1	00
>64°F – with retarder	1	30

In no case shall the temperature of the concrete when placed exceed 90°F.

To encourage start-up testing for mix adjustments at the plant, the first two (2) trucks will be allowed an additional 15 minutes haul time whenever such testing is performed.

Retempering concrete by adding water or by other means will not be permitted. With transit mixers additional water may be added to the batch materials and additional mixing performed to increase the slump to meet the specified requirements provided the addition of water is performed within 45 minutes after the initial mixing operations and provided the water/cementitious ratio specified is not exceeded.

For a mixture which is not mixed on the jobsite, a delivery ticket shall be required for each load. The following information shall be recorded on each delivery ticket: (1) ticket number; (2) name of producer and plant location; (3) contract number; (4) name of Contractor; (5) stamped date and time batched; (6) truck number; (7) quantity batched; (8) amount of admixtures in the batch; (9) amount of water in the batch; and (10) Department mix design number.

For concrete mixed in jobsite stationary mixers, the above delivery ticket may be waived, but a method of verifying the haul time shall be established to the satisfaction of the Engineer.

- (7) **Production and delivery.** The production of ready-mixed concrete shall be such that the operations of placing and finishing will be continuous insofar as the job operations require. The Contractor shall be responsible for producing concrete that will have the required workability, consistency, and plasticity when delivered to the work. Concrete which is unsuitable for placement as delivered will be rejected. The Contractor shall minimize the need to adjust the mixture at the jobsite, such as adding water and admixtures prior to discharging.
- (8) **Use of multiple plants in the same construction item.** The Contractor may simultaneously use central-mixed, truck-mixed, and shrink-mixed concrete from more than one (1) plant, for the same construction item, on the same day, and in the same pour. However, the following criteria shall be met.
- (a) Each plant shall use the same cement, finely divided minerals, aggregates, admixtures, and fibers.
- (b) Each plant shall use the same mix design. However, material proportions may be altered slightly in the field to meet slump and air content criteria. Field water adjustments shall not result in a difference that exceeds 0.02 between plants for

water/cement ratio. The required cement factor for central-mixed concrete shall be increased to match truck-mixed or shrink-mixed concrete, if the latter two (2) types of mixed concrete are used in the same pour.

- (c) The maximum slump difference between deliveries of concrete shall be three-quarters (3/4) inch when tested at the jobsite. If the difference is exceeded, but test results are within specification limits, the concrete may be used. The Contractor shall take immediate corrective action and shall test subsequent deliveries of concrete until the slump difference is corrected. For each day, the first three (3) truckloads of delivered concrete from each plant shall be tested for slump by the Contractor. Thereafter, when a specified test frequency for slump is to be performed, it shall be conducted for each plant at the same time.
- (d) The maximum air content difference between deliveries of concrete shall be 1.5% when tested at the jobsite. If the difference is exceeded, but test results are within specification limits, the concrete may be used. The Contractor shall take immediate corrective action and shall test subsequent deliveries of concrete until the air content difference is corrected. For each day, the first three (3) truckloads of delivered concrete from each plant shall be tested for air content by the Contractor. Thereafter, when a specified test frequency for air content is to be performed, it shall be conducted for each plant at the same time.
- (e) Strength tests shall be performed and taken at the jobsite for each plant. When a specified strength test is to be performed, it shall be conducted for each plant at the same time. The difference between plants for strength shall not exceed 90 pounds per square inch flexural and 900 pounds per square inch compressive. If the strength difference requirements are exceeded, the Contractor shall take corrective action.
- (f) The maximum haul time difference between deliveries of concrete shall be 15 minutes. If the difference is exceeded, but haul time is within specification limits, the concrete may be used. The Contractor shall take immediate corrective action and check subsequent deliveries of concrete.

**501-4.7 Weather limitations on mixing and placing.** No concrete shall be mixed, placed, or finished when the natural light is insufficient, unless an adequate and approved artificial lighting system is operated.

- a. **Cold weather.** Unless authorized in writing by the Engineer, mixing and concreting operations shall be discontinued when a descending air temperature in the shade and away from artificial heat reaches 40°F and shall not be resumed until an ascending air temperature in the shade and away from artificial heat reaches 35°F.

The aggregate shall be free of ice, snow, and frozen lumps before entering the mixer. The temperature of the mixed concrete shall not be less than 50°F at the time of placement. Concrete shall not be placed on frozen material nor shall frozen aggregates be used in the concrete.

When concreting is authorized during cold weather, water and/or the aggregates may be heated to no less than 70°F and not more than 150°F. The apparatus used shall heat the mass uniformly and shall be arranged to preclude the possible occurrence of overheated areas which might be detrimental to the materials.

Curing during cold weather shall be in accordance with paragraph 501-4.14 titled CONCRETE PROTECTION FOR COLD WEATHER.

- b. **Hot weather.** During periods of hot weather when the maximum daily air temperature exceeds 85°F, the following precautions shall be taken.



The forms and/or the underlying surface shall be sprinkled with water immediately before placing the concrete. The concrete shall be placed at the coolest temperature practicable, and in no case shall the temperature of the concrete when placed exceed 90°F. The aggregates and/or mixing water shall be cooled as necessary to maintain the concrete temperature at or not more than the specified maximum.

The concrete placement shall be protected from exceeding an evaporation rate of 0.2 pounds per square foot per hour. When conditions are such that problems with plastic cracking can be expected, and particularly if any plastic cracking begins to occur, the Contractor shall immediately take such additional measures as necessary to protect the concrete surface. If the Contractor's measures are not effective in preventing plastic cracking, paving operations shall be immediately stopped.

Curing during hot weather shall be in accordance with paragraph 501-4.15 titled CONCRETE PROTECTION FOR HOT WEATHER.

- c. **Temperature management program.** Prior to the start of paving operation for each day of paving, the Contractor shall provide the Resident Engineer with a Temperature Management Program for the concrete to be placed to assure that uncontrolled cracking is avoided. As a minimum, the program shall address the following items:
- (1) Anticipated tensile strains in the fresh concrete as related to heating and cooling of the concrete material.
  - (2) Anticipated weather conditions such as ambient temperatures, wind velocity, and relative humidity; and anticipated evaporation rate using Portland Concrete Association (PCA), *Design and Control of Concrete Mixtures, Figure 19-9*.
  - (3) Anticipated timing of initial sawing of joint.
  - (4) Anticipated number and type of saws to be used.
- d. **Rain.** The Contractor shall have available materials for the protection of the concrete during inclement weather. Such protective materials shall consist of rolled polyethylene sheeting at least four (4) mils thick of sufficient length and width to cover the plastic concrete slab and any edges. The sheeting may be mounted on either the paver or a separate movable bridge from which it can be unrolled without dragging over the plastic concrete surface. When rain appears imminent, all paving operations shall stop, and all available personnel shall begin covering the surface of the unhardened concrete with the protective covering.

**501-4.8 Concrete placement.** At any point in concrete conveyance, the free vertical drop of the concrete from one (1) point to another or to the underlying surface shall not exceed three (3) feet. The finished concrete product must be dense and homogeneous, without segregation and conforming to the standards in this specification. Backhoes and grading equipment shall not be used to distribute the concrete in front of the paver. Front end loaders will not be used. All concrete shall be consolidated without voids or segregation, including under and around all load-transfer devices, joint assembly units, and other features embedded in the pavement. Hauling equipment or other mechanical equipment can be permitted on adjoining previously constructed pavement when the concrete strength reaches a flexural strength of 550 pounds per square inch or a compressive strength of 3,500 pounds per square inch, based on the average of four (4) field cured specimens per 1,200 cubic yards of concrete placed. The Contractor shall take additional concrete beams/cylinders as required to demonstrate the concrete strength at no additional cost to the contract. If equipment causes any damage to previously constructed pavements, operations shall cease until the Contractor can satisfy the Resident Engineer that no damage shall occur. Any damage caused by these operations shall be repaired to the satisfaction of the Engineer.

The Contractor shall have available materials for the protection of the concrete during cold, hot and/or inclement weather in accordance with paragraph 501-4.7 titled WEATHER LIMITATIONS ON MIXING AND PLACING.

- a. **Slip-form construction.** The concrete shall be distributed uniformly into final position by a self-propelled slip-form paver without delay. The alignment and elevation of the paver shall be regulated from outside reference lines established for this purpose. The paver shall vibrate the concrete for the full width and depth of the strip of pavement being placed and the vibration shall be adequate to provide a consistency of concrete that will stand normal to the surface with sharp well-defined edges. The sliding forms shall be rigidly held together laterally to prevent spreading of the forms. The plastic concrete shall be effectively consolidated by internal vibration with transverse vibrating units for the full width of the pavement and/or a series of equally placed longitudinal vibrating units. The space from the outer edge of the pavement to longitudinal unit shall not exceed nine (9) inches for slipform and at the end of the dowels for the fill-in lanes.

The term internal vibration means vibrating units located within the specified thickness of pavement section.

The rate of vibration of each vibrating unit shall be sufficient to consolidate the pavement without, segregation, voids, or vibrator trails and the amplitude of vibration shall be sufficient to be perceptible on the surface of the concrete along the entire length of the vibrating unit and for a distance of at least one (1) foot . The frequency of vibration or amplitude should be adjusted proportionately with the rate of travel to result in a uniform density and air content. The paving machine shall be equipped with a tachometer or other suitable device for measuring and indicating the actual frequency of vibrations.

The concrete shall be held at a uniform consistency. The slip-form paver shall be operated with as nearly a continuous forward movement as possible and all operations of mixing, delivering, and spreading concrete shall be coordinated to provide uniform progress with stopping and starting of the paver held to a minimum. If for any reason, it is necessary to stop the forward movement of the paver, the vibratory and tamping elements shall also be stopped immediately. No tractive force shall be applied to the machine, except that which is controlled from the machine.

When concrete is being placed adjacent to an existing pavement, that part of the equipment which is supported on the existing pavement shall be equipped with protective pads on crawler tracks or rubber-tired wheels on which the bearing surface is offset to run a sufficient distance from the edge of the pavement to avoid breaking the pavement edge.

Not more than 15% of the total free edge of each 500 foot segment of pavement, or fraction thereof, shall have an edge slump exceeding one-quarter (1/4) inch, and none of the free edge of the pavement shall have an edge slump exceeding three-eighths (3/8) inch. (The total free edge of 500 feet of pavement will be considered the cumulative total linear measurement of pavement edge originally constructed as nonadjacent to any existing pavement; that is, 500 feet of paving lane originally constructed as a separate lane will have 1,000 feet of free edge, 500 feet of fill-in lane will have no free edge, etc.). The area affected by the downward movement of the concrete along the pavement edge shall be limited to not more than 18 inches from the edge.

When excessive edge slump cannot be corrected before the concrete has hardened, the area with excessive edge slump will be removed the full width of the slip form lane and replaced at the expense of the Contractor as directed by the Engineer.

- b. Fixed-form construction.** Forms shall be drilled in advance of being placed to line and grade to accommodate tie bars/dowel bars where these are specified.

Immediately in advance of placing concrete and after all subbase operations are completed, side forms shall be trued and maintained to the required line and grade for a distance sufficient to prevent delay in placing.

Side forms shall remain in place at least 12 hours after the concrete has been placed, and in all cases until the edge of the pavement no longer requires the protection of the forms. Curing compound shall be applied to the concrete immediately after the forms have been removed.

Side forms shall be thoroughly cleaned and coated with a release agent each time they are used and before concrete is placed against them.

Concrete shall be spread, screed, shaped and consolidated by one (1) or more self-propelled machines. These machines shall uniformly distribute and consolidate concrete without segregation so that the completed pavement will conform to the required cross-section with a minimum of handwork.

The number and capacity of machines furnished shall be adequate to perform the work required at a rate equal to that of concrete delivery. The equipment must be specifically designed for placement and finishing using stationary side forms. Methods and equipment shall be reviewed and accepted by the Engineer.

Concrete for the full paving width shall be effectively consolidated by internal vibrators. The rate of vibration of each vibrating unit shall be sufficient to consolidate the pavement without segregation, voids, or leaving vibrator trails.

Power to vibrators shall be connected so that vibration ceases when forward or backward motion of the machine is stopped.

- c. Consolidation.** Concrete shall be consolidated with the specified type of lane-spanning, gang-mounted, mechanical, immersion type vibrating equipment mounted in front of the paver, supplemented, in rare instances as specified, by hand-operated vibrators. The vibrators shall be inserted into the concrete to a depth that will provide the best full-depth consolidation but not closer to the underlying material than two (2) inches. Vibrators shall not be used to transport or spread the concrete. For each paving train, at least one (1) additional vibrator spud, or sufficient parts for rapid replacement and repair of vibrators shall be maintained at the paving site at all times. Any evidence of inadequate consolidation (honeycomb along the edges, large air pockets, or any other evidence) or over-consolidation (vibrator trails, segregation, or any other evidence) shall require the immediate stopping of the paving operation and adjustment of the equipment or procedures as approved by the Engineer.

If a lack of consolidation of the hardened concrete is suspected by the Resident Engineer, referee testing may be required. Referee testing of hardened concrete will be performed by the Resident Engineer by cutting cores from the finished pavement after a minimum of 24 hours curing. The Resident Engineer shall visually examine the cores for evidence of lack of consolidation. Density determinations will be made by the Resident Engineer based on the water content of the core as taken. ASTM C642 shall be used for the determination of core density in the saturated-surface dry condition. When required, referee cores will be taken at the minimum rate of one (1) for each 500 cubic yards of pavement, or fraction. The Contractor shall be responsible for all referee testing cost if they fail to meet the required density.

The average density of the cores shall be at least 97% of the original concrete mix density, with no cores having a density of less than 96% of the original concrete mix density. Failure to meet the referee tests will be considered evidence that the minimum requirements for

vibration are inadequate for the job conditions. Additional vibrating units or other means of increasing the effect of vibration shall be employed so that the density of the hardened concrete conforms to the above requirements.

**501-4.9 Strike-off of concrete and placement of reinforcement.** Following the placing of the concrete, it shall be struck off to conform to the cross-section specified in the contract documents and to an elevation that when the concrete is properly consolidated and finished, the surface of the pavement shall be at the elevation specified in the contract documents.

When reinforced concrete pavement is placed in two (2) layers, the bottom layer shall be struck off to such length and depth that the sheet of reinforcing steel fabric or bar mat may be laid full length on the concrete in its final position without further manipulation. Bends or kinks in individual wires, or other irregularities, shall be corrected before the sheet is laid in the pavement. The reinforcement shall then be placed directly upon the concrete, after which the top layer of the concrete shall be placed, struck off, and screed. If any portion of the bottom layer of concrete has been placed more than 20 minutes without being covered with the top layer or if initial set has taken place, it shall be removed and replaced with freshly mixed concrete at the Contractor's expense. When reinforced concrete is placed in one (1) layer, the reinforcement may be positioned in advance of concrete placement or it may be placed in plastic concrete by mechanical or vibratory means after spreading.

Reinforcing steel, at the time concrete is placed, shall be free of mud, oil, paint, grease or other materials that may adversely affect or reduce bond with the concrete. Reinforcing steel with rust, mill scale or a combination of both will be considered satisfactory, provided the minimum dimensions, weight, and tensile properties of a hand wire-brushed test specimen are not less than the applicable specification requirements. All laps between sheets shall be held firmly together by wire or clips spaced four (4) feet or less apart.

**501-4.10 Joints.** Joints shall be constructed as specified in the contract documents. All joints shall be constructed with their faces perpendicular to the surface of the pavement and finished or edged as specified in the contract documents. Joints shall not vary more than one-half (1/2) inch from their designated position and shall be true to line with not more than one-quarter (1/4) inch variation in 16 feet. The surface across the joints shall be tested with a 16-foot straightedge as the joints are finished and any irregularities in excess of one-quarter (1/4) inch shall be corrected before the concrete has hardened. All joints shall be so prepared, finished, or cut to provide a groove of uniform width and depth as specified in the contract documents.

**a. Construction.** Longitudinal construction joints shall be slip-formed or formed against side forms as specified in the contract documents.

Transverse construction joints shall be installed at the end of each day's placing operations and at any other points within a paving lane when concrete placement is interrupted for more than 30 minutes or it appears that the concrete will obtain its initial set before fresh concrete arrives. The installation of the joint shall be located at a planned contraction or expansion joint. If placing of the concrete is stopped, the Contractor shall remove the excess concrete back to the previous planned joint.

**b. Contraction.** Contraction joints shall be installed at the locations and spacing as specified in the contract documents. Contraction joints shall be installed to the dimensions required by forming a groove or cleft in the top of the slab while the concrete is still plastic or by sawing a groove into the concrete surface after the concrete has hardened. When the groove is formed in plastic concrete the sides of the grooves shall be finished even and smooth with an edging tool. If an insert material is used, the installation and edge finish shall be according to the manufacturer's instructions. The groove shall be finished or cut clean so that spalling will be avoided at intersections with other joints. Grooving or sawing shall produce a slot at least one-eighth (1/8) inch wide and to the depth specified in the contract documents.

**c. Isolation (expansion).** Isolation joints shall be installed as specified in the contract documents. The premolded filler of the thickness as specified in the contract documents, shall extend for the full depth and width of the slab at the joint. The filler shall be fastened uniformly along the hardened joint face with no buckling or debris between the filler and the concrete interface, including a temporary filler for the sealant reservoir at the top of the slab. The edges of the joint shall be finished and tooled while the concrete is still plastic

**d. Dowels and tie bars for joints.**

**(1) Tie bars.** Tie bars shall consist of deformed bars installed in joints as specified in the contract documents. Tie bars shall be placed at right angles to the centerline of the concrete slab and shall be spaced at intervals specified in the contract documents. They shall be held in position parallel to the pavement surface and in the middle of the slab depth and within the tolerances specified in the contract documents. When tie bars extend into an unpaved lane, they may be bent against the form at longitudinal construction joints, unless threaded bolt or other assembled tie bars are specified. Tie bars shall not be painted, greased, or enclosed in sleeves. When slip-form operations call for tie bars, two (2) piece hook bolts can be installed.

**(2) Dowel bars.** Dowel bars shall be placed across joints in the proper horizontal and vertical alignment as specified in the contract documents. The dowels shall be coated with a bond-breaker or other lubricant recommended by the manufacturer and approved by the Engineer. Dowels bars at longitudinal construction joints shall be bonded in drilled holes.

**(3) Placing dowels and tie bars.** Horizontal spacing of dowels shall be within a tolerance of  $\pm 3/4$  inch. The vertical location on the face of the slab shall be within a tolerance of  $\pm 1/2$  inch. The method used to install dowels shall ensure that the horizontal and vertical alignment will not be greater than one-quarter ( $1/4$ ) inch per foot, except for those across the crown or other grade change joints. Dowels across crowns and other joints at grade changes shall be measured to a level surface. Horizontal alignment shall be checked perpendicular to the joint edge. The portion of each dowel intended to move within the concrete or expansion cap shall be wiped clean and coated with a thin, even film of lubricating oil or light grease before the concrete is placed. Dowels shall be installed as specified in the following subparagraphs.

Dowels and tie bars shall not be placed closer than 0.6 times the dowel bar or tie bar length to the planned joint line. If the last regularly spaced longitudinal dowel and/or tie bar is closer than that dimension, it shall be moved away from the joint to a location 0.6 times the dowel bar and/or tie bar length, but not closer than six (6) inches to its nearest neighbor.

**(a) Contraction joints.** Dowels and tie bars in longitudinal and transverse contraction joints within the paving lane shall be held securely in place by means of rigid metal frames or basket assemblies of an approved type. The basket assemblies shall be held securely in the proper location by means of suitable pins or anchors. Do not cut or crimp the dowel basket tie wires.

At the Contractor's option, dowels and tie bars in contraction joints may be installed by insertion into the plastic concrete using approved equipment and procedures per the paver manufacturer's design. Approval of installation methods will be based on the results showing that the dowels and tie bars are installed within specified tolerances as verified by cores or non-destructive rebar location devices such as the MIT scanner, Pachometer, R-Meter, or approved equivalent and as approved by the Engineer.

**(b) Construction joints.** Install dowels and tie bars by the cast-in- place or the drill-and-dowel method. Installation by removing and replacing in preformed holes will

not be permitted. Dowels and tie bars shall be prepared and placed across joints where indicated, correctly aligned, and securely held in the proper horizontal and vertical position during placing and finishing operations, by means of devices fastened to the forms.

**(c) Joints in hardened concrete.** Install dowels in hardened concrete by bonding the dowels into holes drilled into the concrete. The concrete shall have cured for seven (7) days or reached a minimum flexural strength of 450 pounds per square inch or compressive strength of 3,100 pounds per square inch before drilling begins. Holes one-eighth (1/8) inch greater in diameter than the dowels shall be drilled into the hardened concrete using rotary-core drills. Rotary-percussion drills may be used, provided that excessive spalling does not occur. Spalling beyond the limits of the grout retention ring will require modification of the equipment and operation. Depth of dowel hole shall be within a tolerance of  $\pm 1/2$  inch of the dimension specified in the contract documents. On completion of the drilling operation, the dowel hole shall be blown out with oil-free, compressed air. Dowels shall be bonded in the drilled holes using epoxy resin. Epoxy resin shall be injected at the back of the hole before installing the dowel and extruded to the collar during insertion of the dowel so as to completely fill the void around the dowel. Application by buttering the dowel will not be permitted. The dowels shall be held in alignment at the collar of the hole by means of a suitable metal or plastic grout retention ring fitted around the dowel.

**e. Sawing of joints.** Sawing shall commence, without regard to day or night, as soon as the concrete has hardened sufficiently to permit cutting without chipping, spalling, or tearing and before uncontrolled shrinkage cracking of the pavement occurs and shall continue without interruption until all joints have been sawn. All slurry and debris produced in the sawing of joints shall be removed by vacuuming and washing. Curing compound or system shall be reapplied in the initial saw-cut and maintained for the remaining cure period.

Joints shall be cut in locations as specified in the contract documents. The initial joint cut shall be a minimum one-eighth (1/8) inch wide and to the depth specified in the contract documents. Prior to placement of joint sealant or seals, the top of the joint shall be widened by sawing as specified in the contract documents.

**501-4.11 Finishing.** Finishing operations shall be a continuing part of placing operations starting immediately behind the strike-off of the paver. Initial finishing shall be provided by the transverse screed or extrusion plate. The sequence of operations shall be transverse finishing, longitudinal machine floating if used, straightedge finishing, edging of joints, and then texturing. Finishing shall be by the machine method. The hand method shall be used only on isolated areas of odd slab widths or shapes and in the event of a breakdown of the mechanical finishing equipment. Supplemental hand finishing for machine finished pavement shall be kept to an absolute minimum. Any machine finishing operation which requires appreciable hand finishing, other than a moderate amount of straightedge finishing, shall be immediately stopped and proper adjustments made, or the equipment replaced. Equipment, mixture, and/or procedures which produce more than one-quarter (1/4) inch of mortar-rich surface shall be immediately modified as necessary to eliminate this condition or operations shall cease. Compensation shall be made for surging behind the screeds or extrusion plate and settlement during hardening and care shall be taken to ensure that paving and finishing machines are properly adjusted so that the finished surface of the concrete (not just the cutting edges of the screeds) will be at the required line and grade. Finishing equipment and tools shall be maintained clean and in an approved condition. At no time shall water be added to the surface of the slab with the finishing equipment or tools, or in any other way. Fog (mist) sprays or other surface applied finishing aids specified to prevent

plastic shrinkage cracking, approved by the Engineer, may be used in accordance with the manufacturer's requirements.

- a. **Machine finishing with slipform pavers.** The slipform paver shall be operated so that only a very minimum of additional finishing work is required to produce pavement surfaces and edges meeting the specified tolerances. Any equipment or procedure that fails to meet these specified requirements shall immediately be replaced or modified as necessary. A self-propelled non-rotating pipe float may be used while the concrete is still plastic, to remove minor irregularities and score marks. Only one (1) pass of the pipe float shall be allowed. Equipment, mixture, and/or procedures which produce more than one-quarter (1/4) inch of mortar-rich surface shall be immediately modified as necessary to eliminate this condition or operations shall cease. Remove excessive slurry from the surface with a cutting straightedge and wipe off the edge. Any slurry which does run down the vertical edges shall be immediately removed by hand, using stiff brushes or scrapers. No slurry, concrete or concrete mortar shall be used to build up along the edges of the pavement to compensate for excessive edge slump, either while the concrete is plastic or after it hardens.
- b. **Machine finishing with fixed forms.** The machine shall be designed to straddle the forms and shall be operated to screed and consolidate the concrete. Machines that cause displacement of the forms shall be replaced. The machine shall make only one (1) pass over each area of pavement. If the equipment and procedures do not produce a surface of uniform texture, true to grade, in one (1) pass, the operation shall be immediately stopped and the equipment, mixture, and procedures adjusted as necessary.
- c. **Other types of finishing equipment.** Clary screeds, other rotating tube floats, or bridge deck finishers are not allowed on mainline paving but may be allowed on irregular or odd-shaped slabs, and near buildings or trench drains, subject to the Engineer's approval.

Bridge deck finishers shall have a minimum operating weight of 7,500 pounds and shall have a transversely operating carriage containing a knock-down auger and a minimum of two (2) immersion vibrators. Vibrating screeds or pans shall be used only for isolated slabs where hand finishing is permitted as specified, and only where specifically approved.

- d. **Hand finishing.** Hand finishing methods will not be permitted, except under the following conditions: (1) in the event of breakdown of the mechanical equipment, hand methods may be used to finish the concrete already deposited on the grade and (2) in areas of narrow widths or of irregular dimensions where operation of the mechanical equipment is impractical.
- e. **Floating.** After the concrete has been struck off, consolidated, and finished, it shall be further smoothed and trued, by means of an approved float, using one (1) of the following methods.
  - (1) **Mechanical longitudinal float method.** The forward speed shall be adjusted so that the float will lap the distance specified by the Engineer on each transverse trip. The float shall pass over each area of pavement at least two (2) times, without excessive operation over a given area. Excess water or soupy material shall be wasted over the side on each pass.
  - (2) **Concrete finisher float method.** Excessively wet mortar shall be wasted over the side on each pass.
  - (3) **Hand method.** The ten (10) foot, hand-operated, longitudinal float shall be used parallel to the centerline and passed gradually from one (1) side of the pavement to the other to fill depressions or cut down high areas. Movement ahead along the centerline of the pavement shall be in successive advances of five (5) feet or less. Any excess mortar shall be wasted over the side forms on each pass. Floating shall continue until the entire

surface is found to be free from variations and the slab conforms to the required grade and cross section.

If necessary, following one (1) of the preceding methods of floating, long handled floats having blades at least three (3) feet in length and six (6) inches in width may be used to smooth and fill in open-textured areas in the pavement, but shall not be used to float the entire surface of the pavement in lieu of, or supplementing one (1) of the preceding methods of floating.

- f. Straightedge testing and surface correction.** After the pavement has been struck off and while the concrete is still plastic, it shall be tested for trueness with a 12 or 16-foot finishing straightedge swung from handles capable of spanning at least one-half (1/2) the width of the slab. The straightedge shall be held in contact with the surface in successive positions parallel to the centerline and the whole area gone over from one (1) side of the slab to the other, as necessary. Advancing shall be in successive stages of not more than one-half (1/2) the length of the straightedge. Any excess water and laitance in excess of one-eighth (1/8) inch thick shall be removed from the surface of the pavement and wasted. Any depressions shall be immediately filled with freshly mixed concrete, struck off, consolidated, and refinished. High areas shall be cut down and refinished. Special attention shall be given to assure that the surface across joints meets the smoothness requirements. Straightedge testing and surface corrections shall continue until the entire surface is found to be free from observable departures from the straightedge and until the slab conforms to the required grade and cross-section. The use of long-handled wood floats shall be confined to a minimum; they may be used only in emergencies and in areas not accessible to finishing equipment.
- g. Edging.** After longitudinal floating, straight edging, and before the final finish, the edges of the pavement shall be carefully finished with an edging tool having a radius of one-quarter (1/4) inch and the pavement edge left smooth and true to line.

**501-4.12 Surface texture.** The surface of the pavement shall be finished as designated below for all newly constructed concrete pavements. It is important that the texturing equipment not tear or unduly roughen the pavement surface during the operation. The texture shall be uniform in appearance and approximately 1/16 inch in depth. Any imperfections resulting from the texturing operation shall be corrected to the satisfaction of the Resident Engineer.

- a. Brush or broom finish.** Shall be applied when the water sheen has practically disappeared. The equipment shall operate transversely across the pavement surface.
- b. Burlap drag finish.** Burlap, at least 15 ounces per square yard, will typically produce acceptable texture. To obtain a textured surface, the transverse threads of the burlap shall be removed approximately one (1) foot from the trailing edge. A heavy buildup of grout on the burlap threads produces the desired wide sweeping longitudinal striations on the pavement surface.
- c. Artificial turf finish.** Shall be applied by dragging the surface of the pavement in the direction of concrete placement with an approved full-width drag made with artificial turf. The leading transverse edge of the artificial turf drag will be securely fastened to a lightweight pole on a traveling bridge. At least two (2) feet of the artificial turf shall be in contact with the concrete surface during dragging operations. Approval of the artificial turf will be done only after it has been demonstrated by the Contractor to provide a satisfactory texture. One (1) type that has provided satisfactory texture consists of 7,200 approximately 0.85-inch long polyethylene turf blades per square foot.

**501-4.13 Curing.** Immediately after finishing operations are completed and bleed water is gone from the surface, all exposed surfaces of the newly placed concrete shall be cured for a seven (7) day cure period in accordance with one (1) of the methods below. Failure to provide sufficient cover material of whatever kind the Contractor may elect to use, or lack of water to adequately take



care of both curing and other requirements, shall be cause for immediate suspension of concreting operations. The concrete shall not be left exposed for more than one-half (1/2) hour during the curing period.

When a two-saw-cut method is used to construct the contraction joint, the curing compound shall be applied to the saw-cut immediately after the initial cut has been made. The sealant reservoir shall not be sawed until after the curing period has been completed. When the one (1) cut method is used to construct the contraction joint, the joint shall be cured with wet rope, wet rags, or wet blankets. The rags, ropes, or blankets shall be kept moist for the duration of the curing period.

- a. **Waterproof paper method.** The surface of the concrete shall be covered with waterproof paper as soon as the concrete has hardened sufficiently to prevent marring the surface. The surface of the concrete shall be wetted immediately before the paper is placed. The blankets shall be lapped at least 12 inches end to end, and these laps shall be securely weighted with a windrow of earth, or other approved method, to form a closed joint. The same requirements shall apply to the longitudinal laps where separate strips are used for curing edges, except the lap shall be at least nine (9) inches. The edges of the blanket shall be weighted securely with a continuous windrow of earth or any other means satisfactory to the Resident Engineer to provide an air-tight cover. Any torn places or holes in the paper shall be repaired immediately by patches cemented over the openings, using a bituminous cement having a melting point of not less than 180°F. The blankets may be reused, provided they are air-tight and kept serviceable by proper repairs.

A longitudinal pleat shall be provided in the blanket to permit shrinkage where the width of the blanket is sufficient to cover the entire surface. The pleat will not be required where separate strips are used for the edges. Joints in the blanket shall be sewn or cemented together in such a manner that they will not separate during use.

- b. **White burlap-polyethylene sheeting method.** The surface of the concrete shall be entirely covered with white polyethylene sheeting as soon as the concrete has hardened sufficiently to prevent marring the surface. The surface of the concrete shall be wetted immediately before the sheeting is placed. The sheeting used shall be such length (or width) that it will extend at least twice the thickness of the pavement beyond the edges of the slab. The sheeting shall be placed so that the entire surface and both edges of the slab are completely covered. The sheeting shall be placed and weighted securely with a continuous windrow of earth or any other means satisfactory to the Resident Engineer to provide an air-tight cover. Adjoining sheets shall overlap not less than 12 inches and the laps shall be securely weighted with earth, or any other means satisfactory to the Engineer, to provide an air-tight cover. The covering shall be maintained fully saturated and in position for seven (7) days after the concrete has been placed. Any tears or holes in the sheeting shall be repaired. When sheets are no longer serviceable as a single unit, the Contractor may select from such sheets and reuse those which will serve for further applications, provided two (2) sheets are used as a single unit; however, the double sheet units will be rejected when the Resident Engineer deems that they no longer provide an air tight cover.
- c. **Wetted burlap method.** The surface of the concrete shall be entirely covered with wetted burlap blankets as soon as the concrete has hardened sufficiently to prevent marring the surface. The blankets shall overlap six (6) inches. At least two (2) layers of wetted burlap shall be placed on the finished surface. The burlap shall be kept saturated by means of a mechanically operated sprinkling system. In place of the sprinkling system, at the Contractor's option, two (2) layers of burlap covered with impermeable covering shall be used. The burlap shall be kept saturated with water. Plastic coated burlap may be substituted for one (1) layer of burlap and impermeable covering. The blankets shall be placed so that they are in contact with the edges of the concrete, and that portion of the material in contact with the edges shall be kept saturated with water. The material shall be

maintained fully saturated and in position for seven (7) days. When the forms are stripped, the vertical walls shall also be kept moist. It shall be the responsibility of the Contractor to prevent ponding of the curing water on the subbase.

- d. Membrane curing method.** Membrane curing will not be permitted between November 1 and April 15. Membrane curing will not be permitted where a protective coat, concrete sealer, or waterproofing is to be applied, or at areas where rubbing or a normal finish is required, or at construction joints other than those necessary in pavement or base course.

After all finishing work to the concrete surface has been completed, it shall be sealed with membrane curing compound of the type specified within ten (10) minutes. The seal shall be maintained for the specified curing period. The edges of the concrete shall, likewise, be sealed within ten (10) minutes after the forms are removed. Two (2) separate applications, applied at least one (1) minute apart, each at the rate of not less than one (1) gallon per 250 square feet will be required upon the surfaces and edges of the concrete. These applications shall be made with the mechanical equipment specified. The curing compound shall be agitated immediately before and during the application.

At locations where the coating is discontinuous or where pin holes show or where the coating is damaged due to any cause and on areas adjacent to sawed joints, immediately after sawing is completed, an additional coating of membrane curing compound shall be applied at the above specified rate. The equipment used may be of the same type as that used for coating variable widths of pavement. Before the additional coating is applied adjacent to sawed joints, the cut faces of the joint shall be protected by inserting a suitable flexible material in the joint or placing an adhesive width of impermeable material over the joint, or by placing the permanent sealing compound in the joint. Material, other than the permanent sealing compound, used to protect cut faces of the joint, shall remain in place for the duration of the curing period. In lieu of applying the additional coating, the area of the sawed joint may be cured according to any other method permitted.

When rain occurs before an application of membrane curing compound has dried, and the coating is damaged, the Engineer may require another application be made in the same manner and at the same rate as the original coat. The Engineer may order curing by another method specified, if unsatisfactory results are obtained with membrane curing compound.

- e. Wetted cotton mat method.** After the surface of concrete has been textured or finished, it shall be covered immediately with dry or damp cotton mats. The cotton mats shall be placed in a manner which will not mar the concrete surface. A texture resulting from the cotton mat material is acceptable. The cotton mats shall then be wetted immediately and thoroughly soaked with a gentle spray of water.

The cotton mats shall be maintained in a wetted condition until the concrete has hardened sufficiently to place soaker hoses without marring the concrete surface. The soaker hoses shall be placed on top of the cotton mats at a maximum four (4) foot spacing. The cotton mats shall be kept wet with a continuous supply of water for the remainder of the curing period. Other continuous wetting systems may be used if approved by the Engineer.

After placement of the soaker hoses, the cotton mats shall be covered with white polyethylene sheeting or burlap-polyethylene blankets.

Soaker hoses or a continuous wetting system will not be required if the alternative method keeps the cotton mats wet. Periodic wetting of the cotton mats is acceptable.

The curing covering for each day's paving shall be removed to permit testing of the pavement surface with a profilograph or straightedge, as directed by the Resident Engineer.

Immediately after testing, the surface of the pavement shall be wetted thoroughly, and the curing coverings replaced. The top surface and the edges of the concrete shall not be left unprotected for a period of more than one-half (1/2) hour.

When the official National Weather Service forecast for the construction area predicts a low of 32°F, or lower, or if the actual temperature drops to 32°F, or lower, concrete less than 72 hours old shall be provided at least the following protection.

### Materials for Curing

Minimum Temperature °F	Protection
25-32	Two (2) layers of polyethylene sheeting, one (1) layer of polyethylene and one (1) layer of burlap, or two (2) layers of waterproof paper.
Below 25	6 inches of straw covered with one (1) layer of polyethylene sheeting or waterproof paper.

These protective covers shall remain in place until the concrete is at least 96 hours old. When straw is required on pavement cured with membrane curing compound, the compound shall be covered with a layer of burlap, polyethylene sheeting, or waterproof paper before the straw is applied.

After September 15, there shall be available to the work within four (4) hours, sufficient clean, dry straw to cover at least two (2) days production. Additional straw shall be provided as needed to afford the protection required. Regardless of the precautions taken, the Contractor shall be responsible for protection of the concrete placed and any concrete damaged by cold temperatures shall be removed and replaced.

**501-4.14 Concrete protection for cold weather.** When concrete is placed at temperatures below 40°F when measured in accordance with ASTM C1064, the Contractor shall provide satisfactory methods and means to protect the mix from injury by freezing. The aggregates, or water, or both, shall be heated to place the concrete at temperatures between 50°F and 90°F.

After the concrete has been placed, the Contractor shall provide sufficient protection to enclose and maintain the temperature of the mix at not less than 50°F until at least 60% of the designed strength has been attained. Additional cold weather concreting recommendations can be found in ACI 306R, *Cold Weather Concreting*. If concrete is to be placed under cold weather conditions, the Contractor shall submit the proposed materials and methods for review and approval by the Engineer. The proposed materials and methods shall meet the requirements of Illinois Department of Transportation, Aeronautics Policy Memorandum (PM) 2001-1, *Requirements for Cold Weather Concreting*.

The Contractor shall be responsible for the quality and strength of the concrete placed during cold weather; and any concrete damaged shall be removed and replaced at the Contractor's expense.

**501-4.15 Concrete protection for hot weather.** Concrete shall be properly placed and finished with procedures previously submitted. The concrete-placing temperature shall not exceed 90°F when measured in accordance with ASTM C1064. Cooling of the mixing water and aggregates, or both, may be required to obtain an adequate placing temperature. A retarder meeting the requirements of paragraph 501-2.7 titled ADMIXTURES may be used to facilitate placing and finishing. Steel forms and reinforcement shall be cooled prior to concrete placement when steel temperatures are greater than 120°F. Conveying and placing equipment shall be cooled if necessary, to maintain proper concrete-placing temperature. Additional hot weather concreting recommendations can be found in ACI 305R, *Hot Weather Concreting*. If concrete is to be placed under hot weather conditions, the Contractor shall submit the proposed materials and methods for review and approval by the Engineer.

**501-4.16 Removing forms.** Unless otherwise specified, forms shall not be removed from freshly placed concrete until it has set at least 12 hours and it has hardened sufficiently to permit removal

without chipping, spalling, or tearing. Forms shall be removed carefully avoiding damage to the pavement. After the forms have been removed, the sides of the slab shall be cured in accordance with paragraph 501-4.13 titled CURING.

If honeycombed areas are evident when the forms are removed, materials, placement, and consolidation methods must be reviewed, and appropriate adjustments made to assure adequate consolidation at the edges of future concrete placements. Honeycombed areas that extend into the slab less than approximately one (1) inch shall be repaired with an approved grout, as directed by the Resident Engineer. Honeycombed areas that extend into the slab greater than a depth of one (1) inch shall be considered as defective work and shall be removed and replaced.

**501-4.17 Saw-cut grooving.** If specified in the contract documents, grooved surfaces shall be provided in accordance with the requirements of Item 621 titled SAW-CUT GROOVES.

**501-4.18 Sealing joints.** The joints in the pavement shall be sealed in accordance with Item 604 titled COMPRESSION JOINT SEALS FOR CONCRETE PAVEMENTS or Item 605 titled JOINT SEALANTS FOR PAVEMENTS.

**501-4.19 Protection of pavement.** The Contractor shall protect the pavement and its appurtenances against both public traffic and traffic caused by the Contractor's employees and agents until accepted by the Engineer. This shall include watchmen to direct traffic and the erection and maintenance of warning signs, lights, pavement bridges, crossovers, and protection of unsealed joints from intrusion of foreign material, etc. Any damage to the pavement occurring prior to final acceptance shall be repaired or the pavement replaced at the Contractor's expense.

Aggregates, rubble, or other similar construction materials shall not be placed on airfield pavements. Traffic shall be excluded from the new pavement by erecting and maintaining barricades and signs until the concrete is at least seven (7) days old, or for a longer period if directed by the Resident Engineer.

In paving intermediate lanes between newly paved pilot lanes, operation of the hauling and paving equipment will be permitted on the new pavement after the pavement has been cured for seven (7) days, the joints are protected, the concrete has attained a minimum field cured flexural strength of 450 pounds per square inch or a compressive strength of 3,100 pounds per square inch, and the slab edge is protected.

All new and existing pavement carrying construction traffic or equipment shall be kept clean and spillage of concrete and other materials shall be cleaned up immediately.

Damaged pavements shall be removed and replaced at the Contractor's expense. Slabs shall be removed to the full depth, width, and length of the slab.

**501-4.20 Opening to construction traffic.** The pavement shall not be opened to traffic until test specimens molded and cured in accordance with AASHTO T 23 have attained a flexural strength of 450 pounds per square inch) when tested in accordance with AASHTO T 177 or a compressive strength a 3,100 pounds per square inch when tested in accordance with AASHTO T 22. If such tests are not conducted, the pavement shall not be opened to traffic until 14 days after the concrete was placed. Prior to opening the pavement to construction traffic, all joints shall either be sealed or protected from damage to the joint edge and intrusion of foreign materials into the joint. As a minimum, backer rod or tape may be used to protect the joints from foreign matter intrusion.

**501-4.21 Repair, removal, or replacement of slabs.** New pavement slabs that are broken or contain cracks or are otherwise defective or unacceptable as defined by acceptance criteria in paragraph 501-6.6 titled ACCEPTANCE CRITERIA shall be removed and replaced or repaired, as directed by the Engineer, at the Contractor's expense. Spalls along joints shall be repaired as specified. Removal of partial slabs is not permitted. Removal and replacement shall be full depth, shall be full width of the slab, and the limit of removal shall be normal to the paving lane

and to each original transverse joint. The Engineer will determine whether cracks extend full depth of the pavement and may require cores to be drilled on the crack to determine depth of cracking. Such cores shall have a diameter of two (2) inches to four (4) inches, shall be drilled by the Contractor and shall be filled by the Contractor with a well consolidated concrete mixture bonded to the walls of the hole with a bonding agent, using approved procedures. Drilling of cores and refilling holes shall be at no the Contractor's expense. Repair of cracks as described in this section shall not be allowed if in the opinion of the Engineer the overall condition of the pavement indicates that such repair is unlikely to achieve an acceptable and durable finished pavement. No repair of cracks shall be allowed in any panel that demonstrates segregated aggregate with an absence of coarse aggregate in the upper one-eighth (1/8) inch of the pavement surface.

- a. **Shrinkage cracks.** Shrinkage cracks which do not exceed one-third (1/3) of the pavement depth shall be cleaned and either high molecular weight methacrylate (HMWM) applied; or epoxy resin (Type IV, Grade 1) pressure injected using procedures recommended by the manufacturer and approved by the Engineer. Sandblasting of the surface may be required following the application of HMWM to restore skid resistance. Care shall be taken to ensure that the crack is not widened during epoxy resin injection. All epoxy resin injection shall take place in the presence of the Resident Engineer. Shrinkage cracks which exceed one-third (1/3) the pavement depth shall be treated as full depth cracks.
- b. **Slabs with cracks through interior areas.** Interior area is defined as that area more than six (6) inches from either adjacent original transverse joint. The full slab shall be removed and replaced at the Contractor's expense, when there are any full depth cracks, or cracks greater than one-third (1/3) the pavement depth, that extend into the interior area.
- c. **Cracks close to and parallel to joints.** All full-depth cracks within six (6) inches either side of the joint and essentially parallel to the original joints, shall be treated as follows.
  - (1) **Full depth cracks and original joint not cracked.** The full-depth crack shall be treated as the new joint and the original joint filled with an epoxy resin.
    - (a) **Full-depth crack.** The joint sealant reservoir for the crack shall be formed by sawing to a depth of 3/4 inch  $\pm$  1/16 inch and to a width of 5/8 inch  $\pm$  1/8 inch. The crack shall be sawed with equipment specially designed to follow random cracks. Any equipment or procedure which causes raveling or spalling along the crack shall be modified or replaced to prevent raveling or spalling. The joint shall be sealed with sealant in accordance with Item 605 titled JOINT SEALANTS FOR PAVEMENTS or as directed by the Engineer.
    - (b) **Original joint.** If the original joint sealant reservoir has been sawed out, the reservoir and as much of the lower saw cut as possible shall be filled with epoxy resin, Type IV, Grade 2, thoroughly tooled into the void using approved procedures.

If only the original narrow saw cut has been made, it shall be cleaned and pressure injected with epoxy resin, Type IV, Grade 1, using approved procedures.

Where a parallel crack goes part way across paving lane and then intersects and follows the original joint which is cracked only for the remained of the width, it shall be treated as specified above for a parallel crack, and the cracked original joint shall be prepared and sealed as originally designed.
  - (2) **Full depth cracks and original joint cracked.** If there is any place in the lane width where a parallel crack and a cracked portion of the original joint overlap, the entire slab containing the crack shall be removed and replaced.
- d. **Removal and replacement of full slabs.** Make a full depth cut perpendicular to the slab surface along all edges of the slab with a concrete saw cutting any dowels or tie-bars. Remove damaged slab protecting adjacent pavement from damage. Damage to adjacent

slabs may result in removal of additional slabs as directed by the Engineer at the Contractor's expense.

The underlying material shall be repaired, re-compacted and shaped to grade.

Dowels of the size and spacing specified for other joints in similar pavement on the project shall be installed along all four (4) edges of the new slab in accordance with paragraph 501-4.10 titled JOINTS.

Placement of concrete shall be as specified for original construction. The joints around the new slab shall be prepared and sealed as specified for original construction.

**e. Spalls along joints.**

(1) Spalls less than one (1) inch wide and less than the depth of the joint sealant reservoir, shall be filled with joint sealant material.

(2) Spalls larger than one (1) inch and/or deeper than the joint reservoir, but less than one-half (1/2) the slab depth, and less than 25% of the length of the adjacent joint shall be repaired as follows:

(a) Make a vertical saw cut at least one (1) inch outside the spalled area and to a depth of at least two (2) inches. Saw cuts shall be straight lines forming rectangular areas surrounding the spalled area.

(b) Remove unsound concrete and at least one-half (1/2) inch of visually sound concrete between the saw cut and the joint or crack with a light chipping hammer.

(c) Clean cavity with high-pressure water jets supplemented with compressed air as needed to remove all loose material.

(d) Apply a prime coat of epoxy resin, Type III, Grade I, to the dry, cleaned surface of all sides and bottom of the cavity, except any joint face.

(e) Fill the cavity with low slump concrete or mortar or with epoxy resin concrete or mortar.

(f) An insert or other bond-breaking medium shall be used to prevent bond at all joint faces.

(g) A reservoir for the joint sealant shall be sawed to the dimensions required for other joints, or as required to be routed for cracks. The reservoir shall be thoroughly cleaned and sealed with the sealer specified for the joints.

(3) Spalls deeper than one-half (1/2) of the slab depth or spalls longer than 25% of the adjacent joint require replacement of the entire slab.

**f. Diamond grinding.** Diamond grinding shall be completed prior to pavement grooving. Diamond grinding of the hardened concrete should not be performed until the concrete is at least 14 days old and has achieved full minimum strength. Equipment that causes ravels, aggregate fractures, spalls or disturbance to the joints will not be permitted. The depth of diamond grinding shall not exceed one-half (1/2) inch and all areas in which diamond grinding has been performed will be subject to the final pavement thickness tolerances specified.

Diamond grinding shall be performed with a machine specifically designed for diamond grinding capable of cutting a path at least three (3) feet wide. The saw blades shall be one-eighth (1/8) inch wide with sufficient number of flush cut blades that create grooves between 0.090 and 0.130 inches wide; and peaks and ridges approximately 1/32 inch higher than the bottom of the grinding cut. The Contractor shall determine the number and type of blades based on the hardness of the aggregate. Contractor shall demonstrate to the Engineer that

the grinding equipment will produce satisfactory results prior to making corrections to surfaces.

Grinding will be tapered in all directions to provide smooth transitions to areas not requiring grinding. The slurry resulting from the grinding operation shall be continuously removed and the pavement left in a clean condition. All grinding shall be at the expense of the Contractor.

### CONTRACTOR QUALITY CONTROL (QC)

- 501-5.1 Quality control program.** The Contractor shall develop a Quality Control Program in accordance with Item 100 titled CONTRACTOR QUALITY CONTROL PROGRAM (CQCP). No partial payment will be made for materials that are subject to specific quality control requirements without an approved quality control program.
- 501-5.2 Contractor quality control (CQC).** The Contractor shall provide or contract for testing facilities in accordance with Item 100 titled CONTRACTOR QUALITY CONTROL PROGRAM (CQCP). The Engineer shall be permitted unrestricted access to inspect the Contractor's QC facilities and witness QC activities. The Engineer will advise the Contractor in writing of any noted deficiencies concerning the QC facility, equipment, supplies, or testing personnel and procedures. When the deficiencies are serious enough to be adversely affecting the test results, the incorporation of the materials into the work shall be suspended immediately and will not be permitted to resume until the deficiencies are satisfactorily corrected.
- 501-5.3 Contractor QC testing.** The Contractor shall perform all QC tests necessary to control the production and construction processes applicable to this specification and as set forth in the CQCP. The testing program shall include, but not necessarily be limited to, tests for aggregate gradation, aggregate moisture content, slump, and air content. A QC Testing Plan shall be developed and approved by the Engineer as part of the CQCP.

The Resident Engineer may at any time, notwithstanding previous plant acceptance, reject and require the Contractor to dispose of any batch of concrete mixture which is rendered unfit for use due to contamination, segregation, or improper slump. Such rejection may be based on only visual inspection. In the event of such rejection, the Contractor may take a representative sample of the rejected material in the presence of the Resident Engineer, and if it can be demonstrated in the laboratory, in the presence of the Resident Engineer, that such material was erroneously rejected, payment will be made for the material at the contract unit price.

**a. Fine aggregate.**

- (1) Gradation.** A sieve analysis shall be made at least twice daily in accordance with the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 11-08, *Aggregate Gradation Control System (AGCS)* from randomly sampled material taken from the discharge gate of storage bins or from the conveyor belt.
- (2) Moisture content.** At least two (2) moisture tests shall be made per day. The Contractor shall determine the percent moisture (Above Saturated Surface Dry Moisture) by the *Adjusted Oven Dry Method*, ITP 301, *Fine Aggregate Moisture Content by the Flask Method*, ITP 302, *Aggregate Specific Gravity and Moisture Content by the Dunagan Method*, or ITP 303, *Fine or Coarse Aggregate Moisture Content by Pycnometer Jar Method*.
- (3) Deleterious substances.** Fine aggregate as delivered to the mixer shall be tested for deleterious substances in fine aggregate for concrete prior to production of the test batch, and a minimum of every 30 days during production or more frequently as necessary to control deleterious substances.

**b. Coarse aggregate.**

(1) **Gradation.** A sieve analysis shall be made at least twice daily for each size of aggregate. Tests shall be made in accordance with the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 11-08, *Aggregate Gradation Control System (AGCS)* from randomly sampled material taken from the discharge gate of storage bins or from the conveyor belt.

(2) **Moisture content.** At least two (2) moisture tests shall be made per day. The Contractor shall determine the percent moisture (Above Saturated Surface Dry Moisture) by the *Adjusted Oven Dry Method*, ITP 301, *Fine Aggregate Moisture Content by the Flask Method*, ITP 302, *Aggregate Specific Gravity and Moisture Content by the Dunagan Method*, or ITP 303, *Fine or Coarse Aggregate Moisture Content by Pycnometer Jar Method*.

(3) **Deleterious substances.** Coarse aggregate as delivered to the mixer shall be tested for deleterious substances in coarse aggregate for concrete prior to production of the test batch, and a minimum of every 30 days during production or more frequently as necessary to control deleterious substances.

c. **Slump.** One (1) test shall be made for each subplot. Slump tests shall be performed in accordance with AASHTO T 119 from material randomly sampled from material discharged from trucks at the paving site. Material samples shall be taken in accordance with AASHTO R 60.

d. **Air content.** One (1) test shall be made for each subplot. Air content tests shall be performed in accordance with AASHTO T 152 for gravel and stone coarse aggregate and AASHTO T 196 for slag or other porous coarse aggregate, from material randomly sampled from trucks at the paving site. Material samples shall be taken in accordance with AASHTO R 60.

e. **Unit weight and Yield.** One (1) test shall be made for each subplot. Unit weight and yield tests shall be in accordance with AASHTO T 121. The samples shall be taken in accordance with AASHTO R 60 and at the same time as the air content tests.

f. **Temperatures.** Temperatures shall be checked at least four (4) times per lot at the job site in accordance with ASTM C1064.

g. **Documentation.** The free moisture for each aggregate shall be determined daily and completed on form AER 6, *Concrete Moisture Determination (Adjusted Oven Dry Method)*. From this data, the JMF shall be adjusted for moisture and verified on form AER 12, *Concrete Batch Weight Calculations*. The Contractor and the Resident Engineer shall complete form AER 4, *Concrete Plant Production Mix Verification* a minimum of two (2) times each day of production, to be done on random loads and independent of each other. The Contractor shall complete form AER 15, *PCC Testing Summary* for each paving day. All forms are to be submitted to the Resident Engineer before payment can be made.

**h. Smoothness for contractor quality control.**

The Contractor shall perform smoothness testing in transverse and longitudinal directions daily to verify that the construction processes are producing pavement with variances less than one-quarter (1/4) inch in 16 feet, identifying areas that may pond water which could lead to hydroplaning of aircraft. If the smoothness criterion is not met, appropriate changes and corrections to the construction process shall be made by the Contractor before construction continues

The Contractor may use a 12 or 16-foot straightedge or a profile testing device approved by the Engineer. Straight-edge testing shall start with one-half (1/2) the length of the straightedge at the edge of pavement section being tested and then moved ahead one-half (1/2) the length of the straightedge for each successive measurement. Testing shall be



continuous across all joints. The surface irregularity shall be determined by placing the freestanding (unleveled) straightedge on the pavement surface and allowing it to rest upon the two (2) highest spots covered by its length, and measuring the maximum gap between the straightedge and the pavement surface in the area between the two (2) high points. If an external reference device is used, the data may be evaluated using the FAA profile program, ProFAA, or FHWA ProVal, using the 12-foot straightedge simulation function.

Smoothness readings shall not be made across grade changes or cross slope transitions. The transition between new and existing pavement shall be evaluated separately for conformance with the contract documents.

**(1) Transverse measurements.** Transverse measurements shall be taken for each day's production placed. Transverse measurements shall be taken perpendicular to the pavement centerline each 50 feet or more often as determined by the Resident Engineer. The joint between lanes shall be tested separately to facilitate smoothness between lanes.

**(2) Longitudinal measurements.** Longitudinal measurements shall be taken for each day's production placed. Longitudinal tests shall be parallel to the centerline of paving; at the center of paving lanes when widths of paving lanes are less than 20 feet; and at the third points of paving lanes when widths of paving lanes are 20 feet or greater.

Deviations on the final surface course in either the transverse or longitudinal direction that will trap water greater than one-quarter (1/4) inch shall be corrected with diamond grinding or by removing and replacing the surface course to full depth. Grinding shall be tapered in all directions to provide smooth transitions to areas not requiring grinding. All areas in which diamond grinding has been performed shall be subject to the final pavement thickness tolerances.

Control charts shall be kept to show area of each day's placement, and the percentage of corrective grinding required. Corrections to production and placement shall be initiated when corrective grinding is required. If the Contractor's machines and/or methods produce significant areas that need corrective actions in excess of 10% of a day's production, production shall be stopped until corrective measures are implemented by the Contractor.

i. **Grade.** Grade shall be evaluated prior to and after placement of the concrete surface.

Measurements will be taken at appropriate grade lines (as a minimum at center and edges of paving lane) and longitudinal spacing as shown on cross-sections and plans. The final surface of the pavement will not vary from the grade line elevations and cross-sections specified in the contract documents by more than 0.05 feet vertically and 0.1 feet laterally. The documentation will be provided by the Contractor to the Resident Engineer by the end of the following working day.

Areas with humps or depressions that exceed grade or smoothness and that retain water on the surface must be ground off provided the course thickness after grinding is not more than one-half (1/2) inch less than the thickness specified in the contract documents. If these areas cannot be corrected with grinding, then the slabs that are retaining water must be removed and replaced. All corrections will be at the Contractors expense.

**501-5.4 Control charts.** The Contractor shall maintain linear control charts for fine and coarse aggregate gradation, slump, and air content. The Contractor shall also maintain a control chart plotting the coarseness factor/workability factor from the combined gradations.

Control charts shall be posted in a location satisfactory to the Resident Engineer and shall be kept up to date at all times. As a minimum, the control charts shall identify the project number, the contract item number, the test number, each test parameter, the action and suspension limits, or specification limits, applicable to each test parameter, and the Contractor's test results. The Contractor shall use the control charts as part of a process control system for identifying

potential problems and assignable causes before they occur. If the Contractor's projected data during production indicates a potential problem and the Contractor is not taking satisfactory corrective action, the Engineer may halt production or acceptance of the material.

- a. **Fine and coarse aggregate gradation.** The Contractor shall record the running average of the last five (5) gradation tests for each control sieve on linear control charts. Superimposed on the control charts shall be the action and suspension limits. The Contractor shall take at least two (2) samples per lot to check the final gradation. Sampling and testing shall be per the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 11-08, *Aggregate Gradation Control System (AGCS)* from the flowing aggregate stream or conveyor belt.
- b. **Slump, air content, and temperature.** The Contractor shall maintain linear control charts both for individual measurements and range (that is, difference between highest and lowest measurements) for slump, air content, and temperature in accordance with the following Action and Suspension Limits.
- c. **Combined gradation.** The Contractor shall maintain a control chart plotting the coarseness factor (CF) and workability factor (WF) on a chart.

#### Control Chart Limits<sup>1</sup>

Control Parameter	Individual Measurements	
	Action Limit	Suspension Limit
Gradation <sup>2</sup>	*3	*3
Coarseness Factor (CF)	±3.5	±5
Workability Factor (WF)	±2	±3
Slump	+0.5 to -1 inch	+1 to -1.5 inch
Air Content	±1.5%	±2.0%
Temperature	≥ 85 °F <sup>4</sup>	> 90 °F

1. Control charts shall be developed and maintained for each control parameter indicated.
2. Control charts shall be developed and maintained for each sieve size.
3. Action and suspension limits shall be determined by the Contractor.
4. Add an approved retarding admixture

**501-5.5 Corrective action at suspension limit.** The CQCP shall indicate that appropriate action shall be taken when the process is believed to be out of control. The CQCP shall detail what action will be taken to bring the process into control and shall contain sets of rules to gauge when a process is out of control. As a minimum, a process shall be deemed out of control and corrective action taken if any one (1) of the following conditions exists.

- a. **Fine and coarse aggregate gradation.** When two (2) consecutive averages of five (5) tests are outside of the suspension limits, immediate steps, including a halt to production, shall be taken to correct the grading.
- b. **Coarseness and workability factor.** When the coarseness factor (CF) or workability factor (WF) reaches the applicable suspension limits, the Contractor, immediate steps, including a halt to production, shall be taken to correct the CF and WF.
- c. **Fine and coarse aggregate moisture content.** Whenever the moisture content of the fine or coarse aggregate changes by more than 0.5%, the scale settings for the aggregate batcher and water batcher shall be adjusted.

- d. **Slump.** The Contractor shall halt production and make appropriate adjustments whenever:
- (1) one (1) point falls outside the suspension limit line for individual measurements
  - OR
  - (2) two (2) points in a row fall outside the action limit line for individual measurements.
- e. **Air content.** The Contractor shall halt production and adjust the amount of air-entraining admixture whenever:
- (1) one (1) point falls outside the suspension limit line for individual measurements
  - OR
  - (2) two (2) points in a row fall outside the action limit line for individual measurements.
- f. **Temperature.** The Contractor shall halt production and make appropriate adjustments whenever:
- (1) one (1) point falls outside the suspension limit line for individual measurements
  - OR
  - (2) two (2) points in a row fall outside the action limit line for individual measurements.

#### MATERIAL ACCEPTANCE

- 501-6.1 Quality assurance (QA) acceptance sampling and testing.** All acceptance sampling and testing necessary to determine conformance with the requirements specified in this section, with the exception of coring for thickness determination, will be performed by the Resident Engineer. The Contractor shall provide adequate facilities for the initial curing of beams. The Contractor shall bear the cost of providing initial curing facilities and coring and filling operations.

The samples will be transported while in the molds. The curing, except for the initial cure period, will be accomplished using the immersion in saturated lime water method. During the 24 hours after molding, the temperature immediately adjacent to the specimens must be maintained in the range of 60° to 80°F, and loss of moisture from the specimens must be prevented. The specimens may be stored in tightly constructed wooden boxes, damp sand pits, temporary buildings at construction sites, under wet burlap in favorable weather, or in heavyweight closed plastic bags, or using other suitable methods, provided the temperature and moisture loss requirements are met.

- 501-6.2 Quality assurance (QA) testing laboratory.** Quality assurance testing organizations performing these acceptance tests will be accredited in accordance with AASHTO Materials Reference Laboratory (AMRL). The quality assurance laboratory accreditation must be current and listed on the accrediting authority's website. All test methods required for acceptance sampling and testing must be listed on the lab accreditation. A copy of the laboratory's current accreditation and accredited test methods will be submitted to the Engineer prior to start of construction.

- 501-6.3 Lot size.** Concrete will be accepted for strength and thickness on a lot basis. A standard lot will consist of a one (1) day's production not to exceed 1,200 cubic yards. Each lot will be divided into approximately equal sublots with individual sublots equivalent to 300 cubic yards of concrete. A lot shall consist of the average of four (4) subplot samples but shall not exceed six (6) sublots. The minimum number of sublots per lot shall be three (3). Where three (3) sublots are produced, they will constitute a lot. Where one (1) or two (2) sublots are produced, they will be incorporated into the previous or next lot. Where more than one (1) plant is simultaneously producing concrete for the job, the lot sizes will apply separately for each plant.

**501-6.4 Partial lots.** When operational conditions cause a lot to be terminated before the specified number of tests have been made for the lot or for overages or minor placements to be considered as partial lots, the following procedure will be used to adjust the lot size and the number of tests for the lot.

Where three (3) sublots have been produced, they will constitute a lot. The final lot may thus contain up to six (6) sublots. The final subplot of the project shall only be separated into an additional subplot if the quantity is greater than or equal to 150 cubic yards of concrete or more. Otherwise, this quantity shall be incorporated into the previous subplot and the lot shall be calculated with the remaining sublots. Where one (1) or two (2) sublots have been produced, they will be incorporated into the next lot or the previous lot and the total number of sublots will be used in the acceptance criteria calculation, that is,  $n=5$  or  $n=6$ .

**501-6.5 Acceptance sampling and testing.**

**a. Strength.**

(1) **Sampling.** A minimum of one (1) sample will be taken for each subplot from the concrete delivered to the job site. Random sampling locations will be determined by the Resident Engineer. The concrete will be sampled in accordance with AASHTO R 60.

(2) **Test specimens.** The Resident Engineer will be responsible for the casting, initial curing, transportation, and curing of specimens in accordance with AASHTO T 23. Two (2) specimens will be made from each sample and slump, air content, unit weight, and temperature tests will be conducted for each set of strength specimens. Additional test samples shall be taken for testing at three (3), seven (7), and 14 days until such time as the Engineer is satisfied that the concrete production, sampling and testing is under control. The Engineer may require additional tests to maintain Quality Control. Within 24 to 48 hours, the samples will be transported from the field to the laboratory while in the molds. Samples will be cured in saturated lime water.

The strength of each specimen will be determined in accordance with AASHTO T 177 for flexural strength or AASHTO T 22 for compressive strength. The strength for each subplot will be computed by averaging the results of the two (2) test specimens representing that subplot.

(3) **Acceptance.** Acceptance of pavement for strength will be determined by the Engineer in accordance with paragraph 501-6.6 titled ACCEPTANCE CRITERIA. All individual strength tests within a lot will be checked for outliers in accordance with ASTM E178, at a significance level of 5%. Outliers will be discarded, and the remaining test values will be used to determine acceptance in accordance with paragraph 501-6.6 titled ACCEPTANCE CRITERIA.

**b. Pavement thickness.**

(1) **Sampling.** One (1) core will be taken by the Contractor for each subplot in the presence of the Resident Engineer. Random sampling locations will be determined by the Resident Engineer. Areas, such as thickened edges, with planned variable thickness, will be excluded from sample locations.

Cores shall be a minimum four (4) inches in diameter neatly cut with a core drill. The Contractor will furnish all tools, labor, and materials for cutting samples and filling the cored hole. Core holes will be filled by the Contractor with a non-shrink grout approved by the Engineer within one (1) day after sampling.

(2) **Testing.** The thickness of the cores will be determined by the Resident Engineer by the average caliper measurement in accordance with ASTM C174. Each core shall be photographed, and the photograph included with the test report.

- (3) **Acceptance.** Acceptance of pavement for thickness will be determined by the Resident Engineer in accordance with paragraph 501-6.6 titled ACCEPTANCE CRITERIA.

**501-6.6 Acceptance criteria.**

- a. **General.** Acceptance will be based on the implementation of the Contractor Quality Control Program (CQCP) and the following characteristics of the completed pavements:

- (1) Strength
- (2) Thickness
- (3) Grade
- (4) Profilograph smoothness

- (a) Profilograph smoothness and acceptance only apply when the overall project is a new or reconstructed runway or taxiway greater than 500 feet in length. Profilograph roughness is not applicable to aprons and should be used with caution on projects to rehabilitate runways and/or taxiways unless the project includes provisions to correct existing deficiencies.

- (5) Adjustments for repairs

Strength and thickness will be evaluated for acceptance on a lot basis using the method of estimating PWL. Production quality must achieve 90 PWL or higher to receive full payment. The PWL will be determined in accordance with procedures specified in Item 110 titled METHOD OF ESTIMATING PERCENTAGE WITHIN SPECIFICATION LIMITS (PWL).

The lower specification tolerance limit (L) for strength and thickness will be:

**Lower Specification Tolerance Limit (L)**

<b>Strength</b>	0.93 × strength specified in paragraph 501-3.3 titled CONCRETE MIX PROPORTIONS
<b>Thickness</b>	Lot Plan Thickness in inches, - 0.50 in

- b. **Acceptance criteria.**

- (1) **Strength.** If the PWL of the lot equals or exceeds 90%, the lot will be acceptable.

Where the project has multiple small placements or the total project size is less than 2,000 cubic yards, the use of percent within limits (PWL) is not appropriate and acceptable material will be paid for by the cubic yard. The strength for each subplot shall be computed by averaging the results of that subplot. When subplot strength equals or exceeds the strength as specified in paragraph 501-3.3 titled CONCRETE MIX PROPORTIONS, the lot will be acceptable.

Acceptance and payment for the lot will be determined in accordance with paragraph 501-8.1 titled BASIS OF PAYMENT.

- (2) **Thickness.** If the PWL of the lot equals or exceeds 90%, the lot will be acceptable.

Where the project has multiple small placements or the total project size is less than 2,000 cubic yards, the use of percent within limits (PWL) is not appropriate and acceptable material will be paid for by the cubic yard. If subplot thickness is less than one-half (1/2) inch from plan thickness, the lot will be acceptable.

- (3) **Grade.** The final finished surface of the pavement of the completed project shall be surveyed to verify that the grade elevations and cross-sections specified in the contract documents do not deviate more than 0.05 feet vertically or 0.1 feet laterally.

Cross-sections of the pavement shall be taken at a minimum 50 foot longitudinal spacing and at all longitudinal grade breaks. Minimum cross-section grade points shall include grade at centerline,  $\pm 10$  feet of centerline, and edge of pavement.

The survey and documentation shall be stamped and signed by a professional licensed surveyor. Payment for sublots that do not meet grade for over 25% of the subplot shall be reduced by 5% and not be more than 95%.

- (4) Profilograph roughness for QA acceptance.** The final profilograph shall be the full length of the project to facilitate testing of roughness between lots. The Contractor, in the presence of the Resident Engineer shall perform a profilograph roughness test on the completed project with a profilograph as specified in paragraph 501-4.2 titled EQUIPMENT. Data and results shall be provided within 48 hours of profilograph roughness tests.

The pavement shall have an average profile index less than 15 inches per mile per one-tenth (1/10) mile. The equipment shall utilize electronic recording and automatic computerized reduction of data to indicate "must grind" bumps and the Profile Index for the pavement using a 0.2-inch blanking band. The bump template must span one (1) inch with an offset of 0.4 inches. The profilograph must be calibrated prior to use and be certified through the Profile Equipment Verification (PEV) Program administered by the Department. Profilograms shall be recorded on a longitudinal scale of one (1) inch equals 25 feet and a vertical scale of one (1) inch equals one (1) inch. Profilograph shall be performed one (1) foot right and left of project centerline and 15 feet right and left of project centerline. Any areas that indicate "must grind" shall be corrected with diamond grinding or by removing and replacing full depth of surface course, as directed by the Engineer. Where corrections are necessary, a second profilograph run shall be performed to verify that the corrections produced an average profile index of 15 inches per mile per one-tenth (1/10) mile or less.

- (5) Adjustments for repair.** Sublots with spall repairs, crack repairs, or partial panel replacement, will be limited to no more than 95% payment.
- (6) Adjustment for grinding.** For sublots with grinding over 25% of a subplot, payment will be reduced 5%.

#### METHOD OF MEASUREMENT

- 501-7.1** The quantity of cement concrete pavement shall be measured for payment by the number of square yards of either plain or reinforced pavement as specified, completed and accepted by the Resident Engineer.
- 501-7.2** The test batch shall be measured for payment by the number of each unit as specified, completed, and accepted by the Resident Engineer.

#### BASIS OF PAYMENT

- 501-8.1** Payment for accepted quantities of work performed by the Contractor and measured by the Resident Engineer shall be made at the contract unit price as specified in paragraph 501-7.1 of this section adjusted based on results of strength, thickness, repairs grinding, and smoothness. Payment shall be full compensation for all labor, materials, tools, equipment, and incidentals required to complete the item as specified.
- a. Adjusted payment for strength.** The acceptance of each lot of cement concrete pavement shall be based on the Percentage of Material Within Specification Limits (PWL). The pay

factor for each individual lot shall be calculated in accordance with the Pay Adjustment Schedule table below.

### Pay Adjustment Schedule

Percentage of Materials Within Specification Limits (PWL)	Lot Pay Factor
90 – 100	100
80 – 89.9	0.5 PWL + 55.0
65 – 79.9	2.0 PWL – 65.0
Below 65	Reject <sup>1</sup>

1. The lot shall be removed and replaced unless, after receipt of Department concurrence, the Owner and Contractor agree in writing that the lot will remain; the lot paid at 50% of the contract unit price; and the total project payment limitation reduced by the amount withheld for that lot.

- b. Adjusted payment for thickness.** The acceptance of quantity of cement concrete pavement shall be based on thickness determination. Thickness deficiencies identified during or after placement will be confirmed by coring. The Contractor shall cut three (3) cores per lot to determine the adjustment for thickness. The location of the cores shall be randomly determined by the Resident Engineer. All holes shall be filled by the Contractor with a non-shrink grout approved by the Engineer. All associated costs shall be borne by the Contractor. Where the average thickness of pavement is deficient in thickness by more than 0.2 inch but not more than 1.0 inch, the pay factor for each individual lot shall be calculated in accordance with the table below.

### Pay Adjustment Schedule

Deficiency in Thickness (Average of 3 Tests)	Lot Pay Factor
0.00 – 0.20	100
0.21 – 0.30	80
0.31 – 0.40	72
0.41 – 0.50	68
0.51 – 0.75	57
0.76 – 1.00	50

When the thickness of pavement is deficient by more than one (1) inch and in the judgment of the Engineer the area of such deficiency should not be removed and replaced, there shall be no payment for the area retained. The Contractor may remove such thin pavement and replace it with pavement of the specified thickness. The replacement pavement will be paid for at the contract unit price per square yard and no payment will be made for the thin pavement, which is removed at the Contractor's expense.

- c. Adjusted payment for repairs.** The PWL lot pay factor shall be reduced by 5% and be no higher than 95% for sublots which contain repairs on more than 20% of the slabs within the subplot.
- d. Adjusted payment for grinding.** The PWL lot pay factor shall be reduced by 5% and be no higher than 95% for sublots with grinding over 25% of a subplot.

- e. Profilograph smoothness.** The Contractor will receive full payment when the profilograph average profile index is in accordance with the contract documents. When the final average profile index for the entire length of pavement does not exceed 15 inches per mile per one-tenth (1/10) mile, payment will be made at the contract unit price for the completed pavement.

**501-8.2** Payment for the accepted test batch performed by the Contractor and measured by the Resident Engineer shall be made at the contract unit price as specified in paragraph 501-7.2 of this section. Payment shall be full compensation for all labor, materials, tools, equipment, and incidentals required to complete the item as specified.

## REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

### ASTM International (ASTM)

ASTM A 706	Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM A 775	Standard Specification for Epoxy-Coated Steel Reinforcing Bars
ASTM A 884	Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Reinforcement
ASTM C 87	Standard Test Method for Effect of Organic Impurities in Fine Aggregate on Strength of Mortar
ASTM C 150	Standard Specification for Portland Cement
ASTM C 171	Standard Specification for Sheet Materials for Curing Concrete
ASTM C 174	Standard Test Method for Measuring Thickness of Concrete Elements Using Drilled Concrete Cores
ASTM C 260	Standard Specification for Air-Entraining Admixtures for Concrete
ASTM C 309	Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C 494	Standard Specification for Chemical Admixtures for Concrete
ASTM C 642	Standard Test Method for Density, Absorption, and Voids in Hardened Concrete
ASTM C 1064	Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete
ASTM C 1218	Standard Test Method for Water-Soluble Chloride in Mortar and Concrete
ASTM C 1260	Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)
ASTM C 1293	Standard Test Method for Determination of Length Change of Concrete Due to Alkali-Silica Reaction
ASTM C 1567	Standard Test Method for Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method)
ASTM E 178	Standard Practice for Dealing with Outlying Observations



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ASTM E 190	Standard Test Method for Guided Bend Test for Ductility of Welds
<b>American Association of State Highway and Transportation Officials (AASHTO)</b>	
AMRL	AASHTO Materials Reference Laboratory
AASHTO M 32	Standard Specification for Steel Wire, Plain, for Concrete Reinforcement
AASHTO M 54	Standard Specification for Welded Deformed Steel Bar Mats for Concrete Reinforcement
AASHTO M 55	Standard Method of Test for Steel Welded Wire Reinforcement, Plain, for Concrete
AASHTO M 144	Standard Specification for Calcium Chloride
AASHTO M 154	Standard Specification for Air-Entraining Admixtures for Concrete
AASHTO M 182	Standard Specification for Burlap Cloth Made from Jute or Kenaf and Cotton Mats
AASHTO M 194	Standard Specification for Chemical Admixtures for Concrete
AASHTO M 213	Standard Method of Test for Mass [Weight] of Coating on Aluminum-Coated Iron or Steel Articles
AASHTO M 221	Standard Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete
AASHTO M 227	Standard Specification for Steel Bars, Carbon, Merchant Quality, Mechanical Properties
AASHTO M 295	Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
AASHTO M 302	Standard Specification for Slag Cement for Use in Concrete and Mortars
AASHTO M 307	Standard Specification for Silica Fume Used in Cementitious Mixtures
AASHTO M 321	Standard Specification for High-Reactivity Pozzolans for Use in Hydraulic-Cement Concrete, Mortar, and Grout
AASHTO R 60	Standard Practice for Sampling Freshly Mixed Concrete
AASHTO T 22	Standard Method of Test for Compressive Strength of Cylindrical Concrete Specimens
AASHTO T 23	Standard Method of Test for Making and Curing Concrete Test Specimens in the Field
AASHTO T 26	Standard Method of Test for Quality of Water to Be Used in Concrete
AASHTO T 88	Standard Method of Test for Particle Size Analysis of Soils
AASHTO T 119	Standard Method of Test for Slump of Hydraulic Cement Concrete
AASHTO T 121	Standard Method of Test for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete
AASHTO T 152	Standard Method of Test for Air Content of Freshly Mixed Concrete by the Pressure Method
AASHTO T 155	Standard Method of Test for Water Retention by Liquid Membrane-Forming Curing Compounds for Concrete

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AASHTO T 177	Standard Method of Test for Flexural Strength of Concrete (Using Simple Beam with Center-Point Loading)
AASHTO T 196	Standard Method of Test for Air Content of Freshly Mixed Concrete by the Volumetric Method
AASHTO T 197	Standard Method of Test for Time of Setting of Concrete Mixtures by Penetration Resistance
AASHTO T 260	Standard Method of Test for Sampling and Testing for Chloride Ion in Concrete and Concrete Raw Materials

**American Concrete Institute (ACI)**

ACI 305R	Guide to Hot Weather Concreting
ACI 306R	Guide to Cold Weather Concreting

**Illinois Department of Transportation, Bureau of Materials Illinois Laboratory Test Procedure (ITP)**

*Manual of Test Procedures for Materials*

AASHTO T 11	Illinois Modified, Standard Method of Test for Materials Finer Than 75- $\mu$ m (No. 200) Sieve in Mineral Aggregates by Washing
ITP 19	Bulk Density ("Unit Weight") and Voids in Aggregate

*Manual of Aggregate Quality Test Procedures*

ITP 21	Organic Impurities in Fine Aggregates for Concrete
AASHTO T 96	Illinois Modified, Standard Method of Test for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
AASHTO T 104	Illinois Modified, Standard Method of Test for Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate
AASHTO T 113	Illinois Modified, Standard Method of Test for Lightweight Pieces in Aggregate
ITP 161	Resistance of Concrete to Rapid Freezing and Thawing
ITP 203	Deleterious Particles in Coarse Aggregate
ITP 301	Fine Aggregate Moisture Content by Flask Method
ITP 302	Aggregate Specific Gravity and Moisture Content by Dunagan Method
ITP 303	Fine or Coarse Aggregate Moisture Content by Pycnometer Jar Method

**Illinois Department of Transportation, Bureau of Materials Policy Memoranda (PM)**

PM 11-08	Aggregate Gradation Control System (AGCS)
PM 12-08	Crushed Gravel Producer Self-Testing Program
PM 13-08	Slag Producer Self-Testing Program
PM 16-08	Approval of Concrete Plants and Delivery Trucks
PM 18-08	Acceptance Procedure for Finely Divided Minerals Used in Concrete and Other Applications
PM 20-08	Field Test Procedures for Mixer Performance and Concrete Uniformity Tests

PM 23-08	Welded Wire Reinforcement/Bar Mat Plant Certification Procedure
PM 24-08	Epoxy Coating Plant Certification Procedure
PM 26-08	Reinforcement Bar and/or Dowel Bar Plant Certification Procedure
PM 29-11	Minimum Laboratory Requirements for Alkali-Silica Reactivity (ASR) Testing

**Illinois Department of Transportation, Bureau of Materials Qualified Product List**

Certified ASTM A706 Reinforcing Bar and/or Dowel Bar  
Certified Epoxy Coating Plants  
Certified Welded Wire Reinforcement  
Concrete Admixtures  
Finely Divided Minerals  
Nonshrink Grouts  
Reinforcing Bar Splicer Assemblies and Mechanical Splicers

**Portland Concrete Association (PCA)**

PCA Design and Control of Concrete Mixtures, 16<sup>th</sup> Edition

**Illinois Department of Transportation, Aeronautics Policy Memoranda (PM)**

PM 87-3	Mix Design, Test Batch, Quality Control, and Acceptance Testing of PCC Pavement Mixture
PM 2001-1	Requirements for Cold Weather Concreting

**END ITEM 501**

## Part 8 – Surface Treatments

### Item 608 Emulsified Asphalt Seal Coat

#### DESCRIPTION

- 608-1.1** This item shall consist of the application of an emulsified asphalt surface treatment composed of an emulsion of natural and refined asphalt materials, water and a polymer additive as specified in the contract documents or as directed by the Resident Engineer.

An emulsified asphalt seal coat may be used on taxiways and runways with the application of a suitable aggregate to maintain adequate surface friction; and airfield secondary and tertiary pavements including low-speed taxiways, shoulders, overruns, roads, parking areas, and other general applications with or without aggregate applied.

The terms seal coat, asphalt sealer, and asphalt material are interchangeable throughout this specification. The term emulsified asphalt means an emulsion of natural and refined asphalt materials.

#### MATERIALS

- 608-2.1 Aggregate.** The aggregate material shall be a dry, clean, dust and dirt free, sound, durable, angular shaped manufactured specialty sand, such as that used as an abrasive, with a Mohs hardness of 6 to 8. The Contractor shall submit the specialty sand manufacturer's technical data and a manufacturer's certificate of analysis (COA) indicating that the specialty sand meets the requirements of the specification to the Resident Engineer prior to start of construction. The sand must be approved for use by the Engineer.

#### Aggregate Material Gradation Requirements<sup>1</sup>

Sieve Designation (square openings)	Individual Percentage Retained by Weight
No. 10	0
No. 14	0-4
No. 16	0-8
No. 20	0-35
No. 30	20-50
No. 40	10-45
No. 50	0-20
No. 70	0-5
No. 100	0-2
No. 200	0-2

1. Locally available sand or abrasive material that is slightly outside of the gradation requirements may be approved by the RE with concurrence by the seal coat manufacturer that the proposed aggregate will meet the Item 608 requirement. The RE and manufacturer's field representative should verify acceptance during application of Control strips indicated under paragraph 608-3.2.

**608-2.2 Asphalt emulsion.** The asphalt emulsion shall meet the properties in the following table:

### Concentrated Asphalt Emulsion Properties

Properties	Specification	Limits
Viscosity, Saybolt Furol at 77°F	ASTM D7496	20 – 100 seconds
Residue by Distillation or Evaporation	ASTM D6997 or ASTM D6934	57% minimum
Sieve Test	ASTM D6933	0.1% maximum
24-hour Stability	ASTM D6930	1% maximum
5-day Settlement Test	ASTM D6930	5.0% maximum
Particle Charge <sup>1</sup>	ASTM D7402	Positive 6.5 maximum pH

1. pH may be used in lieu of the particle charge test which is sometimes inconclusive in slow setting, asphalt emulsions.

The asphalt material base residue shall contain not less than 20% gilsonite, or uinitaite and shall not contain any tall oil pitch or coal tar material and shall contain no less than 1% polymer.

### Tests on Residue from Distillation or Evaporation

Properties	Specification	Limits
Viscosity at 275°F	ASTM D4402	1750 cts maximum
Solubility in 1, 1, 1 trichloroethylene	ASTM D2042	97.5% minimum
Penetration	ASTM D5	50 dmm maximum
Asphaltenes	ASTM D2007	15% minimum
Saturates	ASTM D2007	15% maximum
Polar Compounds	ASTM D2007	25% minimum
Aromatics	ASTM D2007	15% minimum

The asphalt emulsion, when diluted in the volumetric proportion of one (1) part concentrated asphalt material to one (1) part hot water or two (2) parts concentrated asphalt material to one (1) part hot water, shall have the following properties:

### One (1)-to-One (1) Dilution Emulsion Properties

Properties	Specification	Limits
<b>In Ready-to-Apply Form, one (1) part concentrate to one (1) part water, by volume</b>		
Viscosity, Saybolt Furol at 77°F	ASTM D7496	5 – 50 seconds
Residue by Distillation or Evaporation	ASTM D6997 or ASTM D6934	28.5% minimum
Pumping Stability <sup>1</sup>		Pass

1. Pumping stability is tested by pumping one (1) pint of seal coat diluted one (1) part concentrate to one (1) part water, at 77°F, through a one-quarter (1/4) inch gear pump operating 1750 revolutions per minute for ten (10) minutes with no significant separation or coagulation.

### Two (2)-to-One (1) Dilution Emulsion Properties

Properties	Specification	Limits
<b>In Ready-to-Apply Form, two (2) parts concentrate to one (1) part water, by volume</b>		
Viscosity, Saybolt Furol at 77°F	ASTM D7496	5 – 50 seconds
Residue by Distillation or Evaporation	ASTM D6997 or ASTM D6934	38% minimum
Pumping Stability <sup>1</sup>		Pass

1. Pumping stability is tested by pumping one (1) pint of seal coat diluted one (1) part concentrate to one (1) part water, at 77°F, through a one-quarter (1/4) inch gear pump operating 1750 revolutions per minute for ten (10) minutes with no significant separation or coagulation.

The Contractor shall provide a copy of the manufacturer's certificate of analysis (COA) for the emulsified asphalt delivered to the project. If the asphalt emulsion is diluted at other than the manufacturer's facility, the Contractor shall provide a supplemental COA from an independent laboratory verifying the asphalt emulsion properties.

The COA shall be provided to and approved by the Engineer before the emulsified asphalt is applied. The furnishing of the vendor's certified test report for the asphalt material shall not be interpreted as a basis for final acceptance. The manufacturer's COA may be subject to verification by testing the material delivered for use on the project.

The asphalt material storage and handling temperature shall be between 50°F-160°F and the material shall be protected from freezing, or whenever outside temperature drops below 40°F for prolonged time periods.

Contractor shall provide a list of airport pavement projects, exposed to similar climate conditions, where this product has been successfully applied within at least five (5) years of the project.

- 608-2.3 Polymer.** The polymer shall meet the properties in the following table:

#### Polymer Properties

Properties	Limits
Solids Content	47% to 65%, Percent by Weight
Weight	8.0 to 9.0 pounds/gallon
pH	3.0 to 8.0
Particle Charge	Nonionic/Cationic
Mechanical Stability	Excellent
Film Forming Temperature, °F	+41°F, minimum
Tg, °F	71°F, maximum

The manufacturer shall provide a copy of the certificate of analysis (COA) for the polymer used in the seal coat; and the Contractor shall include the COA with the emulsified asphalt COA when submitting to the Resident Engineer.

- 608-2.4 Water.** Water used in mixing or curing shall be from potable water sources. Other sources shall be tested in accordance with AASHTO T 26 and must be approved by the Engineer prior to use. Water used in making and diluting the emulsion shall be potable, with a maximum hardness of 90 parts per million calcium and 15 parts per million magnesium; deleterious iron, sulfates, and phosphates maximum seven (7) parts per million, and less than 1 part per million of organic byproducts. Water shall be a minimum of 140°F prior to adding to emulsion.

**608-2.5 Friction characteristics.** Friction test data in accordance with the current Federal Aviation Administration Advisory Circular (AC) 150/5320-12, *Measurement, Construction, and Maintenance of Skid Resistant Airport Pavement Surfaces*, at 40 or 60 miles per hour wet, must include as a minimum; the friction value of pavement surface prior to sealant application; two (2) values, between 24 and 96 hours after application, with a minimum of 24 hours between tests; and one (1) value between 180 days and 360 days after the application. The results of the tests between 24 and 96 hours shall indicate friction is increasing at a rate to obtain similar friction value of the pavement surface prior to application, and the long-term test shall indicate no apparent adverse effect with time relative to friction values and existing pavement surface.

Seal coat material submittals without required friction performance will not be approved. Friction tests performed on this project cannot be used as a substitute of this requirement.

### COMPOSITION AND APPLICATION

**608-3.1 Application rate.** The approximate amounts of material for the asphalt surface treatment shall be as provided in the following table for the treatment area at the specified dilution rate in the contract documents. A dilution rate of one (1) part emulsified asphalt to one (1) part water is recommended for most applications. A dilution rate of two (2) parts emulsified asphalt to one (1) part water is recommended for grooved, rough or course surfaces, or where the pavement is highly oxidized or badly cracked. The actual application rates will vary within the range specified to suit field conditions and will be recommended by the manufacturer's representative and approved by the Engineer from the control strip evaluation.

**Application Rate**

Dilution Rate	Quantity of Emulsion (gal/yd <sup>2</sup> )	Quantity of Aggregate (lb/ yd <sup>2</sup> )
1:1	0.10-0.17	0.20-0.50
2:1	0.08-0.17	0.20-0.50

**608-3.2 Control strip.** Prior to full application, the control strip must be accepted by the Engineer. The surface preparation, personnel, equipment, and method of operation used on the control strip shall be the same as used on the remainder of the work.

A qualified manufacturer's representative shall be present in the field to assist the Contractor in applying the control strip to determine the appropriate application rate of both emulsion and aggregate to be evaluated and approved by the Engineer.

A control strip shall be applied for each differing asphalt pavement surface identified in the project. The control strip shall be used to determine the material application rate of both emulsion and sand prior to full production.

- a. **For taxiway, taxilane and apron surfaces.** The Contractor shall place a control strip at varying application rates as recommended by the manufacturer's representative and acceptable to the Engineer to determine appropriate application rate. The control strip will be located on a representative section of the pavement to receive the asphalt surface treatment designated by the Engineer
- b. **For runway and high-speed exit taxiway surfaces.** The Contractor shall place a control strip a minimum of 300 feet long by 12 feet wide, or width of anticipated application, whichever is greater, at varying application rates as recommended by the manufacturer's representative and acceptable to the Engineer to determine the appropriate application rate.

The control strip should be separated by a minimum of 200 feet between sections. The control strip will be located on a representative section of the pavement to receive the asphalt surface treatment designated by the Engineer. The control strip should be placed under similar field conditions as anticipated for the actual application. The skid resistance of the existing pavement shall be determined for each control strip with a continuous friction measuring equipment (CFME). Before beginning the control strip, the skid resistance of existing pavement can be immediately adjacent to the control strip or at the same location as the control strip if testing prior to application.

The Contractor may begin testing the skid resistance of runway and high-speed exit taxiway control strips after application of the asphalt surface treatment has fully cured, generally eight (8) to 36 hours after application of the control strips depending on site and environmental conditions. Aircraft shall not be permitted on the runway or high-speed exit taxiway control strips until such time as the Contractor validates that its surface friction meets the maintenance planning friction levels in the current Federal Aviation Administration Advisory Circular (AC) 150/5320-12, *Measurement, Construction, and Maintenance of Skid Resistant Airport Pavement Surfaces*, Table 3-2 when tested at speeds of 40 and 60 miles per hour wet with approved CFME.

If the control strip should prove to be unsatisfactory, necessary adjustments to the application rate, placement operations, and equipment shall be made. Additional control strips shall be placed, and additional skid resistance tests performed and evaluated. Full production shall not begin without the Engineer's approval.

### CONSTRUCTION METHODS

**608-4.1 Worker safety.** The Contractor shall obtain a safety data sheet (SDS) for both the asphalt emulsion product and sand and require workmen to follow the manufacturer's recommended safety precautions. All additional industry standard safety precautions regarding the storage and applications of asphalts should be understood and followed by the Contractor.

**608-4.2 Weather limitations.** The asphalt emulsion shall be applied only when the existing pavement surface is dry and when the weather is not foggy, rainy, or the humidity will not allow proper curing, or when the wind velocity will prevent the uniform application of the material. No material shall be applied in strong winds that interfere with the uniform application of the material, or when dust or sand is blowing or when rain is anticipated within eight (8) hours of application completion. The atmospheric temperature and the pavement surface temperature shall both be at, or above 60°F and rising and is expected to remain above 60°F for 24 hours. Seal coat shall not be applied when pavement temperatures are expected to exceed 130°F within the subsequent 72 hours if traffic will be opened on pavement within those 72 hours.

Cover existing buildings, structures, runway edge lights, taxiway edge lights, informational signs, retro-reflective marking and in-pavement duct markers as necessary to protect against overspray before applying the emulsion. Should emulsion get on any light or marker fixture, promptly clean the fixture. If cleaning is not satisfactory to the Resident Engineer, the Contractor shall replace any light, sign or marker with equivalent equipment at the Contractor's expense.

**608-4.3 Equipment and tools.** The Contractor shall furnish all equipment, tools, and machinery necessary for the performance of the work.

**a. Pressure distributor.** The emulsion shall be applied with a manufacturer-approved computer rate-controlled asphalt distributor. The equipment shall be in good working order and contain no contaminants or diluents in the tank. Spray bar tips must be clean, free of burrs, and of a size to maintain an even distribution of the emulsion. Any type of tip or pressure source is suitable that will maintain predetermined flow rates and constant pressure during the application process with application speeds under eight (8) miles per hour or 700 feet per minute. The equipment will be tested under pressure for leaks and to ensure proper set-up before use. The Contractor will provide verification of truck set-up (via



a test-shot area), including but not limited to, nozzle tip size appropriate for application per nozzle manufacturer, spray-bar height and pressure and pump speed appropriate for the viscosity and temperature of sealer material, evidence of triple-overlap spray pattern, lack of leaks, and any other factors relevant to ensure the truck is in good working order before use.

The distributor truck shall be equipped with a 12 foot, minimum, spray bar with individual nozzle control. The distributor truck shall be capable of specific application rates in the range of 0.05 to 0.25 gallons per square yard. These rates shall be computer-controlled rather than mechanical. The distributor truck shall have an easily accessible thermometer that constantly monitors the temperature of the emulsion, and have an operable mechanical tank gauge that can be used to cross-check the computer accuracy.

The distributor truck shall effectively heat and mix the material to the required temperature prior to application in accordance with the manufacturer's recommendations.

The distributor shall be equipped with a hand sprayer to spray the emulsion in areas not accessible to the distributor truck.

- b. Aggregate spreader.** The asphalt distributor truck will be equipped with an aggregate spreader mounted to the distributor truck that can apply sand to the emulsion in a single pass operation without driving through wet emulsion. The aggregate spreader shall be equipped with a variable control system capable of uniformly distributing the sand at the specified rate at varying application widths and speeds. The aggregate spreader must be adjusted to produce an even and accurate application of specified aggregate. Prior to any seal coat application, the aggregate spreader will be calibrated onsite to ensure acceptable uniformity of spread. The Resident Engineer will observe the calibration and verify the results. The aggregate spreader will be re-calibrated each time the aggregate rate is changed either during the application of control strips or production. The Contractor may consult the seal coat manufacturer representative for procedure and guidance. The sander shall have a minimum hopper capacity of 3,000 pounds of sand. Push-type hand sanders will be allowed for use around lights, signs and other obstructions, if necessary.
- c. Power broom/blower.** A power broom and/or blower shall be provided for removing loose material from the surface to be treated.
- d. Equipment calibration.** Asphalt distributors must be calibrated within the same construction season in accordance with ASTM D2995. The Contractor must furnish a current calibration certification for the asphalt distributor truck from any State or other agency as approved by the Engineer.

**608-4.4 Preparation of asphalt pavement surfaces.** Clean the pavement surface immediately prior to placing the seal coat by sweeping, flushing well with water leaving no standing water, or a combination of both, so that it is free of dust, dirt, grease, vegetation, oil or any type of objectionable surface film. Remove oil or grease that has not penetrated the asphalt pavement by scraping or by scrubbing with a detergent, then wash thoroughly with clean water. After cleaning, treat these areas with an oil spot primer. Any additional surface preparation, such as crack repair, shall be in accordance with Item 101, titled PREPARATION/REMOVAL OF EXISTING PAVEMENTS.

- a. New asphalt pavement surfaces.** Allow new asphalt pavement surfaces to cure so that there is no concentration of oils on the surface.

Perform a water-break-free test to confirm that the surface oils have degraded and dissipated. Cast approximately one (1) gallon of clean water out over the surface. The water should sheet out and wet the surface uniformly without crawling or showing oil rings. If signs of crawling or oil rings are apparent on the pavement surface, additional time must be allowed for additional curing and retesting of the pavement surface prior to treatment.

**608-4.5 Emulsion mixing.** The application emulsion shall be obtained by blending asphalt material concentrate, water and polymer, if specified. Always add heated water to the asphalt material concentrate, never add asphalt material concentrate to heated water. Mix one (1) part heated water to one (1) part or two (2) parts asphalt material concentrate by volume as specified in the contract documents.

Add 1% polymer, by volume, to the emulsion mix. If the polymer is added to the emulsion mix at the plant, submit weight scale tickets to the Resident Engineer. As an option, the polymer may be added to the emulsion mix at the job site provided the polymer is added slowly while the asphalt distributor truck circulating pump is running. The mix must be agitated for a minimum of 15 minutes or until the polymer is mixed to the satisfaction of the Resident Engineer.

**608-4.6 Application of asphalt emulsion.** The asphalt emulsion shall be applied using a pressure distributor upon the properly prepared, clean and dry surface at the application rate recommended by the manufacturer's representative and approved by the Engineer from the control strip evaluation for each designated treatment area. The asphalt emulsion should be applied at a temperature between 130°F and 160°F or in accordance with the manufacturer's recommendation. Pavement with excessive surface grade may need to be treated in two (2) applications to achieve the specified application rate.

If low spots and depressions greater than one-half (1/2) inch in depth in the pavement surface cause ponding or puddling of the applied materials, the pavement surface shall be lightly broomed with a broom or brush type squeegee until the pavement surface is free of any pools of excess material.

During all applications, the surfaces of adjacent structures shall be protected to prevent their being spattered or marred.

**608-4.7 Application of aggregate material.** Immediately following the application of the asphalt emulsion, friction sand at the rate recommended by the manufacturer's representative and approved by the Engineer from the control strip evaluation for each designated application area, shall be spread uniformly over the asphalt emulsion in a single-pass operation simultaneous with the sealer application. The aggregate shall be spread to the same width of application as the asphalt material and shall not be applied in such thickness as to cause blanketing.

Sprinkling of additional aggregate material and spraying additional asphalt material over areas that show up having insufficient cover or bitumen, shall be done by hand whenever necessary. In areas where hand work is necessitated, the sand shall be applied before the sealant begins to break.

Minimize aggregate from being broadcast and accumulating on the untreated pavement adjacent to an application pass. Prior to the next application pass, the Contractor shall clean areas of excess or loose aggregate and remove from project site.

### CONTRACTOR QUALITY CONTROL (QC)

**608-5.1 Quality control (QC).** The Contractor shall have a manufacturer's authorized representative on the job site at the beginning of the work and during all emulsified asphalt seal coat applications. The manufacturer's representative shall have knowledge of the material, procedures, and equipment described in the specification and shall be responsible for determining the application rates and shall oversee the preparation and application of the emulsified asphalt seal coat. Documentation of the manufacturer representative's experience and knowledge for applying the emulsified asphalt seal coat product shall be furnished to the Engineer a minimum of ten (10) working days prior to placement of the control strip. The cost of the manufacturer's representative shall be considered incidental to the contract and as a subsidiary obligation of the Contractor.

- 608-5.2 QC plan.** The Contractor must submit a QC plan to the Engineer a minimum of ten (10) days prior to placement of the control strip. The QC plan must address all items that affect the quality of the emulsified asphalt seal coat application including, but not limited to:
- a. Qualifications of personnel.
  - b. Schedule for the project.
  - c. Procedure to monitor the weather/temperature limitations.
  - d. Inspection requirements including emulsified asphalt, control strips, storage of emulsified asphalt, preparation of the pavement surface, and equipment calibration.
  - e. Provisions for obtaining, packaging and shipping acceptance samples and repair of the pavement.
  - f. Provisions for sample testing, testing laboratory name, location, accreditation, contact person, all contact information, testing requested, and report on information.
- 608-5.3 Records.** The Contractor shall maintain an accurate record of each batch of materials used in the formulation of the seal coat and provide the documentation to the Resident Engineer daily.

### MATERIAL ACCEPTANCE

- 608-6.1 Application rate.** The rate of application of the asphalt emulsion shall be verified at least twice per day.
- 608-6.2 Friction tests.** Friction tests in accordance with the current Federal Aviation Administration Advisory Circular (AC) 150/5320-12, *Measurement, Construction, and Maintenance of Skid-Resistant Airport Pavement Surfaces*, shall be performed on all runway and high-speed taxiways that received a seal coat. Each test includes performing friction tests at 40 and 60 miles per hour both wet, 15 feet to each side of the runway centerline with approved continuous friction measuring equipment (CFME). The Contractor shall coordinate testing with the Resident Engineer and provide the Resident Engineer a written report of friction test results. The Resident Engineer shall be present for testing.
- Prior to opening the pavement to aircraft operations, the pavement friction evaluation must be equal or greater than the minimum levels provided in *Table 3-2, "Friction Level Classification for Runway Pavement Surfaces,"* in the current Federal Aviation Administration Advisory Circular (AC) 150/5320-12, *Measurement, Construction, and Maintenance of Skid-resistant Airport Pavement Surfaces*, when tested at speeds of 40 and 60 miles per hour with approved continuous friction measuring equipment (CFME).
- 608-6.3 Freight and waybills.** A weight ticket for each truck load shall be furnished to the Resident Engineer. The truck shall be weighed at a location approved by the Engineer. The ticket shall show the weight of the empty truck (the truck being weighed each time before it is loaded), the weight of the loaded truck, and the net weight of the bituminous material.

### METHOD OF MEASUREMENT

- 608-7.1** The quantity of emulsified asphalt seal coat application shall be measured for payment by the number of square yards as specified, completed, and accepted by the Resident Engineer.
- 608-7.2** The quantity of friction testing shall be per lump sum as specified, completed, and accepted by the Resident Engineer.

### **BASIS OF PAYMENT**

**608-8.1** Payment for accepted quantities of work performed by the Contractor and measured by the Resident Engineer shall be made at the contract unit as specified in paragraphs 608-7.1 through 608-7.2 of this section. Payment shall be full compensation for all surface preparation, furnishing all materials, delivery and application of these materials, for all labor, equipment, tools, and any costs associated with furnishing a qualified manufacturer's representative to assist with control strips, and incidentals necessary to complete the work as specified.

### **REFERENCES**

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

#### **ASTM International (ASTM)**

ASTM D 5	Standard Test Method for Penetration of Asphalt Materials
ASTM D 2007	Standard Test Method for Characteristic Groups in Rubber Extender and Processing Oils and Other Petroleum-Derived Oils by the Clay-Gel Absorption Chromatographic Method
ASTM D 2042	Standard Test Method for Solubility of Asphalt Materials in Trichloroethylene
ASTM D 2995	Standard Practice for Estimating Application Rate of Bituminous Distributors
ASTM D 4402	Standard Test Method for Viscosity Determination of Asphalt at Elevated Temperatures Using a Rotational Viscometer
ASTM D 6930	Standard Test Method for Settlement and Storage Stability of Emulsified Asphalts
ASTM D 6933	Standard Test Method for Oversized Particles in Emulsified Asphalts (Sieve Test)
ASTM D 6934	Standard Test Method for Residue by Evaporation of Emulsified Asphalt
ASTM D 6997	Standard Test Method for Distillation of Emulsified Asphalt
ASTM D 7402	Standard Practice for Identifying Cationic Emulsified Asphalts
ASTM D 7496	Standard Test Method for Viscosity of Emulsified Asphalt by Saybolt Furol Viscometer

#### **American Association of State Highway and Transportation Officials (AASHTO)**

AASHTO T 26	Standard Method of Test for Quality of Water to Be Used in Concrete
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#### **Federal Aviation Administration Advisory Circulars (AC)**

AC 150/5320-12	Measurement, Construction, and Maintenance of Skid-Resistant Airport Pavement Surfaces
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#### **Illinois Department of Transportation, Bureau of Materials Policy Memoranda (PM)**

PM 11-08	Aggregate Gradation Control System (AGCS)
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**END OF ITEM 608**

## Item 608-R Rapid Cure Seal Coat

### DESCRIPTION

**608-R-1.1** This item shall consist of the application of an asphalt surface treatment composed of natural and refined asphalt materials, additives, and light oils as specified in the contract documents or as directed by the Resident Engineer.

A rapid cure seal coat may be used on taxiways and runways with the application of a suitable aggregate to maintain adequate surface friction; and airfield secondary and tertiary pavements including low-speed taxiways, shoulders, overruns, roads, parking areas, and other general applications with or without aggregate applied.

The terms seal coat, asphalt sealer, and asphalt material are interchangeable throughout this specification. The term asphalt means natural and refined asphalt materials in this specification.

### MATERIALS

**608-R-2.1 Aggregate.** The aggregate material shall be a dry, clean, sound, durable, angular shaped, with highly textured surfaces, manufactured specialty abrasive aggregate. It shall have 100% fractured faces, SiO<sub>2</sub> content of 55% minimum, CaO of 3% max, with a sand equivalent greater than 85 and a Mohs hardness of seven (7) or greater. The Contractor shall submit specialty aggregate manufacturer's technical data and a manufacturer's certificate of analysis (COA) indicating that the specialty aggregate meets the requirements of the specification to the Resident Engineer prior to start of construction. The aggregate must be approved for use by the Engineer and shall meet the requirements of the gradation given in the following table when tested per the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 11-08, *Aggregate Gradation Control System (AGCS)*.

### Gradation Requirements

Sieve Size	Gradation Percent Passing
No. 8	100
No. 14	98-100
No. 16	85-100
No. 30	15-45
No. 50	0-8
No. 70	0-2

### Aggregate Characteristics

Test	Standard	Range
Micro-Deval	ASTM D7428	15% max
Magnesium Sulfate Soundness	ASTM C88	2% max
Aggregate Angularity	ASTM C1252 – Test Method A	45% min
Moisture Content (%)	ASTM C566	2% max
Bulk Dry Specific Gravity	ASTM C128	2.6 – 3.0
Absorption (%)	ASTM D2216	3% max
Mohs Hardness	Mohs Scale	7 min

Locally available Department gradations may be blended to meet the aggregate requirements.

**608-R-2.2 Asphalt material.** The asphalt material base residue shall contain not less than 40% gilsonite, or uintaite, and shall not contain any tall oil pitch or coal tar material. The material shall be compatible with asphalt pavement. The solvent-based rapid cure material shall meet the following properties:

#### Properties for Asphalt Sealing Material

Properties	Specification	Limits
Kinematic Viscosity at 140°F	ASTM D4402	10-30 cSt
Percent Residue by Distillation	ASTM D402	30-45%

#### Tests on Residue from Distillation

Properties	Specification	Limits
Penetration at 77°F	ASTM D5	2-12 dmm
Softening Point	ASTM D36	180-200
Solubility in 1,1,1 Trichloroethylene	ASTM D2042	99% min.
HCl Precipitation Value		18-25

The Contractor shall provide a copy of the manufacturer's certificate of analysis (COA) for the asphalt sealer delivered to the project. If the asphalt sealer is diluted at other than the manufacturer's facility, the Contractor shall provide a supplemental COA from an independent laboratory verifying the asphalt sealer properties. The COA shall be provided to and approved by the Engineer before the asphalt material is applied. The furnishing of the vendor's certified test report for the asphalt material shall not be interpreted as a basis for final acceptance. The manufacturer's COA may be subject to verification by testing the material delivered for use on the project.

The asphalt sealing material must be applied in an undiluted form. The material may be stored at ambient temperature for long periods of time if necessary. Storage will follow industry standard recommendations due to the flammability of the material; avoid sparks and open flames to come into contact with the material or any gasses that might be escaping the storage vessel.

**608-R-2.3 Friction characteristics.** Friction test data in accordance with the current Federal Aviation Administration Advisory Circular (AC) 150/5320-12, *Measurement, Construction, and Maintenance of Skid Resistant Airport Pavement Surfaces*, at 40 or 60 miles per hour wet, must include as a minimum; the friction value of pavement surface prior to sealant application; two (2) values, between 24 and 96 hours after application, with a minimum of 24 hours between

tests; and one (1) value between 180 days and 360 days after the application. The results of the tests between 24 and 96 hours shall indicate friction is increasing at a rate to obtain similar friction value of the pavement surface prior to application, and the long-term test shall indicate no apparent adverse effect with time relative to friction values and existing pavement surface.

Seal coat material submittals without required friction performance will not be approved. Friction tests performed on this project cannot be used as a substitute of this requirement.

### COMPOSITION AND APPLICATION

**608-R-3.1 Application rate.** The approximate amounts of material for the asphalt surface treatment shall be as provided in the following table for the treatment area at the specified rate in the contract documents. The actual application rates will vary within the range specified to suit field conditions and will be recommended by the manufacturer's representative and approved by the Engineer from the control strip evaluation.

**Application Rate**

Dilution Rate	Quantity of Sealer (gal/yd <sup>2</sup> )	Quantity of Aggregate (lb/yd <sup>2</sup> )
N/A	0.08-0.15	0.40-0.50

A higher rate is recommended for grooved, rough or course surfaces, or where the pavement is highly oxidized or badly cracked.

**608-R-3.2 Control strip.** Prior to full application, the control strip must be accepted by the Engineer. The surface preparation, personnel, equipment, and method of operation used on the control strip shall be the same as used on the remainder of the work.

A qualified manufacturer's representative shall be present in the field to assist the Contractor in applying the control strip to determine the appropriate application rate of both sealer and aggregate to be evaluated and approved by the Engineer.

If the Engineer has experience and is knowledgeable with the material, procedures, and equipment described in the specification, for control areas described in paragraph 608-R-3.2a, the varying application rates recommended by the manufacturer's representative can be provided from a site visit where the representative observed pavement condition within one month prior to application. A control strip shall be applied for each differing asphalt pavement surface identified in the project. The control strip shall be used to determine the material application rate of both sealer and aggregate prior to full production. The same equipment and method of operation shall be utilized on the control strip as will be utilized on the remainder of the work.

- a. **For taxiway, taxilane and apron surfaces.** Prior to full application, the Contractor shall place control strips at varying application rates as recommended by the Contractor's manufacturer's representative to determine appropriate application rate. The test areas will be located on representative section of the pavement to receive the asphalt surface treatment designated by the Engineer.
- b. **For runway and high-speed exit taxiway surfaces.** Prior to full application, the Contractor shall place a series of control strips a minimum of 300 feet long by 12 feet wide, or width of anticipated application, whichever is greater, at varying application rates as recommended by the manufacturer's representative and acceptable to the Engineer to determine the appropriate application rate. The control strips should be separated by a minimum of 200 feet. The area to be tested will be located on a representative section of the pavement to receive the asphalt surface treatment designated by the Engineer. The control strips should be placed under similar field conditions as anticipated for the actual application. Before

beginning the control strip, the skid resistance of the existing pavement shall be determined for each control strip with a continuous friction measuring equipment (CFME). The skid resistance of existing pavement can be immediately adjacent to the control strip or at the same location as the control strip if testing prior to application.

The Contractor may begin testing the skid resistance of runway and high-speed exit taxiway control strips after application of the asphalt surface treatment has fully cured, generally two (2) to four (4) hours after application of the control strips depending on site conditions. Aircraft shall not be permitted on the runway or high-speed exit taxiway control strips until such time as the Contractor validates that its surface friction meets the maintenance planning friction levels in the current Federal Aviation Administration Advisory Circular (AC) 150/5320-12, *Measurement, Construction, and Maintenance of Skid Resistant Airport Pavement Surfaces*, Table 3-2 when tested at speeds of 40 and 60 miles per hour wet with approved CFME.

If the control strip should prove to be unsatisfactory, necessary adjustments to the application rate, placement operations, and equipment shall be made. Additional control strips shall be placed, and additional skid resistance tests performed and evaluated. Full production shall not begin without the Engineer's approval.

### CONSTRUCTION METHODS

**608-R-4.1 Worker safety.** The Contractor shall obtain a safety data sheet (SDS) for both the asphalt sealer product and aggregate and require workmen to follow the manufacturer's recommended safety precautions. All additional industry standard safety precautions regarding the storage and applications of solvent based asphalts should be understood and followed by the Contractor.

**608-R-4.2 Weather limitations.** The asphalt sealer shall be applied only when the existing pavement surface is dry and when the weather is not foggy, rainy, or the humidity will not allow proper curing, or when the wind velocity will prevent the uniform application of the material. No material shall be applied when dust or aggregate is blowing or when rain is anticipated within four (4) hours of application completion. The atmospheric temperature and the pavement surface temperature shall both be at, or above 55°F and rising. The sealer will shall not be applied when pavement temperatures are expected to exceed 160°F within the subsequent 72 hours if traffic will be opened on pavement within those 72 hours. During application, account for wind drift. Cover existing buildings, structures, runway edge lights, taxiway edge lights, informational signs, retro-reflective marking and in-pavement duct markers as necessary to protect against overspray before applying the sealer. Should sealer get on any light or marker fixture, promptly clean the fixture. If cleaning is not satisfactory to the Resident Engineer, the Contractor shall replace any light, sign or marker with equivalent equipment at the Contractor's expense.

**608-R-4.3 Equipment and tools.** The Contractor shall furnish all equipment, tools, and machinery necessary for the performance of the work.

- a. Pressure distributor.** The sealer shall be applied with a manufacturer-approved computer rate-controlled asphalt distributor. The equipment shall be in good working order and contain no contaminants or diluents in the tank. Spray bar tips must be clean, free of burrs, and of a size to maintain an even distribution of the sealer. Any type of tip or pressure source is suitable that will maintain predetermined flow rates and constant pressure during the application process with application speeds under eight (8) miles per hour or 700 feet per minute. The Contractor will provide verification of truck set-up (via a test-shot area), including but not limited to, nozzle tip size appropriate for application per nozzle manufacturer, spray-bar height and pressure and pump speed appropriate for the viscosity and temperature of sealer material, evidence of triple-overlap spray pattern, lack of leaks, and any other factors relevant to ensure the truck is in good working order before use. The distributor truck shall be equipped with a 12 foot, minimum, spray bar with individual nozzle control. The distributor truck shall be capable of specific application rates in the range of



0.05 to 0.25 gallons per square yard. These rates shall be computer-controlled rather than mechanical. The distributor truck shall have an easily accessible thermometer that constantly monitors the temperature of the sealer and have an operable mechanical tank gauge that can be used to cross-check the computer accuracy.

The distributor truck shall effectively mix the material prior to application.

The distributor shall be equipped with a hand sprayer to spray the sealer in areas not accessible to the distributor truck.

- b. Aggregate spreader.** The asphalt distributor truck will be equipped with an aggregate spreader mounted to the distributor truck that can apply aggregate to the sealer in a single pass operation without driving through wet sealer. The aggregate spreader shall be equipped with a variable control system capable of uniformly distributing the aggregate at the specified rate at varying application widths and speeds. The aggregate spreader must be adjusted to produce an even and accurate application of specified aggregate. Prior to any seal coat application, the aggregate spreader will be calibrated onsite to ensure acceptable uniformity of spread. The Resident Engineer will observe the calibration and verify the results. The aggregate spreader will be re-calibrated each time the aggregate rate is changed either during the application of control strips or production. The Contractor may consult the seal coat manufacturer representative for procedure and guidance. The aggregate spreader shall have a minimum hopper capacity of 3,000 pounds of aggregate. Push-type hand spreaders will be allowed for use around lights, signs and other obstructions, if necessary.
- c. Power broom/blower.** A power broom and/or blower shall be provided for removing loose material from the surface to be treated.
- d. Equipment calibration.** Asphalt distributors must be calibrated within the same construction season in accordance with ASTM D2995. The Contractor must furnish a current calibration certification for the asphalt distributor truck from any State or other agency as approved by the Engineer.

**608-R-4.4 Preparation of asphalt pavement surfaces.** Clean the pavement surface immediately prior to placing the seal coat by sweeping, flushing well with water leaving no standing water, or a combination of both, so that it is free of dust, dirt, grease, vegetation, oil or any type of objectionable surface film. Remove oil or grease that has not penetrated the asphalt pavement by scraping or by scrubbing with a detergent, then wash thoroughly with clean water. After cleaning, treat these areas with an oil spot primer. Any additional surface preparation, such as crack repair, shall be in accordance with Item 101, titled PREPARATION/REMOVAL OF EXISTING PAVEMENTS.

- a. New asphalt pavement surfaces.** Allow new asphalt pavement surfaces to cure so that there is no concentration of oils on the surface. A period of at least 30 days at 70°F daytime temperatures should elapse between the placement of a hot mixed asphalt concrete surface course and the application of the surface treatment.

Perform a water-break-free test to confirm that the surface oils have degraded and dissipated. Cast approximately one (1) gallon of clean water out over the surface. The water should sheet out and wet the surface uniformly without crawling or showing oil rings. If signs of crawling or oil rings are apparent on the pavement surface, additional time must be allowed for additional curing and retesting of the pavement surface prior to treatment.

**608-R-4.5 Application of asphalt sealer.** The asphalt sealer shall be applied using a pressure distributor upon the properly prepared, clean and dry surface at the application rate recommended by the manufacturer's representative and approved by the Engineer from the control strip evaluation for each designated treatment area. Recommended material temperature for application is 70°F to 90°F, but depending on the application equipment used, good material dispersion and pavement coverage may be achieved at lower material temperatures. The material should not be heated above 100°F.

Pavement surfaces which have excessive runoff of seal coat due to excessive amount of material being applied or excessive surface grade shall be treated in two (2) or more applications, if feasible, to the specified application rate at the Contractor's expense. Each additional application shall be performed after the prior application of material has penetrated into the pavement.

If low spots and depressions greater than one-half (1/2) inch in depth in the pavement surface cause ponding or puddling of the applied materials, the pavement surface shall be lightly broomed with a broom or brush type squeegee. Brooming shall continue until the pavement surface is free of any pools of excess material. Ponding and/or puddling shall not cause excessive pavement tackiness and/or additional distress.

During all applications, the surfaces of adjacent structures shall be protected to prevent their being spattered or marred. Asphalt materials shall not be discharged into borrow pits or gutters or on the airport area.

Heating asphalt binders of any kind always constitutes some degree of hazard and caution must be taken. The most hazardous of these are cutback asphalts because of the highly volatile solvents used. Care must be taken not to allow any spark or open flame to come in contact with the cutback asphalt or the gases from cutback asphalt due to the low flash point. It is the Contractor's responsibility to understand and adhere to these standards in regard to staying within the recommended application temperatures of this material and at all times during production.

**608-R-4.6 Application of aggregate material.** Immediately following the application of the asphalt sealer, aggregate at the rate recommended by the manufacturer's representative and approved by the Engineer from the control strip evaluation for each designated application area, shall be spread uniformly over the asphalt sealer in a single-pass operation simultaneous with the sealer application. The sealer material and aggregate shall be applied simultaneously in a single pass operation, so as to not drive through the applied fresh sealer. The aggregate shall be spread to the same width of application as the asphalt material and shall not be applied in such thickness as to cause blanketing.

Sprinkling of additional aggregate material and spraying additional asphalt material over areas that show up having insufficient cover or bitumen, shall be done by hand whenever necessary. In areas where hand work is necessitated, the aggregate shall be applied before the sealant begins to break.

Minimize aggregate from being broadcast and accumulating on the untreated pavement adjacent to an application pass. Prior to the next application pass, the Contractor shall clean areas of excess or loose aggregate and remove from project site.

### CONTRACTOR QUALITY CONTROL (QC)

**608-R-5.1 Quality control (QC).** The Contractor shall have a manufacturer's authorized representative on the job site at the beginning of the work and during all rapid cure seal coat applications. The manufacturer's representative shall have knowledge of the material, procedures, and equipment described in the specification and shall be responsible for determining the application rates and shall oversee the preparation and application of the rapid cure seal coat. Documentation of the manufacturer representative's experience and knowledge for applying the rapid cure seal coat product shall be furnished to the Engineer a minimum of ten (10) working days prior to placement of the control strip. The cost of the manufacturer's representative shall be considered incidental to the contract and a subsidiary obligation of the Contractor.

**608-R-5.2 QC plan.** The Contractor must submit a QC plan to the Engineer a minimum of ten (10) days prior to placement of the control strip. The QC plan must address all items that affect the quality of the rapid cure seal coat application including, but not limited to:

- a. Qualifications of personnel.

- b. Schedule for the project.
- c. Procedure to monitor the weather/temperature limitations.
- d. Inspection requirements including asphalt material, control strips, storage of asphalt material, preparation of the pavement surface, and equipment calibration.
- e. Provisions for obtaining, packaging and shipping acceptance samples and repair of the pavement.
- f. Provisions for sample testing, testing laboratory name, location, accreditation, contact person, all contact information, testing requested, and report on information.

**608-R-5.3 Records.** The Contractor shall maintain an accurate record of each batch of materials used in the formulation of the seal coat and provide the documentation to the Resident Engineer daily.

### MATERIAL ACCEPTANCE

**608-R-6.1 Application rate.** The rate of application of the asphalt emulsion shall be verified at least twice per day.

**608-R-6.2 Friction tests.** Friction tests in accordance with the current Federal Aviation Administration Advisory Circular (AC) 150/5320-12, *Measurement, Construction, and Maintenance of Skid-Resistant Airport Pavement Surfaces*, shall be accomplished on all runway and high-speed taxiways that have received a seal coat. Each test includes performing friction tests at 40 and 60 miles per hour both wet, 15 feet to each side of the runway centerline. The Contractor shall coordinate testing with the Resident Engineer and provide the Resident Engineer a written report of friction test results. The Resident Engineer shall be present for testing.

Prior to opening the pavement to aircraft operations, the pavement friction evaluation must be equal or greater than the minimum levels provided in *Table 3-2, "Friction Level Classification for Runway Pavement Surfaces,"* in the current Federal Aviation Administration Advisory Circular (AC) 150/5320-12 (AC) 150/5320-12, *Measurement, Construction, and Maintenance of Skid-resistant Airport Pavement Surfaces*, when tested at speeds of 40 and 60 miles per hour with approved continuous friction measuring equipment (CFME).

**608-R-6.3 Freight and waybills.** A weight ticket for each truck load shall be furnished to the Resident Engineer. The truck shall be weighed at a location approved by the Engineer. The ticket shall show the weight of the empty truck (the truck being weighed each time before it is loaded), the weight of the loaded truck, and the net weight of the bituminous material.

### METHOD OF MEASUREMENT

**608-R-7.1** The quantity of rapid cure seal coat application shall be measured for payment by the number of square yards as specified, completed, and accepted by the Resident Engineer.

**608-R-7.2** The quantity of friction testing shall be per lump sum as specified, completed, and accepted by the Resident Engineer.

### BASIS OF PAYMENT

**608-R-8.1** Payment for accepted quantities of work performed by the Contractor and measured by the Resident Engineer shall be made at the contract unit price as specified in paragraphs 608-R-7.1 through 608-R-7.2 of this section. Payment shall be full compensation for all surface preparation, furnishing all materials, delivery and application of these materials, for all labor, equipment, tools, and any costs associated with furnishing a qualified manufacturer's representative to assist with control strips, and incidentals necessary to complete the work as specified.

## REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

### ASTM International (ASTM)

ASTM C 88	Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C 128	Standard Test Method for Relative Density (Specific Gravity) and Absorption of Fine Aggregate
ASTM C 566	Standard Test Method for Total Evaporable Moisture Content of Aggregate by Drying
ASTM C 1252	Standard Test Methods for Uncompacted Void Content of Fine Aggregate
ASTM D 5	Standard Test Method for Penetration of Asphalt Materials
ASTM D 36	Standard Test Method for Softening Point of Bitumen (Ring-and-Ball Apparatus)
ASTM D 402	Standard Test Method for Distillation of Cutback Asphalt
ASTM D 2042	Standard Test Method for Solubility of Asphalt Materials in Trichloroethylene
ASTM D 2216	Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
ASTM D 2995	Standard Practice for Estimating Application Rate of Bituminous Distributors
ASTM D 4402	Standard Test Method for Viscosity Determination of Asphalt at Elevated Temperatures Using a Rotational Viscometer
ASTM D 7428	Standard Test Method for Resistance of Fine Aggregate to Degradation by Abrasion in the Micro-Deval Apparatus

### Federal Aviation Administration Advisory Circulars (AC)

AC 150/5320-12	Measurement, Construction, and Maintenance of Skid-Resistant Airport Pavement Surfaces
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### Illinois Department of Transportation, Bureau of Materials Policy Memoranda (PM)

PM 11-08	Aggregate Gradation Control System (AGCS)
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**END OF ITEM 608-R**

## Item 609 Chip Seal Coat

### DESCRIPTION

If specified, a chip seal coat may be used on airfield tertiary pavements including overruns, roads, and other general applications which are not subject to routine turbo-prop and jet engine aircraft.

- 609-1.1** This item shall consist of a chip seal coat as a wearing course composed of a single or multiple applications of asphalt material and aggregate cover placed on the prepared primed base or properly cured wearing surface as specified in the contract documents or as directed by the Resident Engineer.

A chip seal coat may leave excessive amounts of loose aggregate on the surface of the pavement and therefore is only recommended for use on pavements other than airfield pavements. This treatment may be used on airfield tertiary pavements including overruns, roads, and other general applications which are not subject to routine turbo-prop and jet engine aircraft.

### MATERIALS

- 609-2.1 Aggregate.** Coarse aggregate shall consist of sound, tough, durable particles and fragments of stone or gravel, crushed stone, crushed gravel, crushed slag, or crushed concrete, free from films of matter that would prevent thorough coating and bonding with the asphalt material and free from organic matter and other deleterious substances. Materials shall be handled and stored in accordance with all federal, state, and local requirements.

The natural and manufactured materials used as coarse aggregate are defined as follows.

- a. **Gravel.** Gravel shall be the coarse granular material resulting from the reduction of rock by the action of the elements and having subangular to rounded surfaces. It may be partially crushed.
- b. **Crushed stone.** Crushed stone shall be the angular fragments resulting from crushing undisturbed, consolidated deposits of rock by mechanical means. Crushed stone shall be divided into the following, when specified.
  - (1) **Carbonate crushed stone.** Carbonate crushed stone shall be either dolomite or limestone. Dolomite shall contain 11.0% or more magnesium oxide (MgO). Limestone shall contain less than 11.0% magnesium oxide (MgO).
  - (2) **Crystalline crushed stone.** Crystalline crushed stone shall be either metamorphic or igneous stone, including but is not limited to, quartzite, granite, rhyolite and diabase.
- c. **Crushed gravel.** Crushed gravel shall be the product resulting from crushing, by mechanical means, and shall consist entirely of particles obtained by crushing gravel. The acceptance and use of crushed gravel shall be according to the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 12-08 *Crushed Gravel Producer Self-Testing Program*.
- d. **Crushed slag.** Crushed slag shall be the graded product resulting from the processing of air-cooled blast furnace slag. Air-cooled blast furnace slag shall be the nonmetallic product, consisting essentially of silicates and aluminosilicates of lime and other bases, which is

developed in a molten condition simultaneously with iron in a blast furnace. It shall be air-cooled and shall have a compact weight (ITP 19) of not less than 70 pounds per cubic foot. The acceptance and use of air-cooled blast furnace slag shall be according to the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 13-08, *Slag Producer Self-Testing Program*.

- e. **Crushed concrete.** Crushed concrete shall be the angular fragments resulting from crushing Portland cement concrete by mechanical means. The acceptance and use of crushed concrete shall be according to Item 219 titled RECYCLED CONCRETE AGGREGATE BASE COURSE.

The coarse aggregate shall be Class B Quality or better according to the quality standards listed in the following table.

### Coarse Aggregate Quality

Quality Test	Class
	B
Na <sub>2</sub> SO <sub>4</sub> Soundness 5 Cycle, Illinois Modified AASHTO T 104 <sup>1</sup> , % Loss max.	15
Los Angeles Abrasion, Illinois Modified AASHTO T 96, % Loss max.	40 <sup>2</sup>
Deleterious Materials <sup>3</sup>	
Shale, % max.	2.0
Clay Lumps, % max.	0.5
Coal & Lignite, % max.	---
Soft & Unsound Fragments, % max.	6.0
Other Deleterious, % max.	2.0
Total Deleterious, % max.	6.0

1. Does not apply to crushed concrete.
2. Does not apply to crushed slag or crushed steel slag.
3. Test shall be run according to ITP 203.

The crushed aggregate for the applications shall meet the requirements for gradation given in the following table below when tested per the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 11-08, *Aggregate Gradation Control System (AGCS)*.

### Gradation Requirements

Sieve Size	Gradation Percent Passing		
	CA 14	CA 15	CA 16
1/2 inch	90±10	100	100
3/8 inch	45±20	75±15	97±3
No. 4	3±3	7±7	30±15
No. 16		2±2	2±2

The gradations represent the limits which shall determine suitability of aggregate for use from the sources of supply. The final gradation shall be well graded from coarse to fine within the limits designated in the table and shall not vary from the lower limit on one (1) sieve to the high limit on an adjacent sieve or vice versa.

The aggregate shall show no evidence of stripping or swell. The use of anti-strip agents for the control of stripping shall be used if necessary.

**609-2.2 Emulsified asphalt.** The emulsified asphalt shall be one (1) of the applicable materials listed on the current Illinois Department of Transportation's published Qualified Producer List of *Certified Sources for Emulsified Asphalt* and/or the Qualified Producer List of *Certified Sources for Cutback Asphalt and Road Oil*.

The emulsified asphalt shall conform to one (1) of the following.

- a. **Anionic emulsified asphalt.** Anionic emulsified asphalts RS-2 shall be according to AASHTO M 140.
- b. **Cationic emulsified asphalt.** Cationic emulsified asphalts CRS-2 shall be according to AASHTO M 208.
- c. **High float emulsion (HFE).** High float emulsions are medium setting and shall be according to the following table.

Test	HFE-90	HFE-150	HFE-300
Viscosity, Saybolt Furol, at 122°F, (AASHTO T 59), SFS <sup>1</sup>	50 min.	50 min.	50 min.
Sieve Test, No. 20, retained on sieve, (AASHTO T 59), %	0.10 max.	0.10 max.	0.10 max.
Settlement, (AASHTO T 59), % <sup>2</sup>	5 max.	5 max.	5 max.
Storage Stability Test, 1 day, (AASHTO T 59), % <sup>3</sup>	1 max.	1 max.	1 max.
Coating Test, (AASHTO T 59), 3 minutes	stone coated thoroughly		
Distillation Test, (AASHTO T 59):			
Residue from distillation test to 500°F, %	65 min.	65 min.	65 min.
Oil distillate by volume, %	7 max.	7 max.	7 max.
Characteristics of residue from distillation test to 500°F: Penetration at 77°F, (AASHTO T 49), 100 g, 5 sec, dmm	90 – 150	150 – 300	300 min.
Float Test at 140°F, (AASHTO T 50), sec.	1200 min.	1200 min.	1200 min.

1. The emulsion shall be pumpable.
2. The test requirement for settlement may be waived when the emulsified asphalt is used in less than five days; or the purchaser may require that the settlement test be run from the time the sample is received until it is used, if the elapsed time is less than five (5) days.
3. The 24-hour (one (1) day) storage stability test may be used instead of the five (5) day settlement test.

d. **Polymer modified emulsified asphalt.** Polymer modified emulsified asphalts CRSP (Cationic Rapid Setting) and HFP (Anionic High Float) shall be according to the following.

- (1) The emulsified asphalt shall be modified with a styrene-butadiene diblock or triblock copolymer, or a styrene-butadiene rubber.
- (2) Upon examination of the storage stability test cylinder after standing undisturbed for 24 hours, the surface shall show no white, milky colored substance but shall be a homogenous brown color throughout.

- (3) The emulsions shall be according to the following requirements when tested according to AASHTO T 59.

Test	CRSP	HFP
Viscosity, Saybolt Furol, at 122°F, (AASHTO T 59), SFS	100-400.	50 min.
Storage Stability Test, 1 day, (AASHTO T 59), %	1 max.	1 max.
Particle Charge Test	Positive	N/A
Sieve Test, No. 20, retained on sieve, (AASHTO T 59), %	0.10 max.	0.10 max.
Demulsibility, 02.02N CaCl <sub>2</sub> %	N/A	5 max.
Distillation Test, (AASHTO T 59):		
Residue from distillation test to 374°F ± 9°F, %	65 min.	65 min.
Oil distillate by volume, %	3 max.	3 max.

- (4) The Tests on Residue from Distillation shall be according to the following.

Test	CRSP	HFP
Penetration at 77°F, (AASHTO T 49), 100 g, 5 sec, dmm	100 – 200	100 – 200
Ductility, 39.2°F, (AASHTO T 51), mm	300 min.	300 min.
Elastic Recovery, (AASHTO T 301), 39.2°F, %	50 min.	50 min.
Float Test at 140°F, (AASHTO T 50), sec.	N/A	1200 min.

- e. **Medium curing (MC) liquid asphalt.** Medium curing liquid asphalts will be accepted according to the current Bureau of Materials Policy Memorandum (PM), *Cutback Asphalt and Road Oil Acceptance Procedure*. These materials shall be medium curing cutback asphalts consisting of a petroleum residuum fluxed with a suitable distillate. They shall be free from water, show no separation on standing, and shall be according to the requirements listed in the following table.

Test	MC-800	MC-3000
Flash Point, Cleveland open cup, (AASHTO T 48), °F	150 min.	150 min.
Viscosity, Kinematic, at 140°F, (AASHTO T 201), cSt	800 – 1600	3000 – 6000
Distillation Test, (AASHTO T 78):		
Distillate, % by volume of		
total distillate to 680°F:		
Distillate to 500 °F	35 max.	15 max.
Distillate to 600 °F	45 – 80	15 – 75
Residue from distillation test to 680°F, % volume difference by	75 min.	80 min.
Tests on residue from distillation:		
Penetration at 77°F, (AASHTO T 49), 100 g, 5 sec, dmm	120 – 250	120 – 250
Ductility at 77°F, (AASHTO T 51), mm <sup>1</sup>	1000 min.	1000 min.
Solubility in trichloroethylene, (AASHTO T 44), %	99.5 min.	99.5 min.

1. If ductility is less than 1,000 mm at 77°F, the material will be acceptable if the ductility is more than 1,000 mm at 60°F.



- f. **Slow curing (SC) liquid asphalt.** Slow curing liquid asphalts will be accepted according to the current Bureau of Materials Policy Memorandum (PM), *Cutback Asphalt and Road Oil Acceptance Procedure*. These materials shall be slow curing liquid asphalts produced by the distillation of petroleum. The liquid asphalts shall be residues, distillates, or residues fluxed to the desired consistency with petroleum distillates. Each shipment of liquid asphalt shall be uniform in appearance and consistency. All grades shall be free from water and shall not foam when heated to 225°F. The residues of specified penetration shall be smooth and homogeneous in appearance. This material shall be according to the requirements listed in the following table.

Test	SC-3000
Flash Point, Cleveland open cup, (AASHTO T 48), °F	225 min.
Viscosity, Kinematic, at 140°F, (AASHTO T 201), cSt	3,000 – 6,000
Residue of 100 penetration, (ASTM D243), %	80 min.
Ductility at 77°F, of residue of specified penetration, (AASHTO T 51),	1,000 min.
Loss on heating at 325°F, 50 g, 5 hours, (ASTM D6), %	4 max.
Solubility in trichloroethylene, (AASHTO T 44), %	99.0 min.

1. If ductility is less than 1,000 mm at 77°F, the material will be acceptable if the ductility is more than 1,000 mm at 60°F

The Contractor shall provide a copy of the manufacturer's certificate of analysis (COA) for the asphalt material. If the asphalt emulsion is diluted at other than the manufacturer's facility, the Contractor shall provide a supplemental COA from an independent laboratory verifying the asphalt emulsion properties.

The COA shall be provided to and approved by the Resident Engineer before the emulsified asphalt is applied. Furnishing the vendor's certified test report for the asphalt material shall not be interpreted as basis for final acceptance. The manufacturer's COA may be subject to verification by testing the material delivered for use on the project.

- 609-2.3 Asphalt cement.** The asphalt cement shall be one (1) of the applicable materials listed on the current Illinois Department of Transportation's published Qualified Producer List of *Certified Sources for Performance Graded Asphalt Binder*. These materials will be accepted according to the current Bureau of Materials Policy Memorandum (PM) 1-08, *Performance Graded Asphalt Binder Acceptance Procedure*. These materials shall be free from water and shall not foam when heated to any temperature below the actual flash point.

The bituminous material shall be asphalt cement Grade PG 58-22 or PG 64-22 meeting the requirements of AASHTO M 320. Air blown asphalt will not be allowed.

- 609-2.4 Friction characteristics.** Not required.

## COMPOSITION AND APPLICATION

- 609-3.1 Application rate.** The approximate amounts of for the chip seal shall be as provided in the table below for the treatment specified in the contract documents.

### Application Rate

Application No.	Quantity of Aggregate (lb/yd <sup>2</sup> )	Quantity of Asphalt (gal/yd <sup>2</sup> )	Type of Asphalt
1	40-50	0.35-0.45	Asphalt cement
		0.40-0.50	Emulsified asphalt
2	20-25	0.15-0.25	Asphalt cement
		0.20-0.35	Emulsified asphalt
3	15-20	0.15-0.20	Emulsified asphalt

**609-3.2 Control strip.** Prior to full application, the control strip must be accepted by the Engineer. The surface preparation, personnel, equipment, and method of operation used on the control strip shall be the same as used on the remainder of the work.

A qualified manufacturer's representative shall be present in the field to assist the Contractor in applying the control strip to determine the appropriate application rate of both asphalt material and aggregate to be evaluated and approved by the Engineer.

The control strip shall be three (3) lengths of at least 100 feet each for the full width of the distributor bar. Use the appropriate typical application rates specified herein for one (1) surface treatment trial. Make other chip seal coat trials using various amounts of materials as may be deemed necessary.

If the control strip should prove to be unsatisfactory, necessary adjustments to the application rate, placement operations, and equipment shall be made. Additional control strips shall be placed, and additional skid resistance tests performed and evaluated. Full production shall not begin without the Engineer's approval.

### CONSTRUCTION METHODS

**609-4.1 Worker safety.** The Contractor shall obtain a safety data sheet (SDS) for both the asphalt emulsion product and sand and require workmen to follow the manufacturer's recommended safety precautions. All additional industry standard safety precautions regarding the storage and applications of asphalts should be understood and followed by the Contractor.

**609-4.2 Weather limitations.** This work shall be done between May 1 and October 1. The asphalt material shall be applied only when the existing surface or base course is dry or contains no excess moisture in an amount that will not permit uniform distribution and adhesion. Chip seal coat shall not be applied when either the temperature of the air in the shade is 60°F or above or the pavement surface to be treated is below 70°F. No material shall be applied when rain is imminent or when dust or sand is blowing.

This work may be done between October 1 and October 30 providing the temperature of the air for three (3) consecutive days immediately preceding the day of application has been: (1) above 60°F in the shade each day, (2) a minimum of 40°F and (3) the temperature of the air in the shade at time of application is above 60°F.

**609-4.3 Equipment and tools.** The Contractor shall furnish all equipment, tools, and machines necessary for the performance of the work.

**a. Asphalt distributors.** The distributors shall have pneumatic tires of such width and number that the load produced on the base and surface does not exceed 65.0 pounds per square inch of tire width. Distributors shall be designed and equipped to distribute asphalt material uniformly at even heat on various widths of surface at readily determined and controlled rates ranging from 0.05 to 1.00 gallons per square yard, with a pressure range of 25 to 75 pounds per square inch. The allowable variation from any specified rate shall not exceed 5%. Distributor equipment shall include a separate power unit for the bitumen pump, full-

circulation spray bars, tachometer, pressure gauges, volume-measuring devices, a thermometer for reading the temperature of tank contents, and a hose attachment suitable for applying asphalt material to areas not accessible with distributor spray bar. The distributor shall be equipped for circulation and agitation of asphalt material during the heating process.

- b. **Aggregate spreader.** The aggregate spreader shall be a self-propelled mechanical spreader or truck-attached mechanical spreader capable of uniformly distributing aggregate at the specified rates.
- c. **Power rollers.** Power rollers shall be steel-wheeled or pneumatic-tired type, conforming to the following requirements:
  - (1) Steel-wheeled rollers shall have at least one (1) steel drum and weigh a minimum of five (5) tons. Steel wheels of the rollers shall be equipped with adjustable scrapers.
  - (2) Pneumatic-tired rollers shall be self-propelled and have wheels mounted on two (2) axles in such manner that the rear tires will not follow in the tracks of the forward group. Tires shall be uniformly inflated to not less than 60 pounds per square inch nor more than 80 pounds per square inch pressure. The pneumatic-tired rollers shall be equipped with boxes or platforms for ballast loading and shall be loaded so that the tire print width of each wheel is not less than the clear distance between tire prints.
- d. **Power broom/blower.** A power broom and/or blower shall be provided for removing loose material from the surface to be treated.
- e. **Equipment calibration.** Asphalt distributors must be calibrated within the same construction season in accordance with ASTM D2995. The Contractor must furnish a current calibration certification for the asphalt distributor truck from any State or other agency as approved by the Engineer.

**609-4.4 Preparation of asphalt pavement surfaces.** Clean the pavement surface immediately prior to placing the seal coat by sweeping, flushing well with water leaving no standing water, or a combination of both, so that it is free of dust, dirt, grease, vegetation, oil or any type of objectionable surface film. Remove oil or grease that has not penetrated the asphalt pavement by scraping scrubbing with a detergent, then wash thoroughly with clean water. After cleaning, treat these areas with an oil soil spot primer. Any additional surface preparation, such as crack repair, shall be in accordance with Item 101, titled PREPARATION/REMOVAL OF EXISTING PAVEMENTS.

**609-4.5 Spraying application.** The spraying application temperature ranges for emulsified asphalt material applied by a pressure distributor shall be according to the following table.

**Spraying Application Temperature Ranges**

Type and Grade of Asphalt Material	Temperature Ranges °F
	min. – max.
MC-800	200 – 305
MC-3000, SC-3000	230 – 345
RS-2, CRS-2	110 – 160
HFE-90, HFE-150, HFE-300	150 – 180
HFP, CRSP	150 – 180

**609-4.6 Application of asphalt material.** Asphalt material shall be applied on the prepared surface at the rate and temperature specified using a pressure distributor to obtain uniform distribution over all surfaces treated. Unless the distributor is equipped to obtain a satisfactory result at the junction of previous and subsequent applications, building paper shall be spread on the surface for a sufficient distance back from the ends of each application so that flow through the sprays

may be started and stopped on the paper in order that all sprays will operate at full force on the surface treated. Immediately after application, remove and destroy the building paper. Areas inaccessible to the distributor shall be properly treated with asphalt material using the hose attachment. Protect adjacent structures to prevent their being spattered or marred. To ensure proper drainage, the strips shall begin along the centerline of the pavement on a crowned section or on the high side of the pavement with a one-way slope.

- 609-4.7 Application of aggregate material.** Immediately after the application of the asphalt material, the aggregates at the rate specified for each designated application shall be spread uniformly over the asphalt material. Trucks spreading aggregate shall be operated backward so that the asphalt material will be covered before the truck wheels pass over it. The aggregate shall be spread in the same width of application as the asphalt material and shall not be applied in such thickness as to cause blanketing. Spread aggregate evenly by hand on all areas missed by the mechanical spreader. When hand spreading is employed on inaccessible areas, spread aggregate directly from trucks. Additional aggregate shall be spread by hand over areas having insufficient cover and spreading shall continue during these operations when necessary. Back-spotting or sprinkling of additional aggregate material and pouring additional asphalt material over areas that show up having insufficient cover or bitumen, shall be done by hand whenever necessary. Additional spreading of aggregate material shall be done by means of a broom drag, a power broom, or other approved equipment as directed by the Resident Engineer.

Immediately after spreading each application, the aggregate shall be rolled. The rolling shall be continued until no more aggregate material can be worked into the surface. In the construction of the second and third application, blading with the wire-broom moldboard attachment or broom dragging shall begin as soon as possible after the rolling has started and after the surface has set sufficiently to prevent excessive marking. Further blading and rolling on the strip being placed and on adjacent strips previously placed, shall be done as often as necessary to keep the aggregate material uniformly distributed. These operations shall be continued until the surface is evenly covered and cured to the satisfaction of the Resident Engineer.

Multiple applications shall not be applied until the preceding application has set and in no case until at least 24 hours have elapsed. Remove excess aggregate prior to the second application of asphalt material. If the treated surface is excessively moistened by rain, allow the surface to dry for such time as deemed necessary. If dust, dirt, or other foreign matter accumulates on the surface between the applications, the Contractor shall be required to sweep and clean the surface as specified. The asphalt material and the aggregate shall be spread on the clean and properly cured surface and handled as required. Avoid brooming or tracking dirt or any foreign matter on any portion of the pavement surface under construction.

Minimize aggregate from being broadcast and accumulating on the untreated pavement adjacent to an application pass. Prior to the next application pass, the Contractor shall clean areas of excess or loose aggregate and remove from project site.

- 609-4.8 Correction of defects.** Any defects, such as raveling, low centers, lack of uniformity, or other imperfections shall be corrected immediately to the satisfaction of the Resident Engineer.

All defective materials resulting from over-heating, improper handling, or application shall be removed by the Contractor and replaced with approved materials per these specifications.

- 609-4.9 Protection.** Keep all traffic off surfaces freshly treated with asphalt material. Provide sufficient warning signs and barricades so that traffic will not travel over freshly treated surfaces. Protect the treated areas from traffic for at least 24 hours after final application of asphalt material and aggregate, or for such time as necessary to prevent picking up. Immediately prior to opening to traffic, roll the entire treated area with a self-propelled pneumatic-tired roller.

### CONTRACTOR QUALITY CONTROL (QC)

- 609-5.1 Quality control (QC).** The Contractor shall have a manufacturer's authorized representative on the job site at the beginning of the work and during all chip seal coat applications. The manufacturer's representative shall have knowledge of the material, procedures, and equipment described in the specification and will be responsible for determining the application rates and shall oversee the preparation and application of the chip seal coat. Documentation of the manufacturer representative's experience and knowledge for applying the chip seal coat shall be furnished to the Engineer a minimum of ten (10) working days prior to placement of the control strip. The cost of the manufacturer's representative shall be considered incidental to the contract and a subsidiary obligation of the Contractor.
- 609-5.2 QC plan.** The Contractor must submit a QC plan to the Engineer a minimum of ten (10) days prior to placement of the control strip. The QC plan must address all items that affect the quality of the chip seal coat application including, but not limited to:
- a. Qualifications of personnel.
  - b. Schedule for the project.
  - c. Procedure to monitor the weather/temperature limitations.
  - d. Inspection requirements including emulsified asphalt, control strips, storage of emulsified asphalt, preparation of the pavement surface, and equipment calibration.
  - e. Provisions for obtaining, packaging and shipping acceptance samples and repair of the pavement.
  - f. Provisions for sample testing, testing laboratory name, location, accreditation, contact person, all contact information, testing requested, and report on information.
- 609-5.3 Records.** The Contractor shall maintain an accurate record of each batch of materials used in the formulation of the seal coat and provide the documentation to the Resident Engineer daily.

### MATERIAL ACCEPTANCE

- 609-6.1 Application rate.** The rate of application of the chip seal coat shall be verified at least twice per day.
- 609-6.2 Freight and weigh bills.** A weight ticket for each truck load shall be furnished to the Resident Engineer. The truck shall be weighed at a location approved by the Engineer. The ticket shall show the weight of the empty truck (the truck being weighed each time before it is loaded), the weight of the loaded truck, and the net weight of the bituminous material.

### METHOD OF MEASUREMENT

- 609-7.1** The quantity of chip seal coat application shall be measured for payment by the number of square yards as specified, completed, and accepted by the Resident Engineer.

### BASIS OF PAYMENT

- 609-8.1** Payment for accepted quantities of work performed by the Contractor and measured by the Resident Engineer shall be made at the contract unit price as specified in paragraph 609-7.1 of this section. Payment shall be full compensation for furnishing all materials and for all preparation, hauling and application of the materials, and for all labor, equipment, tools, and incidentals necessary to complete the work as specified.

## REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

### ASTM International (ASTM)

ASTM D 6	Standard Test Method for Loss on Heating of Oil and Asphaltic Compounds
ASTM D 243	Standard Test Method for Residue of Specified Penetration
ASTM D 2995	Standard Practice for Estimating Application Rate and Residual Application Rate of Bituminous Distributors

### American Association of State Highway and Transportation Officials (AASHTO)

AASHTO M 140	Standard Specification for Emulsified Asphalt
AASHTO M 208	Standard Specification for Cationic Emulsified Asphalt
AASHTO M 320	Standard Specification for Performance-Graded Asphalt Binder
AASHTO T 44	Standard Method of Test for Solubility of Bituminous Materials
AASHTO T 48	Standard Method of Test for Flash Point of Asphalt Binder by Cleveland Open Cup
AASHTO T 49	Standard Method of Test for Penetration of Bituminous Materials
AASHTO T 50	Standard Method of Test for Float Test for Bituminous Materials
AASHTO T 51	Standard Method of Test for Ductility of Asphalt Materials
AASHTO T 59	Standard Method of Test for Emulsified Asphalts
AASHTO T 78	Standard Method of Test for Distillation of Cutback Asphalt Products
AASHTO T 201	Standard Method of Test for Kinematic Viscosity of Asphalts (Bitumens)
AASHTO T 301	Standard Method of Test for Elastic Recovery Test of Asphalt Materials by Means of a Ductilometer

### Illinois Department of Transportation, Bureau of Materials Illinois Laboratory Test Procedure (ITP)

#### *Manual of Test Procedures for Materials*

AASHTO T 11	Illinois Modified, Standard Method of Test for Materials Finer Than 75- $\mu$ m (No. 200) Sieve in Mineral Aggregates by Washing
ITP 19	Bulk Density ("Unit Weight") and Voids in Coarse Aggregate

#### *Manual of Aggregate Quality Test Procedures*

AASHTO T 96	Illinois Modified, Standard Method of Test for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
AASHTO T 104	Illinois Modified, Standard Method of Test for Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate
AASHTO T 113	Illinois Modified, Standard Method of Test for Lightweight Pieces in Aggregate
ITP 203	Deleterious Particles in Coarse Aggregate

**Illinois Department of Transportation, Bureau of Materials Policy Memoranda (PM)**

PM 1-08	Performance Graded Asphalt Binder Acceptance Procedure
PM 2-08	Cutback Asphalt and Road Oil Acceptance Procedure
PM 11-08	Aggregate Gradation Control System (AGCS)
PM 12-08	Crushed Gravel Producer Self-Testing Program
PM 13-08	Slag Producer Self-Testing Program

**Illinois Department of Transportation, Bureau of Materials Qualified Product List**

Certified Sources for Cutback Asphalt and Road Oil  
Certified Sources for Emulsified Asphalt  
Certified Sources for Performance Graded Asphalt Binder

**END OF ITEM 609**

## Item 623 Emulsified Asphalt Spray Seal Coat

### DESCRIPTION

- 623-1.1** This item shall consist of the application of a polymer modified, asphalt emulsion spray seal coat (seal coat) composed of an emulsion of binders prepared from crude petroleum, mineral fillers, water and polymer, applied to an existing, previously prepared asphalt surface as specified in the contract documents or as directed by the Resident Engineer.

An emulsified asphalt seal coat may be used on all pavements, except runways, serving airplanes 12,500 pounds or less; and any pavements on which aircraft do not operate including shoulders, overruns, roads, and parking areas.

### MATERIALS

- 623-2.1** **Polymer modified asphalt emulsion spray seal.** A seal coat fortified with fillers created from binders prepared from crude petroleum shall meet the properties in the following table:

**Polymer Modified Asphalt Emulsion Spray Seal Properties**

Property	Characteristics	
	Minimum	Maximum
Density at 77°F, lb./gal	9	12
Residue by evaporation, %	44	--
Water content, %, ASTM D95	--	56
Ash content of residue, %	30	40
Uniformity	Uniform homogeneous consistency.	
Wet film continuity	No separation, coagulation, or settlement that cannot be overcome by moderate agitation.	
Resistance to heat	No blistering, sagging, or slipping.	
Resistance to water	No loss of adhesion and no blistering or tendency to re-emulsify.	
Flash point, ASTM D93	No tendency to flash.	
Flexibility	No flaking, cracking, or loss of adhesion to the substrate.	
Polymer modification	Minimum 3% by weight of asphalt binder.	

1. For water content testing, use ASTM D95. For flash point testing, use ASTM D93. For other properties, use AASHTO T 59 and T 111.

The Contractor shall provide a copy of the manufacturer's certificate of analysis (COA) for material delivered to the project. If the asphalt emulsion is diluted at other than the manufacturer's facility, the Contractor shall provide a supplemental COA from an independent laboratory verifying the asphalt emulsion properties. The COA shall be provided to and approved by the Engineer before material is applied. The furnishing of the vendor's certified test report for the asphalt material shall not be interpreted as a basis for final acceptance. The manufacturer's COA may be subject to verification by testing the material delivered for use on the project.



- 623-2.2 Polymer.** The type of polymer used for modification shall be chosen by the manufacturer. The polymer modifier shall be incorporated in the manufacturing process. The Contractor shall submit certification of analysis (COA) indicating that the polymer meets the requirements of the specification, and the manufacturer's approval of its use to the Resident Engineer. The amount of polymer will be a minimum 3% of the weight of the asphalt binder in the seal coat surface treatment.
- 623-2.3 Water.** Water used in mixing or curing shall be from potable water sources, free of harmful soluble salts, and at least 50°F. Other sources shall be tested in accordance with AASHTO T 26 and must be approved by the Engineer prior to use.
- 623-2.4 Friction characteristics.** Not required.

### COMPOSITION AND APPLICATION

- 623-3.1 Application rate.** The approximate amounts of material for the spray seal shall be as provided in the following table. The actual application rates will vary within the range specified to suit field conditions and will be recommended by the manufacturer's representative and approved by the Engineer from the control strip evaluation.

**Application Rate**

	<b>2-coat application</b>	<b>3-coat application</b>
1st Coat	0.14 - 0.20	0.14 - 0.20
2nd Coat	0.10 - 0.20	0.10 - 0.20
3rd Coat	-	0.08 - 0.15
Total Application	0.30 minimum	0.30 – 0.55

- 623-3.2 Control strip.** Prior to full application the control strip must be accepted by the Engineer. The surface preparation, personnel, equipment, and method of operation used on the control strip shall be the same as used on the remainder of the work.

A qualified manufacturer's representative shall be present in the field to assist the Contractor in applying the control strip to determine the appropriate application rate to be evaluated and approved by the Engineer.

The Contractor shall prepare a quantity of mixture sufficient to place a control strip a minimum of 250 square yards at the rate specified. The test area shall be designated by the Engineer and will be located on a representative section of the pavement to be seal coated. Separate control strips by a minimum of 200 feet between sections. The actual application rate will be determined by the Engineer during placement of the control strip and will depend on the condition of the pavement surface.

If the control strip should prove to be unsatisfactory, necessary adjustments to the application rate, placement operations and equipment shall be made. Additional control strips shall be placed and evaluated. Full production shall not begin without the Engineer's approval.

### CONSTRUCTION METHODS

- 623-4.1 Worker safety.** The Contractor shall obtain a safety data sheet (SDS) for both the asphalt sealer product and aggregate and require workmen to follow the manufacturer's recommended safety precautions. All additional industry standard safety precautions regarding the storage and applications of asphalts should be understood and followed by the Contractor.

**623-4.2 Weather limitations.** The spray seal shall be applied only when the existing pavement surface is dry and when the weather is not foggy, rainy, or the humidity will not allow proper curing, or when the wind velocity will prevent the uniform application of the material. No material shall be applied when dust or sand is blowing or when rain is anticipated within eight (8) hours of application completion. The atmospheric temperature and the pavement surface temperature shall both be at, or above 50°F and rising and is expected to remain above 50°F for 24 hours.

Cover existing buildings, structures, runway edge lights, taxiway edge lights, informational signs, retro-reflective marking and in-pavement duct markers as necessary to protect against overspray before applying the emulsion. Should emulsion get on any light or marker fixture, promptly clean the fixture. If cleaning is not satisfactory to the Resident Engineer, the Contractor shall replace any light, sign or marker with equivalent equipment at the Contractor's expense.

**623-4.3 Equipment and tools.** The Contractor shall furnish all equipment, tools, and machinery necessary for the performance of the work. Equipment used to apply the seal coat shall have continuous agitation or mixing capabilities to maintain homogeneous consistency of the seal coat throughout the application process. Spray equipment shall be capable of mixing and spraying seal coat with aggregate added. Self-propelled squeegee equipment with mixing capability shall have at least two (2) squeegee or brush devices (one (1) behind the other) to ensure adequate distribution and penetration of seal coat surface treatment into pavement surface. Hand squeegees and brushes shall be acceptable in areas where practicality prohibits the use of mechanized equipment. A power broom or blower may be used for removing loose material from the surface to be treated.

**623-4.4 Preparation of asphalt pavement surfaces.** Clean the pavement surface immediately prior to placing the seal coat by sweeping, flushing well with water leaving no standing water, or a combination of both, so that it is free of dust, dirt, grease, vegetation, oil or any type of objectionable surface film. Remove oil or grease that has not penetrated the asphalt pavement by scraping or by scrubbing with a detergent, then wash thoroughly with clean water. After cleaning, treat these areas with an oil spot primer. Any additional surface preparation, such as crack repair, shall be in accordance with Item 101 titled PREPARATION/REMOVAL OF EXISTING PAVEMENTS.

**a. New asphalt pavement surfaces.** Allow new asphalt pavement surfaces to cure so that there is no concentration of oils on the surface. A period of at least 30 days at 70°F daytime temperatures shall elapse between the placement of a hot mixed asphalt concrete surface course and the application of the seal coat.

Perform a water-break-free test to confirm that the surface oils have degraded and dissipated. Cast approximately one (1) gallon of clean water out over the surface. The water should sheet out and wet the surface uniformly without crawling or showing oil rings. If signs of crawling or oil rings are apparent on the pavement surface, additional time must be allowed for additional curing and retesting of the pavement surface prior to treatment.

**623-4.5 Emulsion mixing.** Contractor must ensure the mixture is homogeneous with no balling or lumping. Continue to agitate the seal coat mixture in the mixing tank at all times prior to and during application so that a consistent mix is available for application. Small additional increments of water may be needed to provide a workable consistency, but in no case is the water content to exceed the specified amount.

**623-4.6 Application of seal coat.** Application of seal coat generally consists of two (2) application coats of material. The first coat must be dry prior to the application of the second coat or subsequent coats if more than two (2) coats are being applied. During all applications, the surfaces of adjacent structures shall be protected to prevent their being spattered or marred. Should the seal coat get on any light or marker fixture, promptly clean the fixture. If cleaning is not satisfactory to the Resident Engineer, the Contractor shall replace any light, sign or marker with equivalent equipment at the Contractor's expense.

If low spots and depressions greater than one-half (1/2) inch in depth in the pavement surface cause ponding or puddling of the applied materials, the pavement surface shall be broomed with a broom drag. Brooming shall continue until the pavement surface is free of any pools of excess material.

- 623-4.7 Protection.** Keep all traffic off surfaces freshly treated with asphalt material. Provide sufficient warning signs and barricades so that traffic will not travel over freshly treated surfaces. Protect the treated areas from traffic for at least 24 hours until the seal coat has thoroughly cured.

### CONTRACTOR QUALITY CONTROL (QC)

- 623-5.1 Quality control (QC).** The Contractor shall have a manufacturer's authorized representative on the job site at the beginning of the work and during all emulsified asphalt spray seal coat applications. The manufacturer's representative shall have knowledge of the material, procedures, and equipment described in the specification and shall be responsible for determining the application rates and shall oversee the preparation and application of the emulsified asphalt spray seal coat. Documentation of the manufacturer representative's experience and knowledge for applying the emulsified asphalt spray seal coat shall be furnished to the Engineer a minimum of ten (10) working days prior to placement of the control strip. The cost of the manufacturer's representative shall be considered incidental to the contract and a subsidiary obligation of the Contractor.

- 623-5.2 QC plan.** The Contractor must submit a QC plan to the Engineer a minimum of ten (10) days prior to placement of the control strip. The QC plan must address all items that affect the quality of the emulsified asphalt spray seal coat application including, but not limited to:

- a. Qualifications of personnel.
- b. Schedule for the project.
- c. Procedure to monitor the weather/temperature limitations.
- d. Inspection requirements including asphalt material, control strips, storage of asphalt material, preparation of the pavement surface, and equipment calibration.
- e. Provisions for obtaining, packaging and shipping acceptance samples and repair of the pavement.
- f. Provisions for sample testing, testing laboratory name, location, accreditation, contact person, all contact information, testing requested, and report on information.

- 623-5.3 Sampling.** A minimum of one (1) sample per day shall be tested. A random sample of approximately one (1) quart of the composite mix from the onsite storage tank will be obtained daily by the Contractor in the presence of the Resident Engineer and stored in a proper container. The containers shall be sealed against contamination and retained in storage by the Resident Engineer for a period of six (6) months. Samples shall be stored at room temperature and not be subjected to freezing temperatures.

A sample of undiluted asphalt emulsion shall be obtained from each consignment shipped to the job.

- 623-5.4 Records.** The Contractor shall maintain an accurate record of each batch of materials used in the formulation of the seal coat and provide the documentation to the Resident Engineer daily.

### MATERIAL ACCEPTANCE

- 623-6.1 Application rate.** The rate of application of the asphalt emulsion shall be verified at least twice per day.

- 623-6.2 Freight and weigh bills.** A weight ticket for each truck load shall be furnished to the Resident Engineer. The truck shall be weighed at a location approved by the Engineer. The ticket shall show the weight of the empty truck (the truck being weighed each time before it is loaded), the weight of the loaded truck, and the net weight of the bituminous material.

#### METHOD OF MEASUREMENT

- 623-7.1** The quantity of emulsified asphalt spray seal coat application shall be measured for payment by the number of square yards as specified, completed, and accepted by the Resident Engineer.

#### BASIS OF PAYMENT

- 623-8.1** Payment for accepted quantities of work performed by the Contractor and measured by the Resident Engineer shall be made at the contract unit price as specified in paragraph 623-7.1 of this section. Payment shall be full compensation for all surface preparation, furnishing all materials, delivery and application of these materials, for all labor, equipment, tools, and incidentals necessary to complete the work as specified.

#### REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

##### ASTM International (ASTM)

ASTM D 93	Standard Test Methods for Flash Point by Pensky-Martens Closed Cup Tester
ASTM D 95	Standard Test Method for Water in Petroleum Products and Bituminous Materials by Distillation

##### American Association of State Highway and Transportation Officials (AASHTO)

AASHTO T 11	Standard Method of Test for Materials Finer Than 75-micro m (No. 200) Sieve in Mineral Aggregates by Washing
AASHTO T 26	Standard Method of Test for Quality of Water to Be Used in Concrete
AASHTO T 59	Standard Method of Test for Emulsified Asphalts

##### Code of Federal Regulations (CFR)

29 CFR 1910.1200	Occupational Safety and Health Standards, Toxic and Hazardous Substances, Hazard Communication
40 CFR	Protection of Environment

**END OF ITEM 623**

## Item 626 Emulsified Asphalt Slurry Seal Surface Treatment

### DESCRIPTION

- 626-1.1** This item shall consist of a mixture of emulsified asphalt, polymer, mineral aggregate, and water properly proportioned, mixed, and spread on an asphalt pavement surface, as specified in the contract documents or as directed by the Resident Engineer.

An emulsified asphalt slurry seal surface treatment may be used on all pavements on general aviation airports serving airplanes 12,500 pounds or less; all pavements, except runways, on airports serving airplanes 60,000 pounds or less; and any pavements on which aircraft do not operate including shoulders, overruns, roads, and parking areas.

### MATERIALS

- 626-2.1 Aggregate.** The aggregate shall consist of sound and durable manufactured sand, slag, crusher fines, crushed stone, or a combination. The aggregate shall be clean and free from vegetable matter, dirt, and other deleterious substances. The aggregate shall have a sand equivalent of not less than 45% when tested in accordance with ASTM D2419. The aggregate shall show a loss of not more than 35% when tested in accordance with AASHTO T 96. The sodium sulfate soundness loss shall not exceed 12% or the magnesium soundness loss shall not exceed 20% after five (5) cycles when tested in accordance with AASHTO T 104. Aggregate shall be 100% crushed.

The combined aggregate shall conform to the gradation shown in table below when tested in accordance with the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 11-08, *Aggregate Gradation Control System (AGCS)*.

### Gradation Requirements

Sieve Size	Gradation Percent Passing			
	Type I	Type II	Type III	Type IA
3/8 inch	100	100	100	100
No. 4	100	90 - 100	70 - 90	98 - 100
No. 8	90 - 100	65 - 90	45 - 70	85 - 95
No. 16	65 - 90	45 - 70	28 - 50	50 - 75
No. 30	40 - 65	30 - 50	19 - 34	30 - 50
No. 50	25 - 42	18 - 30	12 - 25	18 - 35
No. 100	15 - 30	10 - 21	7 - 18	10 - 21
No. 200	10 - 20	5 - 15	5 - 15	5 - 10
Residual asphalt content percent dry weight of aggregate	10% - 16%	7.5% - 13.5%	6.5% - 12%	9% - 13.5%

The job mix formula (JMF) shall be run using aggregate within the gradation band for the desired type shown in table above. Once the mix design has been submitted and approved by the Engineer, the aggregate used on the project shall not vary by more than the tolerances specified. At no time shall the aggregate used go out of the gradation band.

The aggregate will be accepted at the job location or stockpile based on five (5) gradation test samples in accordance with the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 11-08, *Aggregate Gradation Control System (AGCS)*. If the average of the five (5) tests is within the gradation tolerances, then the materials will be accepted. If the tests show the material to be out of tolerance, the Contractor will be given the choice either to remove the material or blend other aggregates with the stockpile material to bring it into specification. Materials used in blending shall meet the quality tests before blending and shall be blended in a manner to produce a consistent gradation. This blending may require a new mix design.

Screening shall be required at the project stockpile site if there are oversize materials in the mix.

Precautions shall be taken to prevent segregation of the aggregate in storing and handling. The stockpile shall be kept in areas that drain readily.

Locally available Department gradations may be blended to meet the JMF.

- a. **Aggregate tolerance.** Once the mix design has been accepted, the aggregate gradation used on the project may vary from the aggregate gradation used in the mix design on each sieve by the percentages shown in the table below. If the project aggregate fails to remain within this tolerance, a new mix design will be required by the Engineer at the expense of the Contractor.

#### Aggregate Tolerance

Sieve Size	Tolerance
3/8 inch	
No. 4	±5%
No. 8	±5%
No. 16	±5%
No. 30	±5%
No. 50	±4%
No. 100	±3%
No. 200	±2%
Residual Asphalt, percent dry weight of aggregate	±1%

- 626-2.2 Mineral filler.** Mineral filler (baghouse fines) may be added in addition to material naturally present in the aggregate. Mineral filler shall consist of dry limestone dust, fly ash, cement kiln dust, or lime kiln dust and shall meet the following requirements.

- a. **Gradation.** The gradation shall be according to the following.

#### Gradation Requirements

Sieve Size	Percent Passing
No. 30	100
No. 100	92±8
No. 200	82±18

- b. **Loss on ignition.** The loss on ignition for all products shall be a maximum of 5% when tested according to the ITP, *Loss on Ignition for Mineral Filler*.
- c. **Additional requirements.**

### Mineral Filler Requirements

Material Test	Requirement	Standard
Plasticity Index	4 maximum	AASHTO T 90

- 626-2.3 Emulsified asphalt.** The emulsified asphalt shall be one (1) of the applicable materials for the tack coat listed on the current Illinois Department of Transportation's published Qualified Producer List of *Certified Sources for Emulsified Asphalt* and/or the Qualified Producer List of *Certified Sources for Cutback Asphalt and Road Oil*. The cement mixing test is waived for these slurry type emulsions. The type of emulsified asphalt shall be either anionic or cationic, whichever is best suited to the aggregate and job conditions to be encountered.

The Contractor shall provide a copy of the manufacturer's certificate of analysis (COA) for the emulsified asphalt delivered to the project. If the asphalt emulsion is diluted at other than the manufacturer's facility, the Contractor shall provide a supplemental COA from an independent laboratory verifying the asphalt emulsion properties.

The COA shall be provided to and approved by the Engineer before the emulsified asphalt is applied. The furnishing of the vendor's certified test report for the asphalt material shall not be interpreted as a basis for final acceptance. The manufacturer's COA may be subject to verification by testing the material delivered for use on the project.

- 626-2.4 Polymer.** The type of polymer used for modification shall be chosen by the manufacturer. The polymer modifier shall be incorporated in the manufacturing process. The Contractor shall submit a certificate of analysis (COA) indicating that the polymer meets the requirements of the specification, and the asphalt material manufacturer's approval of its use to the Resident Engineer.
- 626-2.5 Water.** Water used in mixing or curing shall be from potable water sources. Other sources shall be tested in accordance with AASHTO T 26 and must be approved by the Engineer prior to use.
- 626-2.6 Friction characteristics.** Not required.

### COMPOSITION AND APPLICATION

- 626-3.1 Composition.** The slurry seal shall consist of a mixture of emulsified asphalt, mineral aggregate, a minimum of 1% polymer, additives as necessary, and water.
- 626-3.2 Job mix formula.** The mix design shall be developed by a laboratory with experience in designing slurry seal mixes and a signed copy shall be submitted in writing by the Contractor to the Engineer at least ten (10) days prior to the start of operations. No slurry seal for payment shall be placed until a mix design has been approved by the Engineer.

The laboratory report (mix design) shall indicate the proportions of aggregates, mineral filler (minimum and maximum), water (minimum and maximum), polymer (%), and asphalt emulsion based on the dry aggregate weight. It shall also report the quantitative effects of moisture content on the unit weight of the aggregate (bulking effects). The mix design shall be in effect until modified in writing by the Engineer. If the sources of materials change, a new mix design shall be established before the new material is used.

The Contractor shall submit to the Engineer for approval a complete mix design on the materials proposed for use, prepared and certified by an approved laboratory. Compatibility of the aggregate, emulsion, mineral filler, and other additives shall be verified by the mix design. The mix design shall be made with the same aggregate and grade of emulsified asphalt that the

Contractor will provide on the project. At a minimum, the required tests and values needed are as follows:

### Slurry Mix Tests

ISSA Technical Bulletin No.	Description	Specification
ISSA TB-100	Wet track abrasion loss one (1) hour soak	50 g/ft <sup>2</sup> max.
ISSA TB-115	Determination of Slurry System Compatibility	Pass

- 626-3.3 Application rate.** Unless otherwise specified, the amount of material for the slurry seal shall be as provided in the following table.

### Application Rates

Mix Measurement	Type I	Type II	Type III	Type IA
Pounds of mixture per square yard	8 - 12	12 - 20	18 - 30	10 – 16

The rate of application shall not vary more than  $\pm 2$  pounds per square yard

- 626-3.4 Control strip.** Prior to full applications, the control strip must be accepted by the Engineer. The surface preparation, personnel, equipment, and method of operation used on the control strip shall be the same as used on the remainder of the work.

A qualified manufacturer's representative shall be present in the field to assist the Contractor in applying the control strip to determine the appropriate application rate of both emulsion and aggregate to be evaluated and approved by the Engineer.

The test area will be located on the existing pavement and designated by the Engineer. Control strips shall be made by each machine after calibration. Separate control strips by a minimum of 200 feet between sections. Samples of the slurry seal may be taken, and the mix consistency verified, by using ISSA TB-106 Measurement of Slurry Seal Consistency test. In addition, the proportions of the individual materials may be verified by the Engineer by using the calibration information provided after machine calibration.

If the control strip should prove to be unsatisfactory, additional control strips shall be placed and evaluated. Full production shall not begin without the Engineer's approval.

### CONSTRUCTION METHODS

- 626-4.1 Worker safety.** The Contractor shall obtain a safety data sheet (SDS) for both the asphalt emulsion product and sand and require workmen to follow the manufacturer's recommended safety precautions. All additional industry standard safety precautions regarding the storage and applications of asphalts should be understood and followed by the Contractor.
- 626-4.2 Weather limitations.** The slurry seal shall not be applied if either the pavement or air temperature is below 50°F and falling but may be applied when both pavement and air temperature are above 45°F and rising. No slurry seal shall be applied when there the finished product will freeze before 24 hours. Do not apply slurry seal during rain or other adverse weather conditions. The mixture shall not be applied when weather conditions prolong opening to traffic beyond a reasonable time.
- 626-4.3 Equipment and tools.** The Contractor shall furnish all equipment, tools, and machinery necessary for the performance of this work.
- a. Slurry mixing equipment.** The machine shall be specifically designed and manufactured to lay slurry seal. The material shall be mixed by a self-propelled slurry seal mixing machine



of either truck mounted or continuous run design. Either type machine shall be able to accurately deliver and proportion the aggregate, emulsified asphalt, mineral filler, and water to a revolving mixer and discharge the mixed product on a continuous flow basis. The machine shall have sufficient storage capacity for materials to maintain an adequate supply to the proportioning controls.

If continuous run equipment is used, the machine shall be equipped to allow the operator full control of the forward and reverse speed of the machine during application of the slurry seal, with a self-loading device, with opposite side driver stations, all part of original equipment manufacturer design.

The aggregate shall be pre-wetted immediately prior to mixing with the emulsion. The mixing unit of the mixing chamber shall be capable of thoroughly blending all ingredients. No excessive mixing shall be permitted. The mixing machine shall be equipped with a fines feeder that provides an accurate metering device or method to introduce a predetermined proportion of mineral filler into the mixer at the same time and location that the aggregate is fed into the mixer.

The mixing machine shall be equipped with a water pressure system and fog-type spray bar adequate for complete fogging of the surface with an application of 0.05 to 0.10 gallons per square yard preceding the spreading equipment.

Sufficient machine storage capacity to mix properly and apply a minimum of five (5) tons of the slurry shall be provided. Proportioning devices shall be calibrated prior to placing the slurry seal.

- b. Slurry spreading equipment.** The mixture shall be spread uniformly by means of a conventional surfacing spreader box attached to the mixer and equipped to agitate and spread the material evenly throughout the box. A front seal shall be provided to ensure no loss of the mixture at the surface contact point. The rear seal shall act as the final strike-off and shall be adjustable. The spreader box and rear strike-off shall be designed and operated to produce a free flow of material of uniform consistency to the rear strike-off. The spreader box shall provide suitable means to side shift the box to compensate for variations in the pavement geometry. A burlap drag or other approved screed may be attached to the rear of the spreader box to provide a uniform mat.
- c. Auxiliary equipment.** Other tools or equipment such as brushes, hand squeegees, hose equipment, tank trucks, water distributors and flushers, power blowers, barricades, etc., shall be provided as required.
- d. Roller.** The roller, if required, shall be a self-propelled pneumatic-tired roller capable of exerting a contact pressure during rolling of 50 pounds per square inch. It shall be equipped with a water spray system, to be used if the slurry is picking up on the tires during rolling.
- e. Tack coat and distributor.** Normally a tack coat is not required unless the surface to be covered is extremely dry and raveled or is concrete or brick. If required, the tack coat should consist of one (1) part emulsified asphalt and three (3) parts water. The emulsified asphalt may be the same as that used in the mix. Pressure distributors used for application of the diluted asphalt emulsion tack coat shall be self-propelled, equipped with pneumatic tires, and capable of uniformly applying 0.05 to 0.15 gallons per square yard of the diluted emulsion over the required width of application. Distributors shall be equipped with tachometers, pressure gauges, and volume-measuring devices. The tack coat shall be applied at least two (2) hours before the slurry seal but within the same day.
- f. Equipment calibration.** Each slurry mixing unit to be used on the project shall be calibrated in the presence of the Engineer prior to construction. Previous calibration documentation covering the exact materials to be used may be accepted by the Engineer provided they were made during the calendar year. The documentation shall include an individual calibration of each material at various settings, which can be related to the machine's

metering devices. No machine will be allowed to work on the project until the calibration has been completed and/or accepted by the Engineer.

**626-4.4 Preparation of asphalt pavement surface.** Clean pavement surface immediately prior to placing the seal coat by sweeping, flushing well with water leaving no standing water, or a combination of both, so that it is free of dust, dirt, grease, vegetation, oil or any type of objectionable surface film. Remove oil or grease that has not penetrated the asphalt pavement by scraping or by scrubbing with a detergent, then wash thoroughly with clean water. After cleaning, treat these areas with an oil spot primer. Any additional surface preparation, such as crack repair, shall be in accordance with Item 101 titled PREPARATION/REMOVAL OF EXISTING PAVEMENTS.

**626-4.5 Application of slurry seal surface treatment.** The surface shall be pre-wet ahead of the slurry spreader box by fogging at a rate that dampens the surface with no apparent standing water. The slurry mixture shall be at the desired consistency when exiting the mixer. Total time of mixing shall not exceed two (2) minutes. A sufficient amount of slurry shall be carried in all parts of the spreader box at all times so that complete coverage of all surface voids and cracks is obtained. Care shall be taken not to overload the spreader box which shall be towed at a slow and uniform rate not to exceed five (5) miles per hour. No lumping, balling, or unmixed aggregate shall be permitted. No segregation of the emulsion and fines from the coarse aggregate will be permitted. If the coarse aggregate settles to the bottom of the mix, the slurry shall be removed from the pavement surface. A sufficient amount of slurry shall be fed into the box to keep a full supply across the full width of the spreader box. The mixture shall not be permitted to overflow the sides of the spreader box. No breaking of the emulsion will be allowed in the spreader box. The finished surface shall have no more than four (4) tear or drag marks greater than one-half (1/2) inch wide and four (4) inches long in any 12 foot by 22-foot section. It shall have no tear or drag marks greater than one (1) inch wide and three (3) inches long.

The finished surface shall have no transverse ripples of one-quarter (1/4) inch or more in depth, as measured with a 12 or 16-foot straightedge laid upon the surface.

Adjacent lanes shall be lapped at the edges a minimum of two (2) inches with a maximum of four (4) inches to provide complete sealing at the overlap. Construction longitudinal and transverse joints shall be neat and uniform without buildup, uncovered areas, or unsightly appearance. All joints shall have no more than one-quarter (1/4) inch difference in elevation when measured across with a 12 or 16-foot straightedge.

In areas where the spreader box cannot be used, the slurry shall be applied by means of a hand squeegee. Upon completion of the work, the seal coat shall have no holes, bare spots, or cracks through which liquids or foreign matter could penetrate to the underlying pavement. The finished surface shall present a uniform and skid resistant texture satisfactory to the Engineer. All wasted and unused material and all debris shall be removed from the site prior to final acceptance.

Upon completion of the project, the Contractor shall sweep the finished surface with a conventional power rotary broom, to remove any potential loose material from the surface. The material removed by sweeping shall be disposed of in a manner satisfactory to the Resident Engineer.

**626-4.6 Protection.** Keep all traffic off surfaces freshly treated with asphalt material. Provide sufficient warning signs and barricades so that traffic will not travel over freshly treated surfaces. The fresh slurry seal application shall be protected by barricades and markers and permitted to dry. Protect the treated areas from traffic for four (4) to 24 hours, depending on weather conditions, until the fresh slurry seal application is dry.

Any damage to uncured slurry shall be repaired at the expense of the Contractor.

### CONTRACTOR QUALITY CONTROL (QC)

- 626-5.1 Quality control (QC).** The Contractor shall have a manufacturer's authorized representative on the job site at the beginning of the work and during all emulsified asphalt slurry seal surface treatments. The manufacturer's representative shall have knowledge of the material, procedures, and equipment described in the specification and shall be responsible for determining the application rates and shall oversee the preparation and application of the emulsified asphalt slurry seal surface treatment. Documentation of the manufacturer representative's experience and knowledge for applying the emulsified asphalt slurry seal surface treatment shall be furnished to the Engineer a minimum of ten (10) working days prior to placement of the control strip. The cost of the manufacturer's representative shall be considered incidental to the contract and a subsidiary obligation of the Contractor.
- 626-5.2 QC plan.** The Contractor must submit a QC plan to the Engineer a minimum of ten (10) days prior to placement of the control strip. The QC plan must address all items that affect the quality of the emulsified asphalt slurry seal surface treatment including, but not limited to:
- Qualifications of personnel.
  - Schedule for the project.
  - Procedure to monitor the weather/temperature limitations.
  - Inspection requirements including emulsified asphalt, control strips, storage of emulsified asphalt, preparation of the pavement surface, and equipment calibration.
  - Provisions for obtaining, packaging and shipping acceptance samples and repair of the pavement.
  - Provisions for sample testing, testing laboratory name, location, accreditation, contact person, all contact information, testing requested, and report on information.
- 626-5.3 Sampling.** Samples of the emulsion that the Contractor proposes to use, together with a statement as to its source, shall be submitted, and approval shall be obtained before using such material. The Contractor shall submit to the Resident Engineer a manufacturer's certified report for each consignment of the emulsion. The manufacturer's certified report shall not be interpreted as a basis for final acceptance. All such reports shall be subject to verification by testing samples of the emulsion received for use on the project.
- 626-5.4 Records.** The Contractor shall maintain an accurate record of each batch of materials used in the formulation of the seal coat and provide the documentation to the Resident Engineer daily.

### MATERIAL ACCEPTANCE

- 626-6.1 Application rate.** The rate of application of the asphalt emulsion shall be verified at least twice per day.
- 626-6.2 Freight and weigh bills.** A weight ticket for each truck load shall be furnished to the Resident Engineer. The truck shall be weighed at a location approved by the Engineer. The ticket shall show the weight of the empty truck (the truck being weighed each time before it is loaded), the weight of the loaded truck, and the net weight of the bituminous material.

### METHOD OF MEASUREMENT

- 626-7.1** The quantity of emulsified asphalt material for surface treatment shall be measured for payment by the pounds of residual asphalt as specified, completed, and accepted by the Resident Engineer.

### **BASIS OF PAYMENT**

**626-8.1** Payment for accepted quantities of work performed by the Contractor and measured by the Resident Engineer shall be made at the contract unit price as specified in paragraphs 626-7.1 of this section. Payment shall be full compensation for all surface preparation, furnishing all materials, delivery and application of these materials, for all labor, equipment, tools, and any costs associated with furnishing a qualified manufacturer's representative to assist with control strips, and incidentals necessary to complete the work as specified.

### **REFERENCES**

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

#### **ASTM International (ASTM)**

ASTM D 2419	Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate
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#### **American Association of State Highway and Transportation Officials (AASHTO)**

AASHTO T 26	Standard Method of Test for Quality of Water to Be Used in Concrete
AASHTO T 90	Standard Method of Test for Determining the Plastic Limit and Plasticity Index of Soils
AASHTO T 96	Standard Method of Test for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
AASHTO T 104	Standard Method of Test for Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate

#### **Illinois Department of Transportation, Bureau of Materials Policy Memoranda (PM)**

PM 11-08	Aggregate Gradation Control System (AGCS)
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#### **Illinois Department of Transportation, Bureau of Materials Qualified Product List**

Certified Sources for Cutback Asphalt and Road Oil

Certified Sources for Emulsified Asphalt

#### **International Slurry Surfacing Association (ISSA)**

ISSA A-105	Recommended Performance Guidelines for Emulsified Asphalt Slurry Seal
ISSA TB-100	Laboratory Test Method for Wet Track Abrasion of Slurry Surfacing Systems
ISSA TB-106	Slurry Seal Consistency Template
ISSA TB-115	Test Method for Determination of Slurry System Compatibility

**END OF ITEM 626**

## Item 629 Thermoplastic Coal Tar Emulsion Surface Treatments

### DESCRIPTION

**629-1.1** This item shall consist of an application of a thermoplastic coal tar emulsion micro-surface, sand slurry seal, or spray seal coat applied to an existing, previously prepared asphalt surface, as specified in the contract documents or as directed by the Resident Engineer.

A thermoplastic coal tar emulsion micro-surface may be used on all pavements on airports serving airplanes less than 60,000 pounds or less; and any pavements on which aircraft do not operate including shoulders, overruns, roads, and parking areas.

A thermoplastic coal tar emulsion sand slurry seal may be used on all pavements on general aviation airports serving airplanes 12,500 pounds or less; all pavements, except runways, on airports serving airplanes less than 60,000 pounds or less; and any pavements on which aircraft do not operate including shoulders, overruns, roads, and parking areas.

A thermoplastic coal tar emulsion spray seal coat maybe used on all pavements, except runways, on general aviation airports serving airplanes 12,500 pounds or less and any pavements on which aircraft do not operate including shoulders, overruns, roads, and parking areas.

### MATERIALS

**629-2.1 Aggregate.** The Contractor shall submit specialty aggregate manufacturer's certificate of analysis (COA) indicating that the specialty aggregate meets the requirements of the specification to the Resident Engineer prior to start of construction. The aggregate must be approved for use by the Engineer shall meet the requirements of the gradation given in the following when tested per the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 11-08, *Aggregate Gradation Control System (AGCS)*.

- a. Thermoplastic coal tar emulsion micro-surface.** The aggregate material shall consist of sound, durable crushed igneous type stone (crushed basalt, granite, trap rock, etc.), be free from films of matter that would prevent thorough coating and bonding with the asphalt material and free from coatings of clay, organic matter, and other deleterious materials. The percentage of wear shall not be greater than 35% when tested in accordance with AASHTO T 96.

### Gradation Requirements

Sieve Size	Gradation Percent Passing	
	Type A	Type B
No. 4	100	100
No. 8	75-95	95-100
No. 16	50-75	65-95
No. 30	30-65	35-65
No. 50.0	20-50	20-45
No. 100	15-25	5-20
No. 200	5-20	0-20

- b. **Thermoplastic coal tar emulsion sand slurry seal.** The aggregate material shall consist of sound, durable crushed igneous type stone (crushed basalt, granite, trap rock, etc.), clean washed masonry sand, or clean washed manufactured silica sand, be free from films of matter that would prevent thorough coating and bonding with the asphalt material and free from coatings of clay, organic matter, and other deleterious materials. Aggregate shall have a minimum Mohs hardness of 6.

#### Gradation Requirements

Sieve Size	Percent Passing
No. 4	100
No. 8	99.5-100
No. 16	85-100
No. 30	50-90
No. 50	15-55
No. 100	0-20
No. 200	0-20

- c. **Thermoplastic coal tar emulsion spray seal coat with sand aggregate.** The aggregate material shall be a dry, clean, dust and dirt free, sound, durable, angular shaped manufactured specialty sand, such as that used as an abrasive, with a minimum Mohs hardness of six (6).

#### Gradation Requirements

Sieve Size	Percent Retained
No. 20	0-2
No. 30	0-12
No. 40	2-60
No. 50	5-60
No. 70	5-60
No. 100	5-30
No. 140	0-10
No. 200	0-2
Finer than No. 200	0-0.3

Locally available Department gradations may be blended to meet the aggregate requirements.

- 629-2.2 Thermoplastic coal tar emulsion.** The emulsion material shall be a thermoplastic coal tar emulsion made up of plastic resin and emulsified coal tar pitch. The thermoplastic coal tar emulsion shall be manufactured as a complete product and tested at the manufacturing plant for material certification. The cured thermoplastic coal tar emulsion sample must pass the fuel-resistance test in accordance with ASTM D5727.

The Contractor shall furnish the manufacturer's certification of analysis (COA) that all thermoplastic coal tar emulsion shipped to the project meets the following testing requirements:

### Thermoplastic Coal Tar Emulsion Properties

Property	Standard	Requirement
Water content	ASTM D5727, Section 6.1.6	≤58%
Ash of Residue	ASTM D5727, Section 6.1.9	≤ 15%
Flexibility	ASTM D5727, Section 6.1.14	1 rating
Resistance to Kerosene	ASTM D5727, Section 6.1.12	Pass with no loss of adhesion and no softening of film
Softening Point	ASTM D36	>212°F

- a. **Health, safety, and environment.** The Contractor must provide a complete safety data sheet (SDS) in accordance with U.S. Department of Labor, Occupational Safety and Health Administration (OSHA), Regulations (Standards – 29 CFR), 1910.1200 which establishes the requirement and minimum information for the SDS for hazardous materials. The SDS, Section II, shall include the Chemical Abstracts Service (CAS) registry numbers for all applicable hazardous ingredients in the coal tar emulsion product. The Contractor must provide the manufacturer's certification that the product complies with the Code of Federal Regulation (CFR) Title 40 – Protection of Environment. The manufacturer's certification shall address compliance for Air Programs, Part 59, National Volatile Organic Compound Emission Standards for Consumer and Commercial Products (for the airport location) and Water Programs, Part 116, Designation of Hazardous Substances.

**629-2.3 Water.** Water used in mixing or curing shall be from potable water sources. Other sources shall be tested in accordance with AASHTO T 26 and must be approved by the Engineer prior to use. The temperature of the water added during mixing shall be at least 50°F.

**629-2.4 Handling and storage.** All emulsion stored on-site shall be agitated at least once per day for a minimum of 15 minutes. The distributor or applicator, pumps and all tools shall be maintained in satisfactory working condition. Spray bar nozzles, pumps, or other equipment can be cleaned mechanically or with clean water.

**629-2.5 Friction characteristics.** Thermoplastic coal tar emulsion micro-surface and sand slurry installations do not require friction testing.

For projects where thermoplastic coal tar emulsion spray seal coat is applied on runway and taxiway surfaces, friction test data in accordance with the current Federal Aviation Administration Advisory Circular (AC) 150/5320-12, *Measurement, Construction, and Maintenance of Skid Resistant Airport Pavement Surfaces*, at 40 or 60 miles per hour wet, must include as a minimum; the friction value of pavement surface prior to sealant application; two (2) values, between 24 and 96 hours after application, with a minimum of 24 hours between tests; and one (1) value between 180 days and 360 days after the application. The results of the tests between 24 and 96 hours shall indicate friction is increasing at a rate to obtain similar friction value of the pavement surface prior to application, and the long-term test shall indicate no apparent adverse effect with time relative to friction values and existing pavement surface.

Thermoplastic coal tar emulsion spray seal coat material submittals without required friction performance will not be approved. Friction tests performed on this project cannot be used as a substitute of this requirement.

### COMPOSITION AND APPLICATION

**629-3.1 Application rate.** Based on the data in this specification, the Contractor shall submit the proportions of thermoplastic coal tar emulsion and aggregate proposed for use to the Engineer

for approval prior to the start of operations. No thermoplastic coal tar emulsion shall be produced for payment until a job mix formula has been approved in writing by the Engineer.

**a. Thermoplastic coal tar emulsion micro-surface.**

Type A aggregate thermoplastic coal tar emulsion micro-surface is generally used for:

- Existing pavements that are moderately rough and raveled and require a substantially improved surface profile or wearing surface.
- Pavements that may require improvement of skid-resistance.
- Areas that require wear protection, oxidation protection and chemical/fuel resistance.

Type B aggregate thermoplastic coal tar emulsion micro-surface is generally used for:

- Existing pavements that are raveled or smooth and require an improved surface profile or wearing surface.
- Pavements that may require improvement of skid-resistance.
- Areas that require wear protection, oxidation protection and chemical/fuel resistance.

The approximate amounts of material for the micro-surface treatment shall be as provided in the following table.

**Application Rate**

Aggregate Type	Composition <sup>1</sup> (lb/gal)	Application Rate <sup>2</sup> (lb/yd <sup>2</sup> )
A	22-24	8
B	20-22	6.5

1. Aggregate (pounds) shall be mixed homogeneously with the thermoplastic coal tar emulsion (gallons).
2. Minimum application rate of uncured thermoplastic coal tar emulsion micro-surface.

**b. Thermoplastic coal tar emulsion sand slurry seal.** The approximate amounts of material for the sand slurry seal surface treatment shall be as provided in the following table.

**Application Rate**

Composition <sup>1</sup> (lb/gal)	Application Rate <sup>2</sup> (lb/yd <sup>2</sup> )
17-19	4

1. Aggregate (pounds) shall be mixed homogeneously with the thermoplastic coal tar emulsion (gallons).
2. Minimum application rate of uncured thermoplastic coal tar emulsion sand slurry seal.



- c. **Thermoplastic coal tar emulsion spray seal coat with or without sand aggregate.** The approximate amounts of material for the spray seal coat shall be as provided in the following tables.

#### Application Rate without Aggregate

Composition	Application Rate (gal/yd <sup>2</sup> )
75% thermoplastic coal tar emulsion and 25% water (±5%)	0.15-0.25

#### Application Rate with Aggregate

Application Coat	Composition <sup>1</sup> (lb/gal)	Application Rate <sup>2</sup> per Coat (gal/yd <sup>2</sup> )	Total Application Rate <sup>2</sup> (gal/yd <sup>2</sup> )
1	6	0.20-0.30	0.20-0.30
2	3	0.10-0.15	0.20-0.30

- Aggregate (pounds) shall be mixed with the undiluted thermoplastic coal tar emulsion (gallons).
- Minimum application rate of uncured thermoplastic coal tar emulsion spray seal coat.

- 629-3.2 Control strip.** Prior to full application, the control strip must be accepted by the Engineer. The surface preparation, personnel, equipment and method of operation used on the control strip shall be the same as used on the remainder of the work.

A qualified manufacturer's representative shall be present in the field to assist the Contractor in applying control strip to determine the quality of the mixture in place as well as the performance of the equipment. The Contractor shall prepare a control strip at the specified application rate.

If the control strip should prove to be unsatisfactory, necessary adjustments to the application rate, placement operations, and equipment shall be made. Additional control strips shall be placed, and additional skid resistance tests performed and evaluated. Full production shall not begin without the Engineer's approval of an appropriate application rate.

- Thermoplastic coal tar emulsion micro-surface and sand slurry installations.** For projects calling for application of the thermoplastic coal tar emulsion micro-surface and sand slurry installations, the Contractor shall prepare a control strip of a minimum 16 feet wide by 100 feet long at the specified application rate. The control strip should be separated by a minimum of 200 feet between sections. The control strip will be designated by the Engineer.
- Thermoplastic coal tar emulsion spray seal coat.** For projects calling for application of the thermoplastic coal tar emulsion spray seal coat, the control strip procedure is dependent on the use of the pavement.
  - For taxiway, taxilane and apron surfaces.** The Contractor shall place a control strip as recommended by the manufacturer's representative and acceptable to the Engineer. The control strip will be located on a representative section of the pavement to receive the thermoplastic coal tar emulsion spray seal coat designated by the Engineer.
  - For runway and high-speed taxiway surfaces.** The Contractor shall place a control strip a minimum of 300 feet long by 12 feet wide, or width of anticipated application, whichever is greater, as recommended by the manufacturer's representative and acceptable to the Engineer. The control strip should be separated by a minimum of 200 feet between sections. The control strip will be designated by the Engineer. The

control strip should be placed under similar field conditions as anticipated for the actual application. Before beginning the control strip, the skid resistance of the existing pavement shall be determined for each control strip with a continuous friction measuring equipment (CFME). The skid resistance test after application shall be at approximately the same location as the test done on the existing pavement.

The Contractor may begin testing the skid resistance of runway and high-speed exit taxiway control strips after application of the thermoplastic coal tar emulsion spray seal has fully cured. Aircraft shall not be permitted on the runway or high-speed exit taxiway control strips for a minimum of 24 hours and until such time as the Contractor validates that its surface friction meets the maintenance planning friction levels in the current Federal Aviation Administration Advisory Circular (AC) 150/5320-12, *Measurement, Construction, and Maintenance of Skid-resistant Airport Pavement Surfaces*, Table 3-2, when tested at speeds of 40 and 60 miles per hour wet with approved CFME.

### CONSTRUCTION METHODS

**629-4.1 Worker safety.** The Contractor shall obtain a safety data sheet (SDS) for both the thermoplastic coal tar emulsion product and aggregate and require workmen to follow the manufacturer's recommended safety precautions. All additional industry standard safety precautions regarding the storage and applications of asphalts should be understood and followed by the Contractor.

**629-4.2 Weather limitations.** The material shall not be applied when the humidity or impending weather conditions will not allow proper drying or when the atmospheric or pavement temperature is below 50°F.

Cover existing buildings, structures, runway edge lights, taxiway edge lights, informational signs, retro-reflective marking and in-pavement duct markers as necessary to protect against overspray before applying the emulsion. Should thermoplastic coal tar emulsion surface treatment get on any light or marker fixture, promptly clean the fixture. If cleaning is not satisfactory to the Resident Engineer, the Contractor shall replace any light, sign or marker with equivalent equipment at the Contractor's expense.

**629-4.3 Equipment and tools.** The Contractor shall furnish all equipment, tools, and machinery necessary for the performance of this work.

**a. Mobile mixing machine.** The mobile mixing machine shall be a truck-mounted mobile mixing plant with a towed-type spreader box. It shall have a water tank and water pump capable of delivering a constant volume of water.

The mobile mixing machine shall have an agitated storage tank for the thermoplastic coal tar emulsion and a non-shearing peristaltic pump with variable rate of flow for the delivery of this material. The mobile mixing machine shall have a hopper for holding aggregate, supplying this material to the mixing chamber by a conveyor belt. The rate of aggregate delivery shall be mechanically dependent upon the speed of the peristaltic pump.

The mobile mixing machine shall be a continuous-flow mixing unit capable of delivering predetermined quantities of thermoplastic coal tar emulsion, aggregate, and if necessary, water, to the mixing chamber and discharging the thoroughly mixed material on a continuous basis. The mobile mixing machine shall deliver the materials to the mixing chamber in a constant proportion in a manner not dependent on power plant or vehicle speed. The machine shall be equipped with a water spray bar capable of fogging the pavement surface to aid in the application process.

Attached to the mixing machine shall be a mechanical-type squeegee distributor, equipped with flexible material in contact with the surface to prevent loss of material from the distributor. It shall be maintained to prevent loss of micro-surfacing on varying grades and adjusted to assure uniform spread. The spreader box may have an adjustable width.

- b. Prime/seal coat distributor.** The prime/seal coat distributor shall be either a truck-mounted 300 to 3,000 gallon or a trailer-mounted unit with a 300 to 1,000- gallon tank containing suitably driven mixing blades to combine predetermined quantities of thermoplastic emulsion and water into a homogeneous mixture. It shall be equipped with a diaphragm style pump capable of delivering a constant volume of material to a spray wand or spray bar. The device shall have a bottom ball valve capable of delivering material to a squeegee spreader or a drag box.
- c. Auxiliary equipment.** Other tools or equipment such as power brooms, power blowers, air compressors, hand brooms, hand squeegees, etc., shall be provided as required.
- d. Equipment calibration.** The Contractor shall furnish all equipment, materials and labor necessary to calibrate the equipment. It shall be calibrated to assure that it will produce and apply a mix that conforms to the job mix formula. Commercial equipment should be provided with a method of calibration by the manufacturer. All calibrations shall be made with the approved job materials prior to applying the slurry seal to the pavement. A copy of the calibration test results shall be furnished to the Engineer.

**629-4.4 Preparation of asphalt pavement surfaces.** Clean the pavement surface immediately prior to placing the surface treatment by sweeping, flushing well with water leaving no standing water, or a combination of both, so that it is free of dust, dirt, grease, vegetation, oil or any type of objectionable surface film. Remove oil or grease that has not penetrated the asphalt pavement by scraping or by scrubbing with a detergent, then wash thoroughly with clean water. After cleaning, treat these areas with an oil spot primer. Any additional surface preparation, such as crack repair, shall be in accordance with Item 101 titled PREPARATION/REMOVAL OF EXISTING PAVEMENTS.

**629-4.5 Application of prime coat.** After preparation of the pavement and acceptance by the Resident Engineer, the prime coat shall be applied to the pavement surface only where thermoplastic coal tar emulsion micro-surface or sand slurry seal will be applied. Apply a tack primer coat of thermoplastic coal tar emulsion diluted with 50% water at the rate of 0.10 gallons of mix per square yard.

**629-4.6 Application of micro-surface and sand slurry seal.** The surface shall be pre-wet by fogging ahead of the spreader box. Water used in pre-wetting the surface shall be applied at such a rate that the entire surface is damp with no apparent flowing water in front of the spreader box. If temperatures are in the colder acceptable range the rate of fogging may be decreased. The mixture shall be of the desired consistency when deposited on the surface, and no additional elements shall be added. A sufficient amount of mixture shall be carried in the spreader box at all times so that even distribution is obtained. No clumped or unmixed aggregate shall be permitted. No segregation of the emulsion and aggregate fines from the coarse aggregate will be permitted.

Upon completion of the work, the thermoplastic coal tar emulsion micro-surface or sand slurry seal shall have no bare spots or cracks through which liquids or foreign matter could penetrate to the underlying pavement. The finished surface shall present a uniform texture.

In areas where the spreader box cannot be used, the thermoplastic coal tar emulsion micro-surface or sand slurry seal shall be applied by a means of a hand squeegee.

**629-4.7 Application of spray seal coat.** Pavement surfaces which have excessive runoff of seal coat due to excessive amount of material being applied or excessive surface grade shall be treated in two (2) or more applications to the specified application rate at the Contractor's expense. If multiple coats are specified, each coat shall be allowed to dry and cure initially before applying any subsequent coats. The initial drying shall allow evaporation of water of the applied mixture, resulting in the coating being able to sustain light foot traffic.

If low spots and depressions greater than one-half (1/2) inch in depth in the pavement surface cause ponding or puddling of the applied materials, the pavement surface shall be broomed with a broom drag. Brooming shall continue until the pavement surface is free of any pools of excess

material. Ponding and/or puddling shall not cause excessive pavement softening and/or additional distress.

During all applications, the surfaces of adjacent structures shall be protected to prevent their being spattered or marred. Thermoplastic coal tar emulsion materials shall not be discharged into borrow pits or gutters.

- 629-4.8 Protection.** Keep all traffic off surfaces freshly treated with thermoplastic coal tar emulsion. Provide sufficient warning signs and barricades so that traffic will not travel over freshly treated surfaces. The fresh emulsion application shall be protected by barricades and markers and shall be permitted to dry for a minimum of 24 hours after the application, before opening to traffic or painting, and shall be sufficiently cured to drive over without damage to the installation.

Any damage to the uncured mixture caused by the Contractor will be the responsibility of the Contractor to repair.

### QUALITY CONTROL (QC)

- 629-5.1 Quality control (QC).** The Contractor shall have a manufacturer's authorized representative on the job site at the beginning of the work and during all thermoplastic coal tar emulsion surface treatments. The manufacturer's representative shall have knowledge of the material, procedures, and equipment described in the specification and shall be responsible for verifying the job mix formula submitted to the Engineer and shall oversee the preparation and application of the thermoplastic coal tar emulsion surface treatment. Documentation of the manufacturer representative's experience and knowledge for applying the thermoplastic coal tar emulsion surface treatment shall be furnished to the Engineer a minimum of ten (10) working days prior to placement of the control strip. The cost of the manufacturer's representative shall be considered incidental to the contract and a subsidiary obligation of the Contractor.

- 629-5.2 QC plan.** The Contractor shall submit a QC plan to the Engineer a minimum of ten (10) days prior to placement of the control strip. The QC plan must address all items that affect the quality of the thermoplastic coal tar emulsion surface treatment including, but not limited to:

- a. Qualifications of personnel.
- b. Schedule for the project.
- c. Procedure to monitor the weather/temperature limitations.
- d. Inspection requirements including rejuvenation product, control strips, storage of rejuvenation product, preparation of the pavement surface, and equipment calibration.
- e. Provisions for obtaining, packaging and shipping acceptance samples and repair of the pavement.
- f. Provisions for sample testing, testing laboratory name, location, accreditation, contact person, all contact information, testing requested, and report on information.

- 629-5.3 Manufacturer sampling.** A sample of undiluted thermoplastic coal tar emulsion shall be obtained at the production facility from each consignment shipped to the job. Manufacturer shall store the samples in containers that are sealed against contamination and retained for a period of six (6) months. Samples shall be stored at room temperature and not be subjected to freezing temperatures.

- 629-5.4 Field emulsion sampling.** All emulsion sampling methods shall be in accordance with ASTM D140. Samples must be taken from the center of an agitated bulk storage tank after a minimum of 15 minutes of continual agitation.

- 629-5.5 Field composite mix sampling.** Composite mix of thermoplastic coal emulsion and aggregate shall be taken directly from the pug mill of the mobile mixing machine for micro-surface and sand

slurry installations into a sealed one (1) gallon container to be weighed. The minimum weight of composite mix shall be the following:

- a. Type A Micro-Surface Composite Mix – Minimum 14 pounds per gallon
- b. Type B Micro-Surface Composite Mix – Minimum 13.5 pounds per gallon
- c. Sand Slurry Composite Mix – Minimum 13 pounds per gallon

### MATERIAL ACCEPTANCE

**629-6.1 Application rate.** The rate of application of the thermoplastic coal tar emulsion shall be verified at least twice per day.

**629-6.2 Friction tests.** Thermoplastic coal tar emulsion micro-surface and sand slurry installations do not require friction testing.

For spray seal versions only. Friction tests shall be run within 30 days prior to application of the seal coat to runway and/or high-speed taxiways and after application of the seal coat. Friction tests in accordance with the current Federal Aviation Administration Advisory Circular (AC) 150/5320-12, *Measurement, Construction, and Maintenance of Skid-Resistant Airport Pavement Surfaces*, shall be accomplished on all runway and high-speed taxiways that have received a seal coat. Each test includes performing friction tests at 40 and 60 miles per hour both wet, 15 feet to each side of the runway centerline. The Contractor shall coordinate testing with the Resident Engineer and provide the Resident Engineer a written report of friction test results. The Resident Engineer shall be present for testing.

Prior to opening the pavement to aircraft operations, the pavement friction evaluation must be equal or greater than the minimum levels provided in *Table 3-2, "Friction Level Classification for Runway Pavement Surfaces,"* in the current Federal Aviation Administration Advisory Circular (AC) 150/5320-12, *Measurement, Construction, and Maintenance of Skid-resistant Airport Pavement Surfaces*, when tested at speeds of 40 and 60 miles per hour with approved continuous friction measuring equipment (CFME).

**629-6.3 Freight and weigh bills.** A weight ticket for each truck load shall be furnished to the Resident Engineer. The truck shall be weighed at a location approved by the Engineer. The ticket shall show the weight of the empty truck (the truck being weighed each time before it is loaded), the weight of the loaded truck, and the net weight of the bituminous material.

### METHOD OF MEASUREMENT

**629-7.1** The quantity of thermoplastic coal tar emulsion surface treatment shall be measured for payment by the number square yards as specified, completed, and accepted by the Resident Engineer.

### BASIS OF PAYMENT

**629-8.1** Payment for accepted quantities of work performed by the Contractor and measured by the Resident Engineer shall be made at the contract unit as specified in paragraph 629-7.1 of this section. Payment shall be full compensation for all surface preparation, furnishing all materials, delivery and application of these materials, for all labor, equipment, tools, and any costs associated with furnishing a qualified manufacturer's representative to assist with control strips, and incidentals necessary to complete the work as specified.

**REFERENCES**

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

**ASTM International (ASTM)**

ASTM D 36	Standard Test Method for Softening Point of Bitumen (Ring-and-Ball Apparatus)
ASTM D 140	Standard Practice for Sampling Bituminous Materials
ASTM D 5727	Standard Specification for Emulsified Refined Coal Tar (Mineral Colloid Type)

**American Association of State Highway and Transportation Officials (AASHTO)**

AASHTO T 26	Standard Method of Test for Quality of Water to Be Used in Concrete
AASHTO T 96	Standard Method of Test for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine

**Code of Federal Regulations (CFR)**

29 CFR Part 1910.1200	Hazard Communication
40 CFR	Protection of the Environment

**Federal Aviation Administration Advisory Circulars (AC)**

AC 150/5320-12	Measurement, Construction, and Maintenance of Skid-Resistant Airport Pavement Surfaces
AC 150/5320-17	Airfield Pavement Surface Evaluation and Rating (PASER) Manuals

**Illinois Department of Transportation, Bureau of Materials Policy Memoranda (PM)**

PM 11-08	Aggregate Gradation Control System (AGCS)
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**END OF ITEM 629**

## Item 630 Refined Coal Tar Emulsion without Additives, Slurry Seal Surface Treatment

### DESCRIPTION

- 630-1.1** This item shall consist of a mixture of refined coal tar emulsion, mineral aggregate, and water properly proportioned, mixed, and spread on new or existing asphalt pavement surface as specified in the contract documents or as directed by the Resident Engineer.

A refined coal tar emulsion without additives, slurry seal surface treatment is intended for use on apron locations serving airplanes 60,000 pounds or less; however, may be used on all pavements on general aviation airports serving airplanes 12,500 pounds or less; and any pavements on which aircraft do not operate including shoulders, overruns, roads, and parking areas. The purpose of this refined coal tar emulsion product is to provide a fuel-resistant surface where pavements are subjected to fuel spills.

### MATERIALS

- 630-2.1 Aggregate.** The aggregate material shall be washed dry silica sand or boiler slag free of dust, trash, clay, organic materials or other deleterious substances. The Contractor shall submit specialty aggregate manufacturer's certificate of analysis (COA) indicating that the specialty aggregate meets the requirements of the specification to the Resident Engineer prior to start of construction. The aggregate must be approved for use by the Engineer. The aggregate must be approved by the Engineer and shall meet the requirements of the gradation given in the following table when tested per the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 11-08, *Aggregate Gradation Control System (AGCS)*.

#### Gradation Requirements

Sieve Size	Gradation Percent Retained
No. 20 or coarser	0-2
No. 30	0-12
No. 40	2-60
No. 50	5-60
No. 70	5-60
No. 100	5-30
No. 140	0-10
No. 200	0-2
Finer than No. 200	0-0.3

Locally available Department gradations may be blended to meet the aggregate requirements.

- 630-2.2 Refined coal tar emulsion.** A refined coal tar emulsion prepared from a high temperature refined coal tar conforming to the requirements of ASTM D490 for grade 11-12. The use of oil and water gas tar is not allowed. Base refined coal tar emulsion must conform to all requirements of ASTM D5727.

The Contractor shall provide a copy of the manufacturer's certificate of analysis (COA) for the emulsified asphalt delivered to the project. If the asphalt emulsion is diluted at other than the manufacturer's facility, the Contractor shall provide a supplemental COA from an independent laboratory verifying the asphalt emulsion properties.

The COA shall be provided to and approved by the Engineer before the emulsified asphalt is applied. The furnishing of the vendor's certified test report for the asphalt material shall not be interpreted as a basis for final acceptance. The manufacturer's COA may be subject to verification by testing the material delivered for use on the project.

**a. Health, safety, and environment.** The Contractor must provide a complete safety data sheet (SDS) in accordance with U.S. Department of Labor, Occupational Safety and Health Administration (OSHA), Regulations (Standards – 29 CFR), 1910.1200 which establishes the requirement and minimum information for the MSDS for hazardous materials. The MSDS, Section II, shall include the Chemical Abstracts Service (CAS) registry numbers for all applicable hazardous ingredients in the coal tar emulsion product. The Contractor must provide the manufacturer's certification that the product complies with the Code of Federal Regulation (CFR) Title 40 – Protection of Environment. The manufacturer's certification shall address compliance for Air Programs, Part 59, National Volatile Organic Compound Emission Standards for Consumer and Commercial Products (for the airport location) and Water Programs, Part 116, Designation of Hazardous Substances.

- 630-2.3 Crack sealant.** Crack sealant shall be certified for compatibility with the refined coal tar emulsion by the manufacturer of the refined coal tar emulsion, and approved by the Engineer.
- 630-2.4 Oil spot primer.** Oil spot primer shall be certified for compatibility with the refined coal tar emulsion by the manufacturer of the refined coal tar emulsion, and approved by the Engineer.
- 630-2.5 Pavement primer.** Pavement primer shall be certified for compatibility with the refined coal tar emulsion by the manufacturer of the refined coal tar emulsion, and approved by the Engineer.
- 630-2.6 Water.** Water used in mixing or curing shall be from potable water sources and at least 50°F. Other sources shall be tested in accordance with AASHTO T 26 and must be approved by the Engineer prior to use. The pH of the water shall conform to the requirements of the coal tar emulsion manufacturer.
- 630-2.7 Friction characteristics.** Not required.

### COMPOSITION AND APPLICATION

- 630-3.1 Application rate.** The Contractor shall submit the recommended formulation of water, emulsion, aggregate and application rate proposed for use to a testing laboratory together with sufficient materials to verify the formulation at least ten (10) days prior to the start of operations. The mix design shall be within the range shown in the table below. No seal coat shall be produced for payment until a mix has been approved by the Engineer. The formulation shall pass the fuel resistance test in accordance with ASTM D5727.

The mix formula for each mixture shall be in effect until modified in writing by the Engineer.

#### Application Rate

Application	Refined Coal Tar Emulsion (gal.)	Water (gal.)	Aggregate (lb.)	Application Rate	
				Minimum (gal./yd <sup>2</sup> )	Maximum (gal./yd <sup>2</sup> )
<b>Prime Coat (where required) as specified by the coal tar emulsion manufacturer</b>					
1st Seal Coat	100	25-30	300-500	0.12	0.17
2nd Seal Coat	100	25-30	300-500	0.12	0.17



The numbers shown in the table represent the maximum recommended range of values. In all cases, the refined coal tar emulsion supplier is to give written approval of specific composition numbers to be used in the mix design.

Additional coats may be specified for greater durability.

Application rates are not to exceed 0.17 gallons per square yard per coat, and at no time are total coats to exceed 0.51 gallons per square yard.

- 630-3.2 Control strip.** Prior to full application, a control strip must be accepted by the Engineer. The surface preparation, personnel, equipment and method of operations used on the control strip shall be the same as used on the remainder of the work.

A qualified manufacturer's representative shall be present in the field to assist the Contractor in applying the control strip to determine the appropriate application rate of both emulsion and sand to be evaluated and approved by the Engineer.

The Contractor shall prepare a quantity of mixture in the proportions shown in the approved mix design sufficient to place a control strip a minimum of 250 square yards at the rate specified. The test area shall be designated by the Engineer and will be located on a representative section of the pavement to be seal coated. Separate control strips by a minimum of 200 feet between sections. The actual application rate will be determined by the Engineer during placement of the control strip and will depend on the condition of the pavement surface.

If the control strip proves to be unsatisfactory, the necessary adjustments to the job mix formula, application rate, placement operations, and equipment shall be made. Additional control strips shall be placed and evaluated. Full production shall not begin without the Engineer's approval.

### CONSTRUCTION METHODS

- 630-4.1 Worker safety.** The Contractor shall obtain a safety data sheet (SDS) for both the asphalt emulsion product and sand and require workmen to follow the manufacturer's recommended safety precautions. All additional industry standard safety precautions regarding the storage and applications of asphalts should be understood and followed by the Contractor.

- 630-4.2 Weather limitations.** The seal coat shall not be applied when the surface is wet or when the humidity or impending weather conditions will not allow proper curing. The seal coat shall be applied only when the atmospheric or pavement temperature is 50°F and rising and is expected to remain above 50°F for 24 hours.

- 630-4.3 Equipment and tools.** The Contractor shall furnish all equipment, tools, and machinery necessary for the performance of the work.

- a. Distributors.** Distributors or spray units used for the spray application of the seal coat shall be self-propelled and capable of uniformly applying 0.12 to 0.55 gallons per square yard of material over the required width of application. Distributors shall be equipped with removable manhole covers, tachometers, pressure gauges, and volume-measuring devices.

The mix tank shall have a mechanically powered, full-sweep, mixer with sufficient power to move and homogeneously mix the entire contents of the tank.

The distributor shall be equipped with a positive placement pump so that a constant pressure can be maintained on the mixture to the spray nozzles.

- b. Mixing equipment.** The mixing machine shall have a continuous flow mixing unit capable of accurately delivering a predetermined proportion of aggregate, water, and emulsion, and of discharging the thoroughly mixed product on a continuous basis. The mixing unit shall be capable of thoroughly blending all ingredients together and discharging the material to the spreader box without segregation.

- c. **Spreading equipment.** Spreading equipment shall be a mechanical-type squeegee distributor attached to the mixing machine, equipped with flexible material in contact with the surface to prevent loss of slurry from the spreader box. It shall be maintained to prevent loss of slurry on varying grades and adjusted to assure uniform spread. There shall be a lateral control device and a flexible strike-off capable of being adjusted to lay the slurry at the specified rate of application. The spreader box shall have an adjustable width. The box shall be kept clean; coal tar emulsion and aggregate build-up on the box shall not be permitted.
- d. **Hand squeegee or brush application.** The use of hand spreading application shall be restricted to places not accessible to the mechanized equipment or to accommodate neat trim work at curbs, etc. Material that is applied by hand shall meet the same standards as that applied by machine.
- e. **Equipment calibration.** The Contractor shall furnish all equipment, materials and labor necessary to calibrate the equipment. It shall be calibrated to assure that it will produce and apply a mix that conforms to the job mix formula. Commercial equipment should be provided with a method of calibration by the manufacturer. All calibrations shall be made with the approved job materials prior to applying the seal coat to the pavement. A copy of the calibration test results shall be furnished to the Resident Engineer. No machine will be allowed to work on the project until the calibration has been completed and/or accepted by the Engineer.

**630-4.4 Preparation of asphalt pavement surfaces.** Clean the pavement surface immediately prior to placing the seal coat by sweeping, flushing well with water leaving no standing water, or a combination of both, so that it is free of dust, dirt, grease, vegetation, oil or any type of objectionable surface film. Remove oil or grease that has not penetrated the asphalt pavement by scraping or by scrubbing with a detergent, then wash thoroughly with clean water. After cleaning, treat these areas with an oil spot primer. Any additional surface preparation, such as crack repair, shall be in accordance with Item 101 titled PREPARATION/REMOVAL OF EXISTING PAVEMENTS.

**630-4.5 Mixing.** Blend the coal tar emulsion mixture. The mixing must produce a smooth homogeneous mixture of uniform consistency. Consult the coal tar emulsion supplier for its recommended order of addition of the ingredients. During the entire mixing and application process, no breaking, segregating or hardening of the emulsion, nor balling or lumping of the sand is to be permitted. Continue to agitate the seal coat mixture in the mixing tank at all times prior to and during application so that a consistent mix is available for application.

Small additional increments of water may be needed to provide a workable consistency, but in no case is the water content to exceed the specified amount.

**630-4.6 Application of slurry seal surface treatment.** In order to provide maximum adhesion, the pavement shall be dampened with a fog spray of water if recommended by the supplier. No standing water shall remain on the surface.

If a prime coat is required, mix and apply the prime coat.

The aggregate filled slurry seal surface treatment shall be applied at a uniform rate as specified in the contract documents.

Each coat shall be allowed to dry and cure initially before applying any subsequent coats. The initial drying shall allow evaporation of water of the applied mixture, resulting in the coating being able to sustain light foot traffic. The initial curing shall enable the mixture to withstand vehicle traffic without damage to the seal coat.

Apply the second coat in the same manner as outlined for the first coat.

Additional coats shall be applied over the entire surface as directed by the Resident Engineer.

The finished surface shall present a uniform texture.

- 630-4.7 Protection.** Keep all traffic off surfaces freshly treated with coal tar emulsion. Provide sufficient warning signs and barricades so that traffic will not travel over freshly treated surfaces. The fresh emulsion application shall be protected by barricades and markers and shall be permitted to dry a minimum of eight (8) hours in dry daylight conditions before opening to traffic, and initially cure enough to support vehicular traffic without damage to the seal coat. Where marginal weather conditions exist during the eight (8) hour drying time, additional drying time shall be required. The length of time shall be as specified by the supplier. The surface shall be checked after the additional drying time for trafficability before opening the section to vehicle traffic.
- 630-4.8 Pavement marking.** Where pavement marking is required, the paint used shall meet the requirements of Item 620 titled RUNWAY AND TAXIWAY MARKING, shall be compatible with the seal coat and as recommended by the coal tar emulsion manufacturer.

### CONTRACTOR QUALITY CONTROL

- 630-5.1 Quality control (QC).** The Contractor shall have a manufacturer's authorized representative on the job site at the beginning of the work and during all refined coal tar emulsion surface treatments. The manufacturer's representative shall have knowledge of the material, procedures, and equipment described in the specification and shall be responsible for determining the application rates and shall oversee the preparation and application of the refined coal tar emulsion surface treatment. Documentation of the manufacturer representative's experience and knowledge for applying the refined coal tar emulsion surface treatment shall be furnished to the Engineer a minimum of ten (10) working days prior to placement of the control strip. The cost of the manufacturer's representative shall be considered incidental to the contract and a subsidiary obligation of the Contractor.
- 630-5.2 QC plan.** The Contractor must submit a QC plan to the Engineer a minimum of ten (10) days prior to placement of the control strip. The QC plan must address all items that affect the quality of the refined coal tar emulsion surface treatment including, but not limited to:
- a. Qualifications of personnel.
  - b. Schedule for the project.
  - c. Procedure to monitor the weather/temperature limitations.
  - d. Inspection requirements including refined coal tar emulsion, control strips, storage of refined coal tar emulsion, preparation of the pavement surface, and equipment calibration.
  - e. Provisions for obtaining, packaging and shipping acceptance samples and repair of the pavement.
  - f. Provisions for sample testing, testing laboratory name, location, accreditation, contact person, all contact information, testing requested, and report on information.
- 630-5.3 Sampling.** A minimum of one (1) sample per day shall be tested for the properties specified in the contract documents. A random sample of approximately one (1) quart of the composite mix will be obtained daily by the Contractor in the presence of the Resident Engineer and stored in a glass container. The containers shall be sealed against contamination and retained in storage by the Resident Engineer for a period of six (6) months. Samples shall be stored at room temperature and not be subjected to freezing temperatures.
- A sample of undiluted coal tar emulsion shall be obtained from each consignment shipped to the job.
- 630-5.4 Records.** The Contractor shall maintain an accurate record of each batch of materials used in the formulation of the seal coat and provide the documentation to the Resident Engineer daily.

### MATERIAL ACCEPTANCE

- 630-6.1 Application rate.** The rate of application of the refined coal tar emulsion shall be verified at least twice per day.
- 630-6.2 Freight and weigh bills.** A weight ticket for each truck load shall be furnished to the Resident Engineer. The truck shall be weighed at a location approved by the Engineer. The ticket shall show the weight of the empty truck (the truck being weighed each time before it is loaded), the weight of the loaded truck, and the net weight of the bituminous material.

### METHOD OF MEASUREMENT

- 630-7.1** The quantity of refined coal tar emulsion shall be measured for payment by the number of gallons as specified, completed, and accepted by the Resident Engineer. Only the actual quantity of undiluted refined coal tar emulsion will be measured for payment.

### BASIS OF PAYMENT

- 630-8.1** Payment for accepted quantities of work performed by the Contractor and measured by the Resident Engineer shall be made at the contract unit as specified in paragraph 630-7.1 of this section. Payment shall be full compensation for all surface preparation, furnishing all materials, delivery and application of these materials, for all labor, equipment, tools, and any costs associated with furnishing a qualified manufacturer's representative to assist with control strips, and incidentals necessary to complete the work as specified.

### REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

#### **ASTM International (ASTM)**

ASTM D 490	Standard Specification for Road Tar
ASTM D 5727	Standard Specification for Emulsified Refined Coal Tar (Mineral Colloid Type)

#### **American Association of State Highway and Transportation Officials (AASHTO)**

AASHTO T 26	Standard Method of Test for Quality of Water to Be Used in Concrete
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#### **Code of Federal Regulations (CFR)**

29 CFR Part 1910.1200	Hazard Communication
40 CFR	Protection of the Environment

#### **Illinois Department of Transportation, Bureau of Materials Policy Memoranda (PM)**

PM 11-08	Aggregate Gradation Control System (AGCS)
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### END OF ITEM 630

## Item 631 Refined Coal Tar Emulsion with Additives, Slurry Seal Surface Treatment

### DESCRIPTION

- 631-1.1** This item shall consist of a mixture of refined coal tar emulsion, mineral aggregate, additives, and water properly proportioned, mixed, and spread on new or existing asphalt pavement surface as specified in the contract documents or as directed by the Resident Engineer.

A refined coal tar emulsion with additives, slurry seal surface treatment is intended for use on apron locations serving airplanes 60,000 pounds or less; however, may be used on all pavements on general aviation airports serving airplanes 12,500 pounds or less; and any pavements on which aircraft do not operate including shoulders, overruns, roads, and parking areas. The purpose of this refined coal tar emulsion product is to provide a fuel-resistant surface where pavements are subjected to fuel spills.

### MATERIALS

- 631-2.1 Aggregate.** The aggregate material shall be washed dry silica sand or boiler slag free of dust, trash, clay, organic materials or other deleterious substances. The Contractor shall submit specialty aggregate manufacturer's certificate of analysis (COA) indicating that the specialty aggregate meets the requirements of the specification to the Resident Engineer prior to start of construction. The aggregate must be approved for use by the Engineer and shall meet the requirements of the gradation given in the following table when per the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 11-08, *Aggregate Gradation Control System (AGCS)*.

#### Gradation Requirements

Sieve Size	Gradation Percent Retained
No. 20 or coarser	0-2
No. 30	0-12
No. 40	2-60
No. 50	5-60
No. 70	5-60
No. 100	5-30
No. 140	0-10
No. 200	0-2
Finer than No. 200	0-0.3

Locally available Department gradations may be blended to meet the aggregate requirements.

- 631-2.2 Refined coal tar emulsion.** A refined coal tar emulsion prepared from a high temperature refined coal tar conforming to the requirements of ASTM D490 for grade 11-12. The use of oil and water gas tar is not allowed. Base refined coal tar emulsion must conform to all requirements of ASTM D5727.

The Contractor shall provide a copy of the manufacturer's certificate of analysis (COA) for the emulsified asphalt delivered to the project. If the asphalt emulsion is diluted at other than the manufacturer's facility, the Contractor shall provide a supplemental COA from an independent laboratory verifying the asphalt emulsion properties.

The COA shall be provided to and approved by the Engineer before the emulsified asphalt is applied. The furnishing of the vendor's certified test report for the asphalt material shall not be interpreted as a basis for final acceptance. The manufacturer's COA may be subject to verification by testing the material delivered for use on the project.

**a. Health, safety, and environment.** The Contractor must provide a complete safety data sheet (SDS) in accordance with U.S. Department of Labor, Occupational Safety and Health Administration (OSHA), Regulations (Standards – 29 CFR, 1910.1200) which establishes the requirement and minimum information for the MSDS for hazardous materials. The MSDS, Section II, shall include the Chemical Abstracts Service (CAS) registry numbers for all applicable hazardous ingredients in the coal tar emulsion product. The Contractor must provide the manufacturer's certification that the product complies with the Code of Federal Regulation (CFR) Title 40 – Protection of Environment. The manufacturer's certification shall address compliance for Air Programs, Part 59, National Volatile Organic Compound Emission Standards for Consumer and Commercial Products (for the airport location) and Water Programs, Part 116, Designation of Hazardous Substances.

**631-2.3 Additive.** Additives are one (1) or more ingredients that can be added to a specific refined coal tar emulsion, water and/or sand mixture to improve the coatings final properties. These properties include durability, fuel resistance, drying time, color uniformity, and/or length of cure time. Additives may also be used to modify the wet mixture's viscosity to improve aggregate suspension.

The type of additive to be used shall be specified by the coal tar emulsion manufacturer and will depend on which final properties are desired.

**631-2.4 Crack sealant.** Crack sealant shall be certified for compatibility with the refined coal tar emulsion by the manufacturer of the refined coal tar emulsion, and approved by the Engineer.

**631-2.5 Oil spot primer.** Oil spot primer shall be certified for compatibility with the refined coal tar emulsion by the manufacturer of the refined coal tar emulsion, and approved by the Engineer.

**631-2.6 Pavement primer.** Pavement primer shall be certified for compatibility with the refined coal tar emulsion by the manufacturer of the refined coal tar emulsion, and approved by the Engineer.

**631-2.7 Water.** Water used in mixing or curing shall be from potable water sources and at least 50°F. Other sources shall be tested in accordance with AASHTO T 26 and must be approved by the Engineer prior to use.

**631-2.8 Friction characteristics.** Not required.

### COMPOSITION AND APPLICATION

**631-3.1 Composition.** The refined coal tar emulsion seal coat is to consist of a mixture of refined coal tar emulsion, water, additive and aggregate, and be proportioned as shown in the table below. The composition must have written approval of the coal tar emulsion manufacturer.

**631-3.2 Application rate.** The Contractor shall submit the recommended formulation of water, emulsion, aggregate and application rate proposed for use to a testing laboratory together with sufficient materials to verify the formulation at least ten (10) days prior to the start of operations. The mix design shall be within the range shown in the below table. No seal coat shall be produced for

payment until a mix has been approved by the Engineer. The formulation shall pass the fuel resistance test in accordance with ASTM D5727.

The mix for each mixture shall be in effect until modified in writing by the Engineer.

### Application Rate

Application	Refined Coal Tar Emulsion Gallons	Water Gallons	Additive Gallons	Aggregate Pounds	Application Rate	
					Minimum (gal./yd <sup>2</sup> )	Maximum (gal./yd <sup>2</sup> )
<b>Prime Coat (where required) as specified by the coal tar emulsion manufacturer</b>						
1st Seal Coat	100	25-70	2-6	300-700	0.12	0.20
2nd Seal Coat	100	25-70	2-6	300-700	0.12	0.20

The numbers shown in the table represent the maximum recommended range of values. In all cases, the refined coal tar emulsion supplier is to give written approval of specific composition numbers to be used in the mix design.

Application rates are not to exceed 0.20 gallons per square yard per coat, and at no time are total coats to exceed 0.51 gallons per square yard.

**631-3.3 Control strip.** Prior to full application, the control strip must be accepted by the Engineer. The surface preparation, personnel, equipment and method of operation used on the control strip shall be the same as used on the remainder of the work.

A qualified manufacturer's representative shall be present in the field to assist the Contractor in applying the control strip to determine the appropriate application rate of both emulsion and sand to be evaluated and approved by the Engineer.

The Contractor shall prepare a quantity of mixture sufficient to place a control strip a minimum of 250 square yards at the rate specified. The test area will be designated by the Engineer on a representative section of the pavement to be seal coated. Separate control strips by a minimum of 200 feet between sections. The actual application rate will be determined by the Engineer during placement of the control strip and will depend on the condition of the pavement surface.

If the control strip should prove to be unsatisfactory, necessary adjustments to the job mix formula, mix composition, application rate, placement operations, and equipment shall be made. Additional control strips shall be placed and evaluated. Full production shall not begin without the Engineer's approval.

### CONSTRUCTION METHODS

**631-4.1 Worker safety.** The Contractor shall obtain a safety data sheet (SDS) for both the asphalt emulsion product and sand and require workmen to follow the manufacturer's recommended safety precautions. All additional industry standard safety precautions regarding the storage and applications of asphalts should be understood and followed by the Contractor.

**631-4.2 Weather limitations.** The seal coat shall not be applied when the surface is wet or when the humidity or impending weather conditions will not allow proper curing. The seal coat shall be applied only when the atmospheric or pavement temperature is 50°F and rising and is expected to remain above 50°F for 24 hours.

**631-4.3 Equipment and tools.** The Contractor shall furnish all equipment, tools, and machinery necessary for the performance of the work.

**a. Distributors.** Distributors or spray units used for the spray application of the seal coat shall be self-propelled and capable of uniformly applying 0.12 to 0.55 gallons per square yard of material over the required width of application. Distributors shall be equipped with

removable manhole covers, tachometers, pressure gauges, and volume-measuring devices.

The mix tank shall have a mechanically powered, full-sweep, mixer with sufficient power to move and homogeneously mix the entire contents of the tank.

The distributor shall be equipped with a positive placement pump so that a constant pressure can be maintained on the mixture to the spray nozzles.

- b. Mixing equipment.** The mixing machine shall have a continuous flow mixing unit capable of accurately delivering a predetermined proportion of aggregate, water, and emulsion, and of discharging the thoroughly mixed product on a continuous basis. The mixing unit shall be capable of thoroughly blending all ingredients together and discharging the material to the spreader box without segregation.
- c. Spreading equipment.** Spreading equipment shall be a mechanical-type squeegee distributor attached to the mixing machine, equipped with flexible material in contact with the surface to prevent loss of slurry from the spreader box. It shall be maintained to prevent loss of slurry on varying grades and adjusted to assure uniform spread. There shall be a lateral control device and a flexible strike-off capable of being adjusted to lay the slurry at the specified rate of application. The spreader box shall have an adjustable width. The box shall be kept clean; coal tar emulsion and aggregate build-up on the box shall not be permitted.
- d. Hand squeegee or brush application.** The use of hand spreading application shall be restricted to places not accessible to the mechanized equipment or to accommodate neat trim work at curbs, etc. Material that is applied by hand shall meet the same standards as that applied by machine.
- e. Equipment calibration.** The Contractor shall furnish all equipment, materials and labor necessary to calibrate the equipment. It shall be calibrated to assure that it will produce and apply a mix that conforms to the job mix formula. Commercial equipment should be provided with a method of calibration by the manufacturer. All calibrations shall be made with the approved job materials prior to applying the seal coat to the pavement. A copy of the calibration test results shall be furnished to the Resident Engineer. No machine will be allowed to work on the project until the calibration has been completed and/or accepted by the Engineer.

**631-4.4 Preparation of asphalt pavement surfaces.** Clean the pavement surface immediately prior to placing the seal coat by sweeping, flushing well with water leaving no standing water, or a combination of both, so that it is free of dust, dirt, grease, vegetation, oil or any type of objectionable surface film. Remove oil or grease that has not penetrated the asphalt pavement by scraping or by scrubbing with a detergent, then wash thoroughly with clean water. After cleaning, treat these areas with an oil spot primer. Any additional surface preparation, such as crack repair, shall be in accordance with Item 101 titled PREPARATION/REMOVAL OF EXISTING PAVEMENTS.

**631-4.5 Mixing.** Blend the coal tar emulsion mixture. The mixing must produce a smooth homogeneous mixture of uniform consistency. Consult the coal tar emulsion supplier for its recommended order of addition of the ingredients. During the entire mixing and application process, no breaking, segregating or hardening of the emulsion, nor balling or lumping of the sand is to be permitted. Continue to agitate the seal coating mixture in the mixing tank at all times prior to and during application so that a consistent mix is available for application.

Small additional increments of water may be needed to provide a workable consistency, but in no case is the water content to exceed the specified amount.

**631-4.6 Application of slurry seal surface treatment.** In order to provide maximum adhesion, the pavement shall be dampened with a fog spray of water if recommended by the supplier. No standing water shall remain on the surface.



If a prime coat is required, mix and apply the prime coat as specified in paragraph 631-3.2.

The aggregate filled slurry seal surface treatment shall be applied at a uniform rate as specified in the contract documents.

Each coat shall be allowed to dry and cure initially before applying any subsequent coats. The initial drying shall allow evaporation of water of the applied mixture, resulting in the coating being able to sustain light foot traffic. The initial curing shall enable the mixture to withstand vehicle traffic without damage to the seal coat.

Apply the second coat in the same manner as outlined for the first coat.

Additional coats shall be applied over the entire surface as directed by the Resident Engineer.

The finished surface shall present a uniform texture.

- 631-4.7 Protection.** Keep all traffic off surfaces freshly treated with coal tar emulsion. Provide sufficient warning signs and barricades so that traffic will not travel over freshly treated surfaces. The fresh emulsion application shall be protected by barricades and markers and shall be permitted to dry a minimum of eight (8) hours in dry daylight conditions before opening to traffic, and initially cure enough to support vehicular traffic without damage to the seal coat. Where marginal weather conditions exist during the eight (8) hour drying time, additional drying time shall be required. The length of time shall be as specified by the supplier. The surface shall be checked after the additional drying time for trafficability before opening the section to vehicle traffic.
- 631-4.8 Pavement marking.** Where pavement marking is required, the paint used shall meet the requirements of Item 620 titled RUNWAY AND TAXIWAY MARKING, shall be compatible with the seal coat and as recommended by the coal tar emulsion manufacturer.

### CONTRACTOR QUALITY CONTROL (QC)

- 631-5.1 Quality control (QC).** The Contractor shall have a manufacturer's authorized representative on the job site at the beginning of the work and during all refined coal tar emulsion surface treatments. The manufacturer's representative shall have knowledge of the material, procedures, and equipment described in the specification and shall be responsible for determining the application rates and shall oversee the preparation and application of the refined coal tar emulsion surface treatment. Documentation of the manufacturer representative's experience and knowledge for applying the refined coal tar emulsion surface treatment shall be furnished to the Engineer a minimum of ten (10) working days prior to placement of the control strip. The cost of the manufacturer's representative shall be considered incidental to the contract and a subsidiary obligation of the Contractor.
- 631-5.2 QC plan.** The Contractor must submit a QC plan to the Engineer a minimum of ten (10) days prior to placement of the control strip. The QC plan must address all items that affect the quality of the refined coal tar emulsion surface treatment including, but not limited to:
- a. Qualifications of personnel.
  - b. Schedule for the project.
  - c. Procedure to monitor the weather/temperature limitations.
  - d. Inspection requirements including refined coal tar emulsion, control strips, storage of refined coal tar emulsion, preparation of the pavement surface, and equipment calibration.
  - e. Provisions for obtaining, packaging and shipping acceptance samples and repair of the pavement.
  - f. Provisions for sample testing, testing laboratory name, location, accreditation, contact person, all contact information, testing requested, and report on information.

**631-5.3 Sampling.** A minimum of one (1) sample per day shall be tested for the properties specified in the contract documents. A random sample of approximately one (1) quart of the composite mix will be obtained daily by the Contractor in the presence of the Resident Engineer and stored in a glass container. The containers shall be sealed against contamination and retained in storage by the Resident Engineer for a period of six (6) months. Samples shall be stored at room temperature and not be subjected to freezing temperatures.

A sample of undiluted coal tar emulsion shall be obtained from each consignment shipped to the job.

**631-5.4 Records.** The Contractor shall maintain an accurate record of each batch of materials used in the formulation of the seal coat and provide the documentation to the Resident Engineer daily.

### MATERIAL ACCEPTANCE

**631-6.1 Application rate.** The rate of application of the refined coal tar emulsion shall be verified at least twice per day.

**631-6.2 Freight and weigh bills.** A weight ticket for each truck load shall be furnished to the Resident Engineer. The truck shall be weighed at a location approved by the Engineer. The ticket shall show the weight of the empty truck (the truck being weighed each time before it is loaded), the weight of the loaded truck, and the net weight of the bituminous material.

### METHOD OF MEASUREMENT

**631-6.1** The quantity of refined coal tar emulsion with additives shall be measured for payment by the number of gallons as specified, completed, and accepted by the Resident Engineer. Only the actual quantity of undiluted refined coal tar emulsion with additives will be measured for payment.

### BASIS OF PAYMENT

**631-7.1** Payment for accepted quantities of work performed by the Contractor and measured by the Resident Engineer shall be made at the contract unit price as specified in paragraph 631-6.1 of this section. Payment shall be full compensation for all surface preparation, furnishing all materials, delivery and application of these materials, for all labor, equipment, tools, and any costs associated with furnishing a qualified manufacturer's representative to assist with control strips, and incidentals necessary to complete the work as specified.

### REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

#### ASTM International (ASTM)

ASTM D 490 Standard Specification for Road Tar

ASTM D 5727 Standard Specification for Emulsified Refined Coal Tar (Mineral Colloid Type)

#### American Association of State Highway and Transportation Officials (AASHTO)

AASHTO T 26 Standard Method of Test for Quality of Water to Be Used in Concrete

**Code of Federal Regulations (CFR)**

29 CFR Part 1910.1200 Hazard Communication

40 CFR Protection of the Environment

**Illinois Department of Transportation, Bureau of Materials Policy Memoranda (PM)**

PM 11-08 Aggregate Gradation Control System (AGCS)

**END OF ITEM 631**

## Item 632 Asphalt Pavement Rejuvenation

### DESCRIPTION

Asphalt pavement rejuvenation is for use on any pavements on which aircraft do not operate including shoulders, overruns, roads, and parking areas. It may be used on airport pavements at airports serving airplanes less than 60,000 lb, except on runways, high speed taxiways, or acute angled exit taxiways.

- 632-1.1** This item shall consist of a rejuvenator properly proportioned, mixed, and spread on an asphalt pavement surface as specified in the contract documents or as directed by the Resident Engineer.

This item governs the application of an asphalt pavement rejuvenation product applied to a previously placed asphalt surface in accordance with these specifications, as specified in the contract documents, or as directed by the Resident Engineer. The purpose of this product is rejuvenation of the upper three-eighths (3/8) inch of oxidized or otherwise aged asphalt binder without causing an unacceptable reduction in the friction characteristics (skid resistance) of the pavement section. Additionally, the rejuvenation product should not introduce unacceptable pavement distresses such as raveling, high temperature deformation (rutting), and loss of strength. The rejuvenation product should not contribute to accelerated deterioration of the pavement.

An asphalt pavement rejuvenator may be used on all pavements on general aviation airports serving airplanes 12,500 pounds or less

The term "rejuvenation product" will carry the same connotation as the term "rejuvenator" or "rejuvenator/sealer." The term "rejuvenation product" will be used throughout this specification for the purpose of recognizing rejuvenation performance for each class of rejuvenation products.

### MATERIALS

- 632-2.1 Rejuvenation product.** The rejuvenation product must be capable of achieving the minimum changes in the asphalt binder properties shown in the tables below after proper application and field exposure.

The binder extracted per AASHTO T 164, Method A and recovered per AASHTO R 59 from samples of the upper three-eighths (3/8) inch of the surface of the treated pavement must exhibit the percent decrease in absolute viscosity or complex viscosity and corresponding phase angle increase listed in the tables below, when compared to the values from adjacent untreated samples from the same pavement in the prescribed timeframe.

The submittal must include independent laboratory test results accredited by an American Association of State Highway Transportation Officials (AASHTO) Materials Reference Laboratory (AMRL). The test results should verify the ability of the proposed rejuvenation product to achieve the minimum changes in asphalt binder properties shown in the tables below.

### Asphalt Pavement Less than Three (3) Years in Age

Item	Property of Recovered Binder <sup>2</sup>	Requirement	Test Method
1	Absolute Viscosity 60°C, P	≥ 25% Decrease	AASHTO T 202
2a	Complex Modulus 60°C, G*		AASHTO T 315
2b	Viscosity 60°C, $\eta = G^* / \omega$ Pa·s		
2c	Phase Angle 60°C, $\delta, ^\circ$	Report	

### Asphalt Pavement More than Three (3) Years in Age

Item	Property of Recovered Binder <sup>1</sup>	Requirement	Test Method
1	Absolute Viscosity 60°C, P	≥ 40% Decrease	AASHTO T 202
2a	Complex Modulus 60°C, G*, kPa		AASHTO T 315
2b	Viscosity 60°C, $\eta^* = G^* / \omega$ Pa·s		
2c	Phase Angle 60°C, $\delta, ^\circ$	Report	

1. Procedures: Sample collection for application and acceptance as noted in this specification. Sample weights and measure by ASTM D3549; Extraction by: AASHTO T 164, Method A using toluene (conditioning to remove moisture will not be accomplished); Recovery by: AASHTO R 59 (Abson); and binder extraction, recovery and testing within 48 hours of obtaining pavement cores or equivalent surface area samples.

The Contractor shall provide a copy of the manufacturer's certificate of analysis (COA) for the emulsified asphalt delivered to the project. If the asphalt emulsion is diluted at other than the manufacturer's facility, the Contractor shall provide a supplemental COA from an independent laboratory verifying the asphalt emulsion properties.

The COA shall be provided to and approved by the Engineer before the emulsified asphalt is applied. The furnishing of the vendor's certified test report for the asphalt material shall not be interpreted as a basis for final acceptance. The manufacturer's COA may be subject to verification by testing the material delivered for use on the project.

- a. Health, safety, and environment.** The Contractor must provide a complete safety data sheet (SDS) in accordance with U.S. Department of Labor, Occupational Safety and Health Administration (OSHA), Regulations (Standards – 29 CFR), 1910.1200 which establishes the requirement and minimum information for the SDS for hazardous materials. The SDS, Section II, shall include the Chemical Abstracts Service (CAS) registry numbers for all applicable hazardous ingredients in the rejuvenation product. The Contractor must provide the manufacturer's certification that the rejuvenation product complies with the Code of Federal Regulation (CFR) Title 40 – Protection of Environment. The manufacturer's certification shall address compliance for Air Programs, Part 59, National Volatile Organic Compound Emission Standards for Consumer and Commercial Products (for the airport location) and Water Programs, Part 116, Designation of Hazardous Substances.

- 632-2.2 Friction characteristics.** Friction test data in accordance with the current Federal Aviation Administration Advisory Circular (AC) 150/5320-12, *Measurement, Construction, and Maintenance of Skid Resistant Airport Pavement Surfaces*, at 40 or 60 miles per hour wet, must include as a minimum; the friction value of pavement surface prior to sealant application; two (2) values, between 24 and 96 hours after application, with a minimum of 24 hours between tests; and one (1) value between 180 and 360 days after the application. The results of the tests between 24 and 96 hours shall indicate friction is increasing at a rate to obtain similar friction

value of the pavement surface prior to application, and the long-term test shall indicate no apparent adverse effect with time relative to friction values and existing pavement surface.

Seal coat material submittals without the required friction performance will not be approved. Friction tests performed on this project cannot be used as a substitute of this requirement.

### COMPOSITION AND APPLICATION

**632-3.1 Control strip.** Prior to full application, the control strip must be accepted by the Engineer. The surface preparation, personnel, equipment and method of operation used on the control strip shall be the same as used on the remainder of the work.

A qualified manufacturer's representative shall be present in the field to assist the Contractor in applying the control strip to determine the appropriate application rate of the rejuvenation to be evaluated and approved by the Engineer.

A control strip shall be applied for each differing asphalt pavement surface identified in the project. The control strip shall be used to determine the material application rate of both emulsion and sand prior to full production.

The Contractor must obtain pavement cores or saw cut "slabs" equivalent surface area samples. The pavement cores or equivalent surface area samples must be taken after application of the rejuvenation control strips is fully cured. The pavement cores shall be tested in accordance with the contract documents for the purpose of determining a recommendation for the rejuvenation product application rates. The Contractor is responsible for all sampling and testing associated with the control strip.

For runway and taxiway surfaces, the Contractor shall place control strips to determine skid resistance. The skid resistance of the existing pavement shall be determined for each test areas/section with a continuous friction measuring equipment (CFME). Test areas shall be a minimum of 300 feet (90 m) long by 12 feet (3.6 m) wide, or width of anticipated application, whichever is greater. The area to be tested will be located on a representative section of the pavement to receive the surface treatment designated by the Engineer. The test areas/sections should be placed under similar field conditions as anticipated for the actual application. The skid resistance test after application shall be at approximately the same location as the test done on the existing pavement. The Contractor may begin testing the skid resistance of control strips after application of the asphalt surface treatment has fully cured. Aircraft shall not be permitted on the runway or taxiway control strips until such time as the Contractor validates that its surface friction meets the minimum friction levels in *Table 3-2, "Friction Level Classification for Runway Pavement Surfaces,"* in the current Federal Aviation Administration Advisory Circular (AC) 150/5320-12, *Measurement, Construction, and Maintenance of Skid-resistant Airport Pavement Surfaces*, when tested at speeds of 40 and 60 miles per hour with approved CFME.

If the control strip should prove to be unsatisfactory, additional control strips shall be placed and additional skid resistance tests performed and evaluated. Full production shall not begin without the Engineer's approval. Any pavement areas damaged by the surface treatment shall be removed and replaced as directed by the Engineer at the Contractor's expense.

### CONSTRUCTION

**632-4.1 Worker safety.** The rejuvenation product must be handled with caution. The Contractor shall obtain a safety data sheet (SDS) for the rejuvenation product and require workmen to follow the manufacturer's recommended safety precautions. All additional industry standard safety precautions regarding the storage and applications of asphalts should be understood and followed by the Contractor.

**632-4.2 Weather limitations.** The rejuvenation product must be applied only when the existing surface is dry, and the weather forecast is in accordance with the manufacturer's recommendations for

application and curing. The rejuvenation product must not be applied during inclement weather or when rain or freezing temperatures are anticipated within 24 hours before or after application. If weather conditions interfere with application and/or curing, the Engineer may suspend the job or require remedial action as deemed necessary.

Cover existing buildings, structures, runway edge lights, taxiway edge lights, informational signs, retro-reflective marking and in-pavement duct markers as necessary to protect against overspray before applying the rejuvenation product. Should the rejuvenation product get on any light or marker fixture, promptly clean the fixture. If cleaning is not satisfactory to the Resident Engineer, the Contractor shall replace any light, sign or marker with equivalent equipment at the Contractor's expense.

**632-4.3 Equipment.** The Contractor must furnish all equipment and hardware necessary for the performance of the work. The rejuvenation product should be delivered in dedicated tankers and/or containers with agitating equipment and filters, per manufacturer's recommendations. The distributor must be designed and equipped in accordance with the manufacturer's recommendations, but include as a minimum, the following characteristics:

- a. Adequate heating capability for rapid heating of the rejuvenator to the proper application temperature.
- b. A positive displacement pump capable of pumping low viscosity material and providing a preselected constant pressure to deliver the specified rates of application.
- c. A full circulation spray bar and applicator that maintain proper nozzles, which provide the specified rate of application.
- d. A hooded spray bar and applicator that maintain proper nozzle height.
- e. A positive shut-off for the spray bar and a hand spray (with hose) equipped with a positive shut-off at the spray gun.
- f. A thermometer installed in the distributor tank to measure the temperature of the rejuvenation product at the time of the application.
- g. A speedometer calibrated to a minimum of tenths of miles per hour.
- h. A chart listing the capacity of the tank in gallons for each one (1) inch of depth. A chart showing speed/pressure application rates must also be included.

**632-4.4 Preparation of asphalt pavement surfaces.** Clean the pavement surface immediately prior to placing the seal coat by sweeping, flushing well with water leaving no standing water, or a combination of both, so that it is free of dust, dirt, grease, vegetation, oil or any type of objectionable surface film. Remove oil or grease that has not penetrated the asphalt pavement by scarping or by scrubbing with a detergent, then wash thoroughly with clean water. After cleaning, treat these areas with an oil spot primer. Any additional surface preparation, such as crack repair, shall be in accordance with Item 101 titled PREPARATION/REMOVAL OF EXISTING PAVEMENTS.

**632-4.5 Application of rejuvenation product.**

- a. Following preparation and subsequent inspection of the surface and consideration for skid resistance, the rejuvenation product shall be uniformly applied over the surface to be treated at the approved rate with an allowable variation from the approved rate of application of  $\pm 5\%$ , in accordance with ASTM D2995.
- b. Materials shall be applied at the temperature recommended by the manufacturer.

To obtain uniform application of the material on the surface treated at the junction of previous and subsequent applications, heavy paper or cardboard, equivalent technique, must be spread on the surface at a sufficient distance back from the ends of each application so that the material may be started and stopped on the paper. Immediately after application, the building paper must be removed and properly disposed.

Areas missed by the distributor must be properly treated with the hand spray.

c. Other rejuvenation product application procedures include:

- (1) **Equipment calibration.** Contractor must furnish all equipment, materials, and labor necessary to calibrate the asphalt distributor or other application equipment. Calibration must be made with approved job material and prior to applying the rejuvenation product to the prepared surface. Calibration of the asphalt distributor and the specialized asphalt spray applicator must be in accordance with ASTM D2995.
- (2) **Excess rejuvenation product removal.** Manufactured sand, as approved by the Engineer, must be provided by the Contractor at no additional costs and must be spread in sufficient quantity to effectively blot up any excess rejuvenation product remaining on the treated pavement surface after 24 hours.
- (3) **Ponding and puddling of rejuvenation product.** If low spots and depressions in the pavement surface cause ponding or puddling of the rejuvenation product, the pavement surface must be broomed with a broom drag. Brooming should continue until the pavement surface is free of any pools of excess material. Ponding and/or puddling must not cause excess pavement softening and/or additional distress.
- (4) **Excess runoff of rejuvenation product.** The application rate should be reduced, and the Engineer notified, if the surface grade of the pavement surface causes excessive runoff of the rejuvenation product. Additional rejuvenation product, if necessary, may be subsequently applied after the first application of material has penetrated into the pavement to achieve the required properties of the treated binder
- (5) **Insufficient rejuvenation product.** When it is determined by the Resident Engineer that the actual application rate of the rejuvenation product is more than 5% below the approved application rate, subsequent applications of materials must be made to bring the actual application rate up to the approved rate; additional rejuvenation product must penetrate into the pavement surface within 24 hours after application. Multiple applications may be required at the discretion of the Resident Engineer, requiring additional pavement sampling and rejuvenation testing to assure compliance with the contract documents.

**632-4.6 Cure time remedial option.** The Contractor must apply sand to the surface of the treated asphalt pavement if the rejuvenation product does not meet the cure time requirement and/or the frictional characteristics have been reduced to an unacceptable level.

The manufactured sand must be dry, hard, durable, free from clay, salt and foreign matter and well graded that is 100% passing the No. 8 sieve and less than 10% passing the No. 200 sieve. The sand must be uniformly applied at a rate of  $3.0 \pm 0.5$  pounds per square yard, rolled as recommended by the Contractor and accepted by the Resident Engineer into the treated surface and any surplus removed with a power broom.

All manufactured sand or approved substitute used during the treatment must be removed from the airport as soon as practical after treatment of a pavement and prior to opening any airfield pavement. This should be accomplished by a combination of hand and mechanical sweeping. All turnouts must be cleaned of any sand to the satisfaction of the Resident Engineer.

If, after sand is swept and in the opinion of the Resident Engineer, a hazardous condition exists on the pavement, the Contractor must apply additional sand and sweep same immediately following reapplication.

The Contractor is responsible for all materials, equipment, and costs associated with the application, removal and disposal of the sand. No additional compensation will be allowed for reapplication and removal of sand.



- 632-4.7 Protection.** Keep all traffic off surfaces freshly treated with rejuvenation product. Provide sufficient warning signs and barricades so that traffic will not travel over freshly treated surfaces. The fresh rejuvenation product application shall be protected by barricades and markers and shall be not be disturbed for a period of at least 24 hours.

#### QUALITY CONTROL (QC)

- 632-5.1 Quality control (QC).** The Contractor shall have a manufacturer's authorized representative on the job site at the beginning of the work and during all rejuvenation product applications. The manufacturer's representative shall have knowledge of the material, procedures, and equipment described in the specification and will be responsible for determining the application rates and shall oversee the preparation and application of the rejuvenation product. Documentation of the manufacturer representative's experience and knowledge for applying the rejuvenation product shall be furnished to the Engineer a minimum of ten (10) working days prior to placement of the control strip. The cost of the manufacturer's representative shall be considered incidental to the contract and a subsidiary obligation of the Contractor.
- 632-5.2 QC plan.** The Contractor must submit a QC plan to the Engineer a minimum of ten (10) days prior to placement of the control strip. The QC plan must address all items that affect the quality of the rejuvenation application including, but not limited to:
- a. Qualifications of personnel.
  - b. Schedule for the project.
  - c. Procedure to monitor the weather/temperature limitations.
  - d. Inspection requirements including rejuvenation product, control strips, storage of rejuvenation product, preparation of the pavement surface, and equipment calibration.
  - e. Provisions for obtaining, packaging and shipping acceptance samples and repair of the pavement.
  - f. Provisions for sample testing, testing laboratory name, location, accreditation, contact person, all contact information, testing requested, and report on information.
- 632-5.3 Sampling.** A minimum of one (1) sample per each shipment shall be tested for the properties specified in the contract documents. A sample will be obtained by the Contractor in the presence of the Resident Engineer in accordance with ASTM D140 and store in accordance with the SDS, Section VII for a period of at least six (6) months
- 632-5.4 Warranty.** The Contractor must provide a manufacturer's warranty that the treated pavement will retain the lower binder properties as specified, for a period of two (2) years from the date of treatment. For compliance with the warranty, the Owner may obtain cores and perform tests in accordance with contract documents. The Contractor must further warrant that from the date the rejuvenation product was applied, the material will not flake, peel, chip, spall, nor otherwise contribute to or accelerate the aging of the pavement. The Contractor must reapply the rejuvenation product, as necessary, or provide remedial actions at no additional cost to the contract. The Resident Engineer must designate and record an area of no less than ten (10) square yards of untreated and ten (10) square yards of treated pavement as the control strip for warranty testing. In the event a pay reduction, or no payment, is enforced, the warranty is rescinded.

## MATERIAL ACCEPTANCE

**632-6.1 Quality assurance (QA).** Quality assurance testing organizations performing these acceptance tests shall be in accordance with the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 6-08, *Minimum Private Laboratory Requirements for Construction Materials Testing or Mix Design*.

- a. Sampling.** Sampling of the pavement sections to be treated must be performed before and after the pavement has been treated with the rejuvenation product. The Contractor will be responsible for obtaining all pavement core samples as approved by the Resident Engineer for testing. At the discretion and approval of the Resident Engineer, the before samples collected and tested for application may suffice for before samples for acceptance.

Random sampling locations for untreated samples will be determined by the Resident Engineer.

Three (3) cores will be taken by the Contractor for every 20,000 square yards of treated pavement section in the presence of the Resident Engineer. The before and after cores must be taken in the same general area, at a minimum within the same paving lane and within one foot of each other.

Cores shall be a minimum six (6) inches in diameter neatly cut with a core drill. The Contractor will furnish all tools, labor, and materials for cutting samples and filling the cored hole. Core holes will be filled by the Contractor with suitable materials and methods as approved by the Resident Engineer within one (1) day after sampling.

The treated pavement cores or equivalent surface area samples must be taken 30-45 days after application of the rejuvenation product.

Pavement core samples must be placed in labeled sealable plastic bags immediately after taking, cleaning and removing sampling water (blotting). The sealed samples must then be placed in labeled plastic core canisters. The specimens must be shipped to the designated laboratory within 24 hours of collection.

- b. Testing.** All acceptance testing necessary to determine conformance with this specification must be submitted to the Resident Engineer verifying that the rejuvenation product achieves the minimum decrease in the asphalt binder properties as measured from binder in the top 3/8 inch  $\pm$  1/32 inch of the samples.

Extract the asphalt binder from the top 3/8 inch  $\pm$  1/32 inch of the cores precisely cut from the field specimens. Binder extraction must be by AASHTO T 164, Method A with toluene, and recovered according to AASHTO R 59 (Abson Method).

- (1) Viscosity of the asphalt material must be measured in accordance with AASHTO T 202. The percent decrease in the binder properties must be computed as follows:

$$100 (\text{absolute viscosity, } P, \text{ of untreated sample}) - (\text{absolute viscosity, } P, \text{ of treated sample}) / (\text{absolute viscosity, } P, \text{ of untreated samples})$$

- (2) The complex modulus,  $G^*$ , kPa, must be measured in accordance with AASHTO T 315 C, at 140°F, 10 radians per second or other recorded frequency. The percent decrease in the binder properties must be computed as follows:

$$100 (\text{complex modulus, } G^*, \text{ kPa of untreated sample}) - (\text{complex modulus, } G^*, \text{ kPa, of treated sample}) / (\text{complex modulus, } G^*, \text{ kPa, of untreated samples})$$

- (3) The complex viscosity,  $\eta^*$ , at 140°F must be calculated and reported from the complex modulus,  $G^*$  and angular frequency,  $\omega$  radians per second.

Test results for absolute viscosity, complex modulus (and viscosity), and phase angle must be reported. In the event of binders recovered from aged pavements and/or pavements using polymer modified binders before treatment exhibiting absolute viscosities greater than

200,000 P, the viscosity reduction compliance requirement should be determined based on the complex modulus,  $G^*$ , kPa.

- 632-6.2 Friction tests.** The friction of surfaces must be inspected by the Contractor and Resident Engineer a minimum of 48 hours after application of the rejuvenation product. In the event either the Contractor or the Resident Engineer has concern on the friction of these surfaces, the Contractor must apply sand to the surface of the treated asphalt pavement to the satisfaction of the Resident Engineer.

Friction tests in accordance with the current Federal Aviation Administration Advisory Circular (AC) 150/5320-12, *Measurement, Construction, and Maintenance of Skid-Resistant Airport Pavement Surfaces*, shall be accomplished on all runways and high-speed taxiways that have received a rejuvenator application. Each test includes performing friction tests at 40 and 60 miles per hour both wet, 15 feet to each side of the runway centerline. A control friction test shall be run within 30 days prior to application of the rejuvenator to runway and another friction test shall be run after application of the rejuvenator to the entire project. The Contractor shall schedule testing with the Resident Engineer and the Resident Engineer shall be present for testing. The Contractor shall provide the Resident Engineer a written report of friction test results.

Prior to opening the pavement to aircraft operations, the pavement friction evaluation must be equal or greater than the minimum levels provided in *Table 3-2, "Friction Level Classification for Runway Pavement Surfaces,"* in the current Federal Aviation Administration Advisory Circular (AC) 150/5320-12, *Measurement, Construction, and Maintenance of Skid-resistant Airport Pavement Surfaces*, when tested at speeds of 40 and 60 miles per hour with approved continuous friction measuring equipment (CFME).

- 632-6.3 Freight and weigh bills.** A weight ticket for each truck load shall be furnished to the Resident Engineer. The truck shall be weighed at a location approved by the Engineer. The ticket shall show the weight of the empty truck (the truck being weighed each time before it is loaded), the weight of the loaded truck, and the net weight of the bituminous material.

#### METHOD OF MEASUREMENT

- 632-7.1.** The quantity of asphalt pavement rejuvenation application shall be measured for payment by the number of square yards as specified, completed, and accepted by the Resident Engineer.
- 632-7.2** The quantity of friction testing shall be per lump sum as specified, completed, and accepted by the Resident Engineer.

#### BASIS OF PAYMENT

- 632-8.1** Payment for accepted quantities of work performed by the Contractor and measured by the Resident Engineer shall be made at the contract unit price as specified in paragraphs 632-7.1 through 632-7.2 of this section adjusted according to the following.
- a. Adjusted payment.** The payment for accepted rejuvenation product must be calculated in accordance with the table below.
  - b. Final payment.** Final payment will not be made until rejuvenation success has been confirmed by acceptance testing. Final payment will be full compensation for furnishing all materials and for all labor, equipment, tools, and incidentals necessary to complete the item.

### Pay Adjustment Schedule

Binder Rejuvenation at Acceptance Percent Reduction in Absolute Viscosity or Complex Modulus		Pay Factor
Pavement More Than 3 Years in Age	Pavement Less Than 3 Years in Age	
≥ 40	≥ 25	100
30.0 - 39.9	20.0 - 24.9	75
Less than 30.0	Less than 20.0	No payment

### REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

#### ASTM International (ASTM)

ASTM D 140	Standard Practice for Sampling Bituminous Materials
ASTM D 2995	Standard Practice for Estimating Application Rate of Bituminous Distributors
ASTM D 3549	Standard Test Method for Thickness or Height of Compacted Bituminous Paving Mixture Specimens

#### American Association of State Highway and Transportation Officials (AASHTO)

AMRL	AASHTO Materials Reference Laboratory
AASHTO R 59	Standard Specification for Recovery of Asphalt Binder from Solution by Abson Method
AASHTO T 164	Standard Method of Test for Quantitative Extraction of Asphalt Binder from Hot-Mix Asphalt (HMA)
AASHTO T 202	Standard Method of Test for Viscosity of Asphalts by Vacuum Capillary Viscometer
AASHTO T 315	Standard Method of Test for Determining the Rheological Properties of Asphalt Binder Using a Dynamic Shear Rheometer (DSR)

#### Code of Federal Regulations (CFR)

29 CFR Part 1910.1200	Hazard Communication
40 CFR	Protection of the Environment

#### Federal Aviation Administration Advisory Circulars (AC)

AC 150/5320-12	Measurement, Construction, and Maintenance of Skid-Resistant Airport Pavement Surfaces
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#### Illinois Department of Transportation, Bureau of Materials Policy Memoranda (PM)

PM 6-08	Minimum Private Laboratory Requirement for Construction Materials Testing or Mix Design
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**END OF ITEM 632**

## Part 9 – Miscellaneous

### Item 602 Emulsified Asphalt Prime Coat

#### DESCRIPTION

- 602-1.1** This item shall consist of an application of emulsified asphalt material on the prepared base course as specified in the contract documents.

#### MATERIALS

- 602-2.1 Emulsified asphalt material.** The emulsified asphalt material shall be one (1) of the applicable materials for the tack coat listed on the current Illinois Department of Transportation's published Qualified Producer List of *Certified Sources for Emulsified Asphalt* and/or the Qualified Producer List of *Certified Sources for Cutback Asphalt and Road Oil*.

The Contractor shall provide a copy of the manufacturer's certificate of analysis (COA) for the emulsified asphalt material. The COA shall be provided to and approved by the Resident Engineer before the emulsified asphalt material is applied. The furnishing of the COA for the emulsified asphalt material shall not be interpreted as a basis for final acceptance. The manufacturer's COA may be subject to verification by testing the material delivered for use on the project.

The emulsified asphalt prime coat shall conform to one (1) of the following.

- a. Penetrating emulsified prime (PEP).** The PEP shall be according to the following requirements when tested according to AASHTO T 59.

Test	PEP
Viscosity, Saybolt Furol, at 77°F, SFS	75 max
Sieve test, retained on No. 20 sieve, %	0.10 max.
Distillation to 500°F residue, %	38 min.
Oil distillate by volume, %	4 max.

The PEP shall be tested according to the current Bureau of Materials ITP, *Sand Penetration Test of Penetrating Emulsified Prime (PEP)*. The time of penetration shall be equal to or less than that of MC-30. The depth of penetration shall be equal to or greater than that of MC-30.

- b. Medium curing (MC) liquid asphalt.** Medium curing liquid asphalts will be accepted according to the current Bureau of Materials Policy Memorandum (PM) 2-08, *Cutback Asphalt and Road Oil Acceptance Procedure*. These materials shall be medium curing cutback asphalts consisting of a petroleum residuum fluxed with a suitable distillate. They shall be free from water, show no separation on standing, and shall be according to the requirements listed in the following table.

Test	MC-30
Flash Point, (Tag open cup), (AASHTO T 79), °F <sup>1</sup>	100 min.
Viscosity, Kinematic, at 140°F, (AASHTO T 201), cSt	30 to 60
Distillation Test (AASHTO T 78): Distillate, percent by volume of total distillate to 680 °F:	
Distillate to 437 °F	25 max.
Distillate to 500 °F	40 to 70
Distillate to 600 °F	75 to 93
Residue from distillation to 680 °F, percent volume by difference	50 min.
Tests on residue from distillation:	
Penetration at 77°F, 100 g, 5 sec, (AASHTO T 49), dmm	120 to 250
Ductility at 77°F, (AASHTO T 51), mm <sup>2</sup>	1,000 min.
Solubility in trichloroethylene, (AASHTO T 44), %	99.5 min.

- Flash point by Cleveland open cup may be used for products having a flash point greater than 175°F.
- If ductility is less than 1,000 mm at 77°F, the material will be acceptable if the ductility is more than 1,000 mm at 60°F.

When emulsified asphalts are used, any dilution with water shall be performed by the emulsion producer. The emulsified asphalt shall be thoroughly agitated within 24 hours of application and show no separation of water and emulsion.

## CONSTRUCTION METHODS

**602-3.1 Weather limitations.** This work shall be done between May 1 and October 1. The emulsified asphalt prime coat shall be applied only when the existing surface is dry, the temperature of the air in the shade is 50°F or above, the temperature has not been below 35°F for the 12 hours prior to application, and the weather is not foggy or rainy.

This work may be done between October 1 and October 30 providing the temperature of the air for three (3) consecutive days immediately preceding the day of application has been: (1) above 50°F in the shade each day, (2) a minimum of 40°F and (3) the temperature of the air in the shade at time of application is above 50°F.

**602-3.2 Equipment.** The Contractor shall provide equipment for heating and applying the emulsified asphalt material. The emulsion shall be applied with a manufacturer-approved computer rate-controlled asphalt distributor. The equipment shall be in good working order and contain no contaminants or diluents in the tank. Spray bar tips must be clean, free of burrs, and of a size to maintain an even distribution of the emulsion. Any type of tip or pressure source is suitable that will maintain predetermined flow rates and constant pressure during the application process with application speeds under eight (8) miles per hour or 700 feet per minute.

Provide a distributor with pneumatic tires of such size and number that the load produced on the base surface does not exceed 65.0 pounds per square inch of tire width to prevent rutting, shoving or otherwise damaging the base, surface or other layers in the pavement structure.

The equipment will be tested under pressure for leaks and to ensure proper set-up before use to verify truck set-up (via a test-shot area), including but not limited to, nozzle tip size appropriate for application, spray-bar height and pressure and pump speed, evidence of triple-overlap spray pattern, lack of leaks, and any other factors relevant to ensure the truck is in good working order before use.

The distributor truck shall be equipped with a minimum 12-foot spreader spray bar with individual nozzle control with computer-controlled application rates. The distributor truck shall have an easily accessible thermometer that constantly monitors the temperature of the emulsion, and have an operable mechanical tank gauge that can be used to cross-check the computer accuracy. If the distributor is not equipped with an operable quick shutoff valve, the operations shall be started and stopped on building paper.

The distributor truck shall be equipped to effectively heat and mix the material to the required temperature prior to application as required. Heating and mixing shall be done in accordance with the manufacturer's recommendations. Do not overheat or over mix the material.

The distributor shall be equipped with a hand sprayer.

Asphalt distributors must be calibrated annually in accordance with ASTM D2995. The Contractor must furnish a current calibration certification for the asphalt distributor truck from any State or other agency as approved by the Engineer.

A power broom and power blower suitable for cleaning the surfaces to which the asphalt coat is to be applied shall be provided.

- 602-3.3 Spraying application.** The spraying application temperature ranges for emulsified asphalt material applied by a pressure distributor shall be according to the following table.

**Spraying Application Temperature Ranges**

Type and Grade of Asphalt Material	Temperature Ranges °F
	min. – max.
PEP	60 – 130
MC-30	85 – 190

- 602-3.4 Application of emulsified asphalt material.** Immediately before applying the prime coat, the full width of the surface to be primed shall be swept with a power broom to remove all loose dirt and other objectionable material.

The asphalt emulsion material shall be uniformly applied with an asphalt distributor that will provide a residual asphalt rate on the prepared surface of 0.15 to 0.30 gallons per square yard.

Following application of the emulsified asphalt material and prior to application of the succeeding layer of pavement, allow the asphalt coat to cure and to obtain evaporation of any volatiles or moisture. Maintain the coated surface until the succeeding layer of pavement is placed, by protecting the surface against damage and by repairing and recoating deficient areas. The prime coat shall be permitted to cure until the penetration has been approved by the Resident Engineer, but at no time shall the curing period be less than 24 hours for MC-30 or four (4) hours for PEP. Pools of prime occurring in the depressions shall be broomed or squeegeed over the surrounding surface the same day the prime coat is applied. Keep traffic off surfaces freshly treated with asphalt material. Provide sufficient warning signs and barricades so that traffic will not travel over freshly treated surfaces.

The base shall be primed one-half (1/2) width at a time. The prime coat on the second half/width shall not be applied until the prime coat on the first half/width has cured so that it will not pick up under traffic.

The residual asphalt rate will be verified a minimum of once as specified herein for which at least 2,000 tons of asphalt will be placed. The test will be according to the Illinois Department of Transportation, Bureau of Materials Manual of Test Procedures for Materials, *Determination of Residual Asphalt in Prime and Tack Coat Materials, Appendix B.24*. The prime coat shall be fully cured prior to asphalt placement to prevent pickup by haul trucks or paving equipment. If pickup occurs, paving shall cease in order to provide additional cure time, and all areas where the pickup occurred shall be repaired.

If after five (5) days, loss of tack or prime coat is evident prior to covering with asphalt, additional prime coat shall be placed as determined by the Resident Engineer at the Contractor's expense.

**602-3.5 Trial application rates.** The Contractor shall apply a minimum of three (3) lengths of at least 100 feet for the full width of the distributor bar to evaluate the amount of emulsified asphalt material that can be satisfactorily applied with the equipment. Apply three (3) different application rates of emulsified asphalt materials within the application range specified in paragraph 602-3.4 titled APPLICATION OF EMULSIFIED ASPHALT MATERIAL. Other trial applications can be made using various amounts of material as directed by the Resident. The trial application is to demonstrate the equipment can uniformly apply the emulsified asphalt material within the rates specified and determine the application rate for the project.

**602-3.6 Freight and waybills.** Emulsified asphalt prime coat will be measured by weight. A weight ticket for each truck load shall be furnished to the Resident Engineer. The truck shall be weighed at a location approved by the Engineer. The ticket shall show the weight of the empty truck (the truck being weighed each time before it is loaded), the weight of the loaded truck, and the net weight of the bituminous material. The percentage of asphalt residue of the actual certified product shall be shown on the producer's bill of lading or attached certificate of analysis (COA). If the producer adds extra water to an emulsion at the request of the purchaser, the amount of water shall also be shown on the bill of lading.

#### METHOD OF MEASUREMENT

**602-4.1** The quantity of emulsified asphalt material for prime coat shall be measured for payment by the number of gallons of residual asphalt as specified, completed and accepted by the Resident Engineer. The emulsified asphalt material paid for will be the measured quantities used in the accepted work, provided that the measured quantities are not 5% over the specified application rate. Any amount of emulsified asphalt material more than 5% over the specified application rate for each application will be deducted from the measured quantities.

#### BASIS OF PAYMENT

**602-5.1** Payment for accepted quantities of work performed by the Contractor and measured by the Resident Engineer shall be made at the contract unit price as specified in paragraph 602-4.1 of this section. Payment shall be full compensation for furnishing all materials and for all preparation, delivering, and applying the materials, and for all labor, equipment, tools, and incidentals necessary to complete the work as specified.

#### REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

##### **ASTM International (ASTM)**

ASTM D 2995	Standard Practice for Estimating Application Rate and Residual Application Rate of Bituminous Distributors
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##### **American Association of State Highway and Transportation Officials (AASHTO)**

AASHTO T 44	Standard Method of Test for Solubility of Bituminous Materials
AASHTO T 49	Standard Method of Test for Penetration of Bituminous Materials
AASHTO T 51	Standard Method of Test for Ductility of Asphalt Materials
AASHTO T 59	Standard Method of Test for Emulsified Asphalts



AASHTO T 78 Standard Method of Test for Distillation of Cutback Asphalt Products

AASHTO T 79 Standard Method of Test for Flash Point with Tag Open-Cup Apparatus for Use with Material Having a Flash Point Less Than 93 degrees Celsius (200 degrees Fahrenheit)

AASHTO T 201 Standard Method of Test for Kinematic Viscosity of Asphalts (Bitumens)

**Illinois Department of Transportation, Bureau of Materials Illinois Laboratory Test Procedure (ITP)**

*Manual of Test Procedures for Materials*

Sand Penetration Test of Penetrating Emulsified Prime (PEP)

**Illinois Department of Transportation, Bureau of Materials Policy Memoranda (PM)**

PM 2-08 Cutback Asphalt and Road Oil Acceptance Procedure

**Illinois Department of Transportation, Bureau of Materials Qualified Product List**

Certified Sources for Cutback Asphalt and Road Oil

Certified Sources for Emulsified Asphalt

**END OF ITEM 602**

## Item 603 Emulsified Asphalt Tack Coat

### DESCRIPTION

- 603-1.1** This item shall consist of preparing and treating an asphalt or concrete surface with asphalt material as specified in the contract documents.

### MATERIALS

- 603-2.1 Asphalt materials.** The asphalt material shall be one (1) of the applicable materials for the tack coat listed on the current Illinois Department of Transportation's published Qualified Producer List of *Certified Sources for Emulsified Asphalt* and/or the Qualified Producer List of *Certified Sources for Cutback Asphalt and Road Oil*.

The emulsified asphalt shall not be diluted. The Contractor shall provide a copy of the manufacturer's certificate of analysis (COA) for the asphalt material to the Resident Engineer before the asphalt material is applied for review and acceptance. The furnishing of COA for the asphalt material shall not be interpreted as a basis for final acceptance. The manufacturer's COA may be subject to verification by testing the material delivered for use on the project.

The emulsified asphalt tack coat shall conform to one (1) of the following.

- a. Anionic emulsified asphalt.** Anionic emulsified asphalts SS-1, SS-1h, RS-1, and RS-2 shall be according to AASHTO M 140.
- b. Cationic emulsified asphalt.** Cationic emulsified asphalts CSS-1, CRS-1, and CRS-2 shall be according to AASHTO M 208.
- c. High float emulsion (HFE).** High float emulsions are medium setting and shall be according to the following table.

Test	HFE-90
Viscosity, Saybolt Furol, at 122°F, (AASHTO T 59), SFS <sup>1</sup>	50 min.
Sieve Test, No. 20, retained on sieve, (AASHTO T 59), %	0.10 max.
Settlement, (AASHTO T 59), % <sup>2</sup>	5 max.
Storage Stability Test, 1 day, (AASHTO T 59), % <sup>3</sup>	1 max.
Coating Test, (AASHTO T 59), 3 minutes	stone coated thoroughly
Distillation Test, (AASHTO T 59): Residue from distillation test to 500°F, % Oil distillate by volume, %	65 min. 7 max.
Characteristics of residue from distillation test to 500°F: Penetration at 77°F, (AASHTO T 49), 100 g, 5 sec, dmm	90 – 150
Float Test at 140°F, (AASHTO T 50), sec.	1200 min.

1. The emulsion shall be pumpable.
2. The test requirement for settlement may be waived when the emulsified asphalt is used in less than five (5) days' time; or the purchaser may require that the settlement test be run from the time the sample is received until it is used, if the elapsed time is less than five (5) days.
3. The 24 hour (one (1) day) storage stability test may be used instead of the five (5) day settlement test.

- d. Latex modified emulsified asphalt.** The emulsified asphalt shall be a quick traffic latex modified asphalt emulsion containing a minimum of 3.0% latex solids by weight of asphalt binder. The latex shall be milled or blended into the emulsifier solution prior to the emulsification process. The CSS-1h latex modified emulsified asphalt shall be according to the following.

Test (AASHTO T 59)	CSS-1h
Viscosity, Saybolt Furol, 77°F, SFS	20-100
Storage Stability Test, 24 hours, %	1 max.
Particle Charge Test	Positive
Sieve Test, No. 20, retained on sieve, %	0.10 max.
Distillation Test, Residue from distillation test to 347°F ± 9°F, %	62 min.
Tests on Residue from Distillation	
Penetration, 77°F, 100 grams, 5 seconds, (AASHTO T 49), dmm	40 – 90
Ductility, 77°F, 50 mm/min, (AASHTO T 51), mm	400 min.
Solubility in trichloroethylene, (AASHTO T 44), %	97.5 min.
Softening Point, (AASHTO T 53), °F	135 min.
Absolute Viscosity, 140°F, (AASHTO T 202), Poises	8,000 min.

- e. Polymer modified emulsified asphalt.** Polymer modified emulsified asphalts SS-1hP (anionic) or CSS-1hP (cationic) shall be according to the SS-1h requirements of paragraph 603-2.1 a. titled ANIONIC EMULSIFIED ASPHALT or the CSS-1h requirements of paragraph 603-2.1 b. titled CATIONIC EMULSIFIED ASPHALT, respectively, with the following exceptions for both types.

- (1) The emulsified asphalt shall be modified with a styrene-butadiene diblock or triblock copolymer, or a styrene-butadiene rubber.
- (2) The cement mixing and ductility tests will be waived.
- (3) Upon examination of the storage stability test cylinder after standing undisturbed for 24 hours, the surface shall show no white, milky colored substance and shall be a homogenous brown color throughout.
- (4) The distillation for polymer modified emulsion shall be performed according to AASHTO T 59, except the temperature shall be 374°F ± 9°F and measured using an ASTM 16F thermometer.
- (5) The residue from distillation shall have a minimum elastic recovery value of 30% when tested according to AASHTO T 301. The specified temperature shall be 39.2°F ± 1.0°F.

- f. Non-tracking emulsified asphalt.** Non-Tracking emulsified asphalt SS-1vh shall be according to the following.

Test	SS-1vh
Saybolt Viscosity at 77°F, (AASHTO T 59), SFS	20 - 200
Storage Stability Test, 24 hr, (AASHTO T 59), %	1 max.
Residue by Evaporation, 325°F ± 5°F, (AASHTO T 59), %	50 min.
Sieve Test, No. 20, (AASHTO T 59), %	0.3 max.
Tests on Residue from Evaporation	
Penetration at 77°F, 100 g, 5 sec, (AASHTO T 49), dmm	20 max.
Softening Point, (AASHTO T 53), °F	149 min.
Solubility, (AASHTO T 44), %	97.5 min.
Original DSR at 82°C, (AASHTO T 315), kPa	1.00 min.

- g. Rapid curing (RC) liquid asphalt.** Rapid curing liquid asphalt will be accepted according to the current Bureau of Materials Policy Memorandum (PM) 2-08, *Cutback Asphalt and Road Oil Acceptance Procedure*. This material shall be a rapid curing cutback asphalt consisting of a petroleum residuum fluxed with a suitable distillate. The liquid asphalt shall be free from water, show no separation on standing, and shall be according to the requirements listed in the following table.

Test	RC-70
Viscosity, Kinematic, at 140°F, (AASHTO T 201), cSt	70 to 140
Distillation Test (AASHTO T 78): Distillate, percent by volume of total distillate to 680 °F:	
Distillate to 374 °F	10 min.
Distillate to 437 °F	50 min.
Distillate to 500 °F	70 min.
Distillate to 600 °F	85 min.
Residue from distillation to 680 °F, percent volume by difference	55 min.
Tests on residue from distillation:	
Penetration at 77°F, 100 g, 5 sec, (AASHTO T 49), dmm	80 to 120
Ductility at 77°F, (AASHTO T 51), mm <sup>1</sup>	1,000 min.
Solubility in trichloroethylene, (AASHTO T 44), %	99.5 min.

- If ductility is less than 1,000 mm at 77°F, the material will be acceptable if the ductility is more than 1,000 mm at 60°F.

## CONSTRUCTION METHODS

- 603-3.1 Weather limitations.** This work shall be done between May 1 and October 1. The emulsified asphalt tack coat shall be applied only when the existing surface is dry, the temperature of the air in the shade is 50°F or above, the temperature has not been below 35°F for the 12 hours prior to application, and the weather is not foggy or rainy.

This work may be done between October 1 and October 30 providing the temperature of the air for three (3) consecutive days immediately preceding the day of application has been: (1) above 50°F in the shade each day, (2) a minimum of 40°F and (3) the temperature of the air in the shade at time of application is above 50°F.

- 603-3.2 Equipment.** The Contractor shall provide equipment for heating and applying the emulsified asphalt material. The emulsion shall be applied with a manufacturer-approved computer rate-controlled asphalt distributor. The equipment shall be in good working order and contain no contaminants or diluents in the tank. Spray bar tips must be clean, free of burrs, and of a size to maintain an even distribution of the emulsion. Any type of tip or pressure source is suitable that will maintain predetermined flow rates and constant pressure during the application process with application speeds under eight (8) miles per hour or 700 feet per minute.

Provide a distributor with pneumatic tires of such size and number that the load produced on the base surface does not exceed 65.0 pounds per square inch of tire width to prevent rutting, shoving or otherwise damaging the base, surface or other layers in the pavement structure.

The equipment will be tested under pressure for leaks and to ensure proper set-up before use to verify truck set-up (via a test-shot area), including but not limited to, nozzle tip size appropriate for application, spray-bar height and pressure and pump speed, evidence of triple-overlap spray pattern, lack of leaks, and any other factors relevant to ensure the truck is in good working order before use.

The distributor truck shall be equipped with a minimum 12-foot spreader spray bar with individual nozzle control with computer-controlled application rates. The distributor truck shall have an easily accessible thermometer that constantly monitors the temperature of the emulsion, and have an operable mechanical tank gauge that can be used to cross-check the computer accuracy. If the distributor is not equipped with an operable quick shutoff valve, the operations shall be started and stopped on building paper.

The distributor truck shall be equipped to effectively heat and mix the material to the required temperature prior to application as required. Heating and mixing shall be done in accordance with the manufacturer's recommendations. Do not overheat or over mix the material.

The distributor shall be equipped with a hand sprayer.

Asphalt distributors must be calibrated annually in accordance with ASTM D2995. The Contractor must furnish a current calibration certification for the asphalt distributor truck from any State or other agency as approved by the Engineer.

A power broom and/or power blower suitable for cleaning the surfaces to which the asphalt tack coat is to be applied shall be provided.

- 603-3.3 Spraying application.** The spraying application temperature ranges for emulsified asphalt material applied by a pressure distributor shall be according to the following table.

**Spraying Application Temperature Ranges**

Type and Grade of Asphalt Material	Temperature Ranges °F
	min. – max.
RC-70	120 – 225
RS-1, CRS-1	75 – 130
RS-2, CRS-2	110 – 160
SS-1vh	160 – 180
SS-1, SS-1h, CSS-1, CSS-1h	75 – 130
SS-1hP, CSS-1hP	75 – 130
HFE-90	150 – 180

- 603-3.4 Application of emulsified asphalt material.** The emulsified asphalt shall not be diluted. Immediately before applying the emulsified asphalt tack coat, the full width of surface to be treated shall be swept with a power broom and/or power blower to remove all loose dirt and other objectionable material.

The emulsified asphalt material shall be uniformly applied with an asphalt distributor at the rates appropriate for the conditions and surface specified in the table below

**Emulsified Asphalt**

Surface Type to be Tacked	Residual Asphalt Rate, gal/SY	Emulsion Application Bar Rate, gal/SY
New asphalt	0.02-0.05	0.03-0.07
Existing asphalt	0.04-0.07	0.06-0.11
Milled Surface	0.04-0.08	.06-0.12
Concrete	0.03-0.05	0.05-0.08

After application of the tack coat, the surface shall be allowed to cure without being disturbed for the period of time necessary to permit drying and setting of the tack coat. This period shall be determined by the Resident Engineer. The Contractor shall protect the tack coat and maintain the surface until the next course has been placed. When the tack coat has been disturbed by the Contractor, tack coat shall be reapplied at the Contractor's expense.

The residual asphalt rate will be verified a minimum of once as specified herein for which at least 2000 tons of asphalt will be placed. The test will be according to the Illinois Department of Transportation, Bureau of Materials Manual of Test Procedures for Materials, *Determination of Residual Asphalt in Prime and Tack Coat Materials, Appendix B.24*. The tack coat shall be fully cured prior to asphalt placement to prevent pickup by haul trucks or paving equipment. If pickup occurs, paving shall cease in order to provide additional cure time, and all areas where the pickup occurred shall be repaired.

If after five (5) days, loss of tack or prime coat is evident prior to covering with asphalt, additional tack coat shall be placed as determined by the Resident Engineer at the Contractor's expense.

- 603-3.5 Freight and waybills.** Emulsified asphalt tack coat will be measured by weight. A weight ticket for each truck load shall be furnished to the Resident Engineer. The truck shall be weighed at a location approved by the Engineer. The ticket shall show the weight of the empty truck (the truck being weighed each time before it is loaded), the weight of the loaded truck, and the net weight of the bituminous material. The percentage of asphalt residue of the actual certified product shall be shown on the producer's bill of lading or attached certificate of analysis (COA). If the producer adds extra water to an emulsion at the request of the purchaser, the amount of water shall also be shown on the bill of lading.

#### METHOD OF MEASUREMENT

- 603-4.1** The quantity of emulsified asphalt material for tack coat shall be measured for payment by the number of gallons residual asphalt as specified, completed and accepted by the Resident Engineer. The emulsified asphalt material paid for will be the measured quantities used in the accepted work, provided that the measured quantities are not 5% over the specified application rate. Any amount of emulsified asphalt material more than 5% over the specified application rate for each application will be deducted from the measured quantities.

#### BASIS OF PAYMENT

- 603.5-1** Payment for accepted quantities of work performed by the Contractor and measured by the Resident Engineer shall be made at the contract unit price as specified in paragraph 603-4.1 of this section. Payment shall be full compensation for furnishing all materials, for all preparation, delivery, and application of these materials, and for all labor, equipment, tools, and incidentals necessary to complete the work as specified.

#### REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

##### **ASTM International (ASTM)**

ASTM D 2995	Standard Practice for Estimating Application Rate and Residual Application Rate of Bituminous Distributors
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**American Association of State Highway and Transportation Officials (AASHTO)**

AASHTO M 140	Standard Specification for Emulsified Asphalt
AASHTO M 208	Standard Specification for Cationic Emulsified Asphalt
AASHTO T 44	Standard Method of Test for Solubility of Bituminous Materials
AASHTO T 49	Standard Method of Test for Penetration of Bituminous Materials
AASHTO T 50	Standard Method of Test for Float Test for Bituminous Materials
AASHTO T 51	Standard Method of Test for Ductility of Asphalt Materials
AASHTO T 53	Standard Method of Test for Softening Point of Bitumen (Ring-and-Ball Apparatus)
AASHTO T 59	Standard Method of Test for Emulsified Asphalts
AASHTO T 78	Standard Method of Test for Distillation of Cutback Asphalt Products
AASHTO T 201	Standard Method of Test for Kinematic Viscosity of Asphalts (Bitumens)
AASHTO T 202	Standard Method of Test for Viscosity of Asphalts by Vacuum Capillary Viscometer
AASHTO T 301	Standard Method of Test for Elastic Recovery Test of Asphalt Materials by Means of a Ductilometer
AASHTO T 315	Standard Method of Test for Determining the Rheological Properties of Asphalt Binder Using a Dynamic Shear Rheometer (DSR)

**Illinois Department of Transportation, Bureau of Materials Illinois Laboratory Test Procedure (ITP)**

*Manual of Test Procedures for Materials*

**Illinois Department of Transportation, Bureau of Materials Policy Memoranda (PM)**

PM 2-08                      Cutback Asphalt and Road Oil Acceptance Procedure

**Illinois Department of Transportation, Bureau of Materials Qualified Product List**

Certified Sources for Cutback Asphalt and Road Oil

Certified Sources for Emulsified Asphalt

**END ITEM 603**

## Item 604 Compression Joint Seals for Concrete Pavements

### DESCRIPTION

- 604-1.1** This item shall consist of preformed polychloroprene compression seals used for sealing joints of rigid pavements as specified in the contract documents.

### MATERIALS

- 604-2.1** **Compression seals.** Compression joint seal materials shall be a vulcanized elastomeric compound using polychloroprene as the only base polymer. The material and the manufactured seal shall conform to ASTM D2628 and Corps of Engineers Concrete Research Division (CRD) C548 where jet fuel and/or heat blast resistance is required.

The joint seal shall be a labyrinth type seal. The uncompressed depth of the face of the compression seal (that is to be bonded to the joint wall) shall be greater than the uncompressed width of the seal, except that for seals one (1) inch or greater in width, the depth need be only one (1) inch or greater. The actual width of the uncompressed seal shall be as recommended by the joint seal manufacturer for the type and width of joints as specified in the contract documents. The tolerance on the seal shall be +1/8 inch or -1/16 inch, below the top of the pavement surface or bottom of groove for grooved pavement.

The Contractor shall provide a copy of the manufacturer's certificate of analysis (COA) for the joint seal material delivered to the project. The COA shall be provided to and approved by the Resident Engineer before the material is installed. The furnishing of the vendor's certified test report shall not be interpreted as a basis for final acceptance. The manufacturer's COA may be subject to verification by testing the material delivered for use on the project.

Materials delivered to the job site shall be inspected for defects, unloaded, and stored with a minimum of handling to avoid damage. Storage facilities shall be provided at the job site to protect materials from weather and maintain materials at temperatures recommended by the manufacturer.

Representative sample of joint seal material will be sampled and retained by the Resident Engineer for possible testing.

- 604-2.2** **Lubricant/adhesive.** Lubricant/adhesive used for the compression elastomeric joint seal shall be a one (1) component compound conforming to ASTM D4070.

### CONSTRUCTION METHODS

- 604-3.1** **Equipment.** Machines, tools, and equipment used in the performance of the work required by this section shall be approved by the Engineer before the work starts and shall be maintained by the Contractor in satisfactory condition at all times.

**a. Joint cleaning equipment.**

- (1) **Concrete saw.** A self-propelled power saw with water-cooled diamond saw blades shall be provided for cutting joints to the depths and widths specified and for removing filler, existing old joint seal or other material embedded in the joints or adhered to the joint faces.



- (2) **Waterblasting equipment.** Waterblasting equipment shall include a trailer-mounted water tank, pumps, high-pressure hose, a wand with safety release cutoff controls, nozzle, and auxiliary water resupply equipment. The water tank and auxiliary water resupply equipment shall be of sufficient capacity to permit continuous operations. The pumps, hoses, wand, and nozzle shall be of sufficient capacity to permit the cleaning of both walls of the joint and the pavement surface for a width of at least one-half (1/2) inch on either side of the joint. The pump shall be capable of supplying a pressure of at least 3,000 pounds per square inch. A pressure gauge mounted at the pump shall show at all times the pressure in pounds per square inch (psi) at which the equipment is operating.
- (3) **Sandblasting equipment.** Sandblasting equipment shall include an air compressor, hose, and a long-wearing venturi-type nozzle of proper size, shape, and opening. The maximum nozzle opening should not exceed one-quarter (1/4) inch. The air compressor shall be portable and shall be capable of furnishing not less than 150 cubic feet per minute and maintaining a line pressure of not less than 90 pounds per square inch at the nozzle while in use. The compressor shall be equipped with traps that will maintain the compressed air free of oil and water. The nozzle shall have an adjustable guide that will hold the nozzle aligned with the joint about one (1) inch above the pavement surface and will direct the blast to clean the joint walls. The height, angle of inclination, and the size of the nozzle shall be adjusted as necessary to ensure satisfactory results.
- b. **Sealing equipment.** Equipment used to install the compression seal shall place the compression seal to the prescribed depths within the specified tolerances without cutting, nicking, twisting, or otherwise damaging the seal. The equipment shall not stretch or compress the seal more than 2.0% longitudinally during installation. The machine shall be an automatic self-propelled joint seal application equipment and shall be engine powered. The machine shall include a reservoir for the lubricant/adhesive, a device for conveying the lubricant/adhesive in the proper quantities to the sides the preformed seal or the sidewalls of the joint, a reel capable of holding one (1) full spool of compression seal, and a power-driven apparatus for feeding the joint seal through a compression device and inserting the seal into the joint. The equipment shall also include a guide to maintain the proper course along the joint being sealed. The machine shall at all times be operated by an experienced operator.

Hand operated joint seal application equipment may be used for localized areas and for projects less than 500 square yards. The equipment shall be a two-axle, four-wheel machine that includes means for compressing and inserting the compression seal into the joint and a reel capable of holding one (1) full spool of compression seal material.

## CONSTRUCTION METHODS

- 604-4.1 Weather limitations.** The ambient temperature and the pavement temperature within the joint wall shall be at least 35°F and rising at the time of installation of the materials. Sealant application will not be permitted if moisture or any foreign material is observed in the joint.
- 604-4.2 Trial joint seal and lubricant/adhesive installation.** Prior to the cleaning and sealing of the joints for the entire project, a control strip at least 200 feet long shall be prepared at a location designated by the Resident Engineer using the specified materials and the approved equipment, to demonstrate the materials and construction processes for joint preparation and sealing of all types of joints included in the project. No other joints shall be sealed until the test installation has been approved by the Engineer.

If materials or installation do not meet requirements, the materials shall be removed, and the joints shall be cleaned, and a new trial joint seal installation shall be performed at the Contractor's expense. The Engineer approved trial section will be incorporated into the permanent work.

**604-4.3 Preparation of joints.** Immediately before installation of the compression joint seal, the joints shall be thoroughly cleaned to remove all laitance, filler, existing sealer, foreign material and protrusions of hardened concrete from the sides and upper edges of the joint space to be sealed. Cleaning shall extend along pavement surfaces at least one-half (1/2) inch on either side of the joint. After final cleaning and immediately prior to sealing, the joints shall be blown out with compressed air and left free of debris and water. Any irregularity in the joint face that would prevent uniform contact between the joint seal and the joint face shall be corrected prior to the installation of the joint seal.

**a. Sawing.** Joints shall be sawed to clean and to open them to the full specified width and depth. Immediately following the sawing operation, the joint faces and opening shall be thoroughly cleaned using a water jet to remove all saw cuttings or debris remaining on the faces or in the joint opening. Compression seal shall be installed within three (3) calendar days of the time the joint cavity is sawed. Depth of the joint cavity shall be in accordance with manufacturer's instructions. Submit printed copies of manufacturers' instructions 60 days prior to use on the project. The saw cut for the joint seal cavity shall at all locations be centered over the joint line. The nominal width of the sawed joint seal cavity shall be as follows; the actual width shall be within a tolerance of  $\pm 1/16$  inch.

(1) If a nominal 13/16-inch wide compression seal is furnished, the nominal width of the saw cut shall be one-half (1/2) inches when the pavement temperature at the time of sawing is between 25 and 80°F. If the pavement temperature at the time of sawing is above this range, the nominal width of the saw cut shall be decreased 1/16 inch. If the pavement temperature at the time of sawing is below this range, the nominal width of the saw cut shall be increased 1/16 inch.

(2) If a nominal one (1) inch wide compression seal is furnished, the nominal width of the saw cut shall be 9/16 inches when the pavement temperature at the time of sawing is between 25 and 140°F. If the pavement temperature at the time of sawing is above this range, the nominal width of the saw cut shall be decreased 1/16 inch. If the pavement temperature at the time of sawing is below this range, the nominal width of the saw cut shall be increased 1/16 inch.

(3) The pavement temperature shall be measured and recorded in the presence of the Resident Engineer. Measurement shall be made each day before commencing sawing and at any other time during the day when the temperature appears to be moving out of the allowable sawing range.

**b. Waterblast cleaning.** The concrete joint faces and pavement surfaces extending at least one-half (1/2) inch from the joint edges shall be waterblasted clean. A multiple pass technique shall be used until the surfaces are free of dust, dirt, curing compound, or any residue that might prevent ready insertion or uniform contact of the seal and bonding of the lubricant/adhesive to the concrete. After final cleaning and immediately prior to sealing, the joints shall be blown out with compressed air and left completely free of debris and water.

**c. Sandblast cleaning.** The concrete joint faces and pavement surfaces extending at least one-half (1/2) inch from the joint edges shall be sandblasted clean. A multiple pass technique shall be used until the surfaces are free of dust, dirt, curing compound, or any residue that might prevent ready insertion or uniform contact of the seal and bonding of the lubricant/adhesive to the concrete. After final cleaning and immediately prior to sealing, the joints shall be blown out with compressed air and left completely free of debris and water.

**d. Rate of progress.** Cleaning of the joint faces shall be limited to the linear footage of joint that can be sealed during the same workday.

**604-4.4 Installation of the compression seal.**

**a. Time of installation.** Joints shall be sealed within three (3) calendar days of sawing the joint seal cavity and the final cleaning of the joint walls, or a temporary seal shall be installed to prevent infiltration of foreign material. If rain interrupts the sealing operations, the joints

shall be washed, cleaned with air and be dry before proceeding with installing of the lubricant/adhesive and compression seal.

- b. Installation Sequence.** Longitudinal joints shall be sealed first, then seal the transverse joints. Transverse joint seals will be continuous from edge to edge of the pavement. Intersections shall be made monolithic by use of joint seal adhesive and care in fitting the intersection parts together. Seals which do not reach an intersection shall be removed and replaced with new seal as directed by the Resident Engineer at the Contractor's Expense. Seal extender pieces shall not be used at intersections.
- c. Sealing joints.** The sides of the joint seal or the sides of the joint shall be covered with a coating of lubricant/adhesive and the seal installed as specified. Butt joints and seal intersections shall be coated with liberal applications of lubricant/adhesive. Lubricant/adhesive spilled on the pavement shall be removed immediately to prevent setting on the pavement.

The joint seal shall be placed at a uniform depth within the tolerances specified. The compression joint seal shall be placed to a depth of 3/16 inch  $\pm$  1/8 inch, below the pavement surface or below the depth of the groove unless otherwise directed by the Resident Engineer.

The seal shall be installed in the longest practicable lengths in longitudinal joints and shall be cut at the joint intersections to provide continuous installation of the seal in the transverse joints. The joint seal shall be installed in an upright position, free from twisting, distortion, and cuts. If stretch of installed joint seal exceeds 1%, adjustments shall be made to the installation equipment and procedure. Stretch of installed joint seals exceeding 2% stretch shall be removed and replaced.

After installation of the longitudinal joint seals, it shall set for a minimum of one (1) hour prior to cutting the seal at the joint intersections. For all transverse joints, the minimum length of the preformed joint seal shall be the pavement width from edge to edge.

**604-4.5 Clean-up.** Upon completion of the project, all unused materials shall be removed from the site, all lubricant/adhesive on the pavement surface shall be removed, and the pavement shall be left in clean condition.

**604-4.6 Quality control and quality assurance.**

- a. Quality control.** The application equipment shall be inspected to assure uniform application of lubricant/adhesive to the sides of the compression joint seal or the walls of the joint. Equipment causing cutting, twisting, nicking, excessive stretching or compressing of the compression seal, or improper application of the lubricant/adhesive, shall not be used until causes of the deficiencies are determined and corrected by the Contractor.

The seal shall be inspected by the Contractor a minimum of once per 400 feet of seal for compliance to the shrinkage or compression requirements. Measurements shall be made at the same interval to determine conformance with depth and width installation requirements.

- b. Quality assurance.** Cleaned joints shall be approved by the Resident Engineer prior to installation of the lubricant/adhesive and compression joint seal.

Conformance to stretching and compression limitations shall be determined by the Resident Engineer using the following procedures:

- (1) Mark the top surface of the compression seal at one (1) foot intervals in a manner clear and durable to enable length determinations of the seal.
- (2) After installation, the distance between the marks on the seal shall be measured by the Contractor.

- (3) If the stretching or compression exceeds the specified limit, the seal shall be removed and replaced with new joint seal at the Contractor's Expense. The seal shall be removed up to the last correct measurement.

**604-4.7 Acceptance.** The joint sealing system (compression seal and lubricant/adhesive) shall be inspected by the Resident Engineer for proper rate of cure and bonding to the concrete, cuts, twists, nicks, and other deficiencies. Seals exhibiting any defects prior to final acceptance of the project, shall be removed from the joint, wasted, and replaced with new material in a satisfactory manner, at the Contractor's expense, as determined by the Engineer.

#### METHOD OF MEASUREMENT

**604-5.1** The quantity of compression joint seals shall be measured for payment by the number of linear feet as specified, completed and accepted by the Resident Engineer.

#### BASIS OF PAYMENT

**604-6.1** Payment for accepted quantities of work performed by the Contractor and measured by the Resident Engineer shall be made at the contract unit prices as specified in paragraph 604-5.1 of this section. Payment shall full compensation for all labor, materials, the use of all equipment, and tools required to complete the work as specified.

#### REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

##### ASTM International (ASTM)

ASTM D 2628 Standard Specification for Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements

ASTM D 4070 Standard Specification for Adhesive Lubricant for Installation of Preformed Elastomeric Bridge Compression Seals in Concrete Structures

##### Corps of Engineers

CRD C548 Standard Specification for Jet-Fuel and Heat Resistant Preformed Polychloroprene Elastomeric Joint Seals for Rigid Pavements

##### Unified Facilities Criteria (UFC)

UFC 3-250-08FA Standard Practice for Sealing Joints and Cracks in Rigid and Flexible Pavements

#### END ITEM 604

## Item 605 Joint Sealants for Pavements

### DESCRIPTION

- 605-1.1** This item shall consist of providing and installing a resilient and adhesive joint sealing material capable of effectively sealing joints in pavement; joints between different types of pavements; and cracks in existing pavement as specified in the contract documents.

### MATERIALS

- 605-2.1** **Joint sealants.** Joint sealant materials shall meet the requirements of one (1) of the following.
- ASTM D6690 Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements
  - ASTM D7116 Standard Specification for Joint Sealants, Hot Applied, Jet Fuel Resistant Types for Portland Cement Concrete Pavements
  - ASTM D5893 Standard Specifications for Cold Applied, Single Component, Chemically Curing Silicone Joint Sealant for Portland Cement Concrete Pavements.
  - Silicone joint sealant material shall be Dow Corning 888 non-sag silicone joint sealer, Pecora 301 or an approved equal.

Each lot or batch of sealant shall be delivered to the jobsite in the manufacturer's original sealed container. Each container shall be marked with the manufacturer's name, batch or lot number, the safe heating temperature, and shall be accompanied by the certificate of analysis (COA) stating that the sealant meets the requirements of this specification.

- 605-2.2** **Backer rod.** The material furnished shall be a compressible, non-shrinking, non-staining, non-absorbing material that is non-reactive with the joint sealant in accordance with ASTM D5249. The backer-rod material shall be  $25\% \pm 5\%$  larger in diameter than the nominal width of the joint.

- 605-2.3** **Bond breaking tapes.** Provide a bond breaking tape or separating material that is a flexible, non-shrinkable, non-absorbing, non-staining, and non-reacting adhesive-backed tape. The material shall have a melting point at least 5°F greater than the pouring temperature of the sealant being used when tested in accordance with ASTM D789. The bond breaker tape shall be approximately one-eighth (1/8) inch wider than the nominal width of the joint and shall not bond to the joint sealant.

### CONSTRUCTION METHODS

- 605-3.1** **Time of application.** Joints shall be sealed as soon after completion of the curing period as feasible and before the pavement is opened to traffic, including construction equipment. The pavement temperature shall be 50°F and rising at the time of application of the poured joint sealing material. Do not apply sealant if moisture is observed in the joint.

If the pavement must be opened to traffic prior to placement of the sealant, the Contractor shall temporarily fill the joint with a jute or nylon rope immediately after the joint is sawed. The rope should be slightly larger than the joint and should be forced into the joint so that the top of the rope is one-eighth (1/8) inch below the pavement surface. The rope shall be removed immediately prior to cleaning.

**605-3.2 Equipment.** Machines, tools, and equipment used in the performance of the work required by this section shall be approved before the work is started and maintained in satisfactory condition at all times. Submit a list of proposed equipment to be used in performance of construction work including descriptive data, seven (7) days prior to use on the project.

- a. **Tractor-mounted routing tool.** Provide a routing tool, used for removing old sealant from the joints, of such shape and dimensions and so mounted on the tractor that it will not damage the sides of the joints. The tool shall be designed so that it can be adjusted to remove the old material to varying depths as required. The use of V-shaped tools or rotary impact routing devices will not be permitted. Hand-operated spindle routing devices may be used to clean and enlarge random cracks.
- b. **Concrete saw.** Provide a self-propelled power saw, with water-cooled diamond or abrasive saw blades, for cutting joints to the depths and widths specified.
- c. **Sandblasting equipment.** Sandblasting is not allowed.
- d. **Waterblasting equipment.** The Contractor must demonstrate waterblasting equipment including the pumps, hose, guide and nozzle size, under job conditions, before approval in accordance with paragraph 605-3.3 titled PREPARATION OF JOINTS. The Contractor shall demonstrate, in the presence of the Resident Engineer, that the method cleans the joint and does not damage the joint.
- e. **Hand tools.** Hand tools may be used, when approved, for removing defective sealant from a crack and repairing or cleaning the crack faces. Hand tools should be carefully evaluated for potential spalling effects prior to approval for use.
- f. **Hot-poured sealing equipment.** The unit applicators used for heating and installing ASTM D6690 joint sealant materials shall be mobile and shall be equipped with a double-boiler, agitator-type kettle with an oil medium in the outer space for heat transfer; a direct-connected pressure-type extruding device with a nozzle shaped for inserting in the joint to be filled; positive temperature devices for controlling the temperature of the transfer oil and sealant; and a recording type thermometer for indicating the temperature of the sealant. The applicator unit shall be designed so that the sealant will circulate through the delivery hose and return to the inner kettle when not in use.
- g. **Cold-applied, single-component sealing equipment.** The equipment for installing ASTM D5893 single component joint sealants shall consist of an extrusion pump, air compressor, following plate, hoses, and nozzle for transferring the sealant from the storage container into the joint opening. The dimension of the nozzle shall be such that the tip of the nozzle will extend into the joint to allow sealing from the bottom of the joint to the top. Maintain the initially approved equipment in good working condition, serviced in accordance with the supplier's instructions, and unaltered in any way without obtaining prior approval. Small hand-held air-powered equipment (i.e., caulking guns) may be used for small applications.

**605-3.3 Preparation of joints.** Pavement joints for application of material in this specification must be dry, clean of all scale, dirt, dust, curing compound, and other foreign matter. The Contractor shall demonstrate, in the presence of the Resident Engineer, that the method cleans the joint and does not damage the joint.

- a. **Sawing.** All joints shall be sawed in accordance with specifications and plan details. The minimum allowable joint width is one-half (1/2) inch. The width to depth ratio for the silicone joint sealer shall be 2-to-1. The joint sealer shall be recessed three-eighths (3/8) inch below the surface of the pavement. The depth of the second stage saw cut shall be enough to allow for the joint sealer recess, the joint sealer thickness and the height of the compressed backer rod. Immediately after sawing the joint, the resulting slurry shall be completely removed from joint and adjacent area by flushing with a jet of water, and by use of other tools as necessary.

New Portland Cement Concrete Pavement joints shall be sawed in two (2) stages. The first stage shall consist of sawing joints to prevent random cracking according to Item 501 titled CEMENT CONCRETE PAVEMENT. The second stage saw cut shall then be performed no earlier than 72 hours after the concrete has been placed.

Joints which are to be sealed with preformed elastomeric joint material shall be constructed to the width, depth and shape shown on the plans or as specified. Maximum tolerances shall be  $\pm 1/16$  inch for width or beveled edge, and  $\pm 1/8$  inch for depth. When contraction joints greater than three-eighths ( $3/8$ ) inch in width are constructed in two (2) stages, the second-stage sawing shall not be done sooner than 72 hours after the concrete at the joint has been placed.

If the joint has opened  $1/16$  inch or more as measured at the slab edge at the time of final sawing, the sawed width shall be increased so that the net width will meet the above tolerance when the joint is closed. Any irregularity in the joint face resulting from tearing, spalls, saw misalignment, etc., and which would prevent contact between the lip of the sealer and the joint face, shall be corrected prior to installation of the sealer.

- b. **Sealing.** Immediately before sealing, the joints shall be thoroughly cleaned of all remaining laitance, curing compound, filler, protrusions of hardened concrete, old sealant and other foreign material from the sides and upper edges of the joint space to be sealed. Cleaning shall be accomplished by tractor-mounted routing equipment, a concrete saw, or waterblaster as specified in paragraph 605-3.2 titled EQUIPMENT. The newly exposed concrete joint faces and the pavement surface extending a minimum of one-half ( $1/2$ ) inch from the joint edge shall be sandblasted clean. Sandblasting shall be accomplished in a minimum of two (2) passes. One (1) pass per joint face with the nozzle held at an angle directly toward the joint face and not more than three (3) inches from it. After final cleaning and immediately prior to sealing, blow out the joints with compressed air and leave them completely free of debris and water. The joint faces shall be surface dry when the seal is applied.
- c. **Resealing.** When joints are to be resealed, the existing joint material shall be removed to the depth as specified in the contract documents. When joints are to be resealed with joint sealer other than that originally used, it will be necessary to remove all existing joint sealer and asphalt stains from the joint opening. It may be necessary to widen the joint with a grooving machine so that the joint sealer will develop a satisfactory bond with the clean concrete.

When it is necessary to seal random cracks, they shall be cut, grooved, and cleaned in a manner satisfactory for sealing by methods and equipment similar to that used for the joints.

Joint preparation and sealant installation shall be accomplished within the same day. These operations will only be allowed to proceed when the joint is dry, and the air temperature is above  $41^{\circ}\text{F}$ . The Contractor shall not install any joint sealer material until the Resident Engineer has inspected and approved the condition of the joints immediately prior to the installation of the sealer.

- d. **Backer rod.** When the joint opening is of a greater depth than indicated for the sealant depth, plug or seal off the lower portion of the joint opening using a backer rod in accordance with paragraph 605-2.2 titled BACKER ROD to prevent the entrance of the sealant below the specified depth. Take care to ensure that the backer rod is placed at the specified depth and is not stretched or twisted during installation.
- e. **Bond-breaking tape.** Where inserts or filler materials contain bitumen, or the depth of the joint opening does not allow for the use of a backup material, insert a bond-separating tape breaker in accordance with paragraph 605-2.3 titled BOND BREAKING TAPES to prevent incompatibility with the filler materials and three-sided adhesion of the sealant. Securely bond the tape to the bottom of the joint opening so it will not float up into the new sealant.

- 605-3.4 Installation of sealants.** Joints shall be inspected for proper width, depth, alignment, and preparation, and shall be approved by the Resident Engineer before sealing is allowed. Sealants shall be installed in accordance with the following requirements:

Immediately preceding, but not more than 50 feet ahead of the joint sealing operations, perform a final cleaning with compressed air. For beveled joints the sealer shall be installed in a compressed condition at the depth of not less than 1/16 inch nor more than 3/16 inch below the bottom edge of the bevel. For joints with vertical sides, the joint sealer shall be installed in a compressed condition at a depth of one-quarter (1/4) inch  $\pm$  1/16 inch below the pavement surface. Remove and discard excess or spilled sealant from the pavement by approved methods. Install the sealant in such a manner as to prevent the formation of voids and entrapped air. In no case shall gravity methods or pouring pots be used to install the sealant material.

In transverse joints the minimum length of sealer without cuts or splices shall be 25 feet. Sealer shall not be spliced between adjacent joints or slab edge. Where different sizes of sealer intersect, the larger may be notched to accommodate a thorough installation of the smaller.

Traffic shall not be permitted over newly sealed pavement until authorized by the Resident Engineer. When a primer is recommended by the manufacturer, apply it evenly to the joint faces in accordance with the manufacturer's instructions. Check the joints frequently to ensure that the newly installed sealant is cured to a tack-free condition within the time specified.

The use of a backer rod or bond breaking tapes in the bottom of the joint to be filled is recommended to control the depth of the sealant, to achieve the desired shape factor, and to support the sealant against indentation and sag. Backer rod and bond breaking tapes should be compatible with the sealant and should be compressible without extruding the sealant, and should recover to maintain contact with the joint faces when the joint is open.

- 605-3.5 Inspection.** The Contractor shall inspect the joint sealant for proper rate of cure and set, bonding to the joint walls, cohesive separation within the sealant, reversion to liquid, entrapped air and voids. Sealants exhibiting any of these deficiencies at any time prior to the final acceptance of the project shall be removed from the joint, wasted, and replaced as specified at the Contractor's expense.

- 605-3.6 Clean-up.** Upon completion of the project, remove all unused materials from the site and leave the pavement in a clean condition.

#### METHOD OF MEASUREMENT

- 605-4.1** The quantity of joint sealing material shall be measured for payment by the number of linear feet of sealant as specified, completed, and accepted by the Resident Engineer.

#### BASIS OF PAYMENT

- 605-5.1** Payment for accepted quantities of work performed by the Contractor and measured by the Resident Engineer shall be made at the contract unit price as specified in paragraph 605-4.1 of this section. Payment shall be full compensation for furnishing all materials, for all preparation, delivering, and placing of these materials, and for all labor, equipment, tools, and incidentals necessary to complete the work as specified.



**REFERENCES**

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

**ASTM International (ASTM)**

ASTM D 789	Standard Test Method for Determination of Relative Viscosity of Polyamide (PA)
ASTM D 5249	Standard Specification for Backer Material for Use with Cold- and Hot-Applied Joint Sealants in Portland-Cement Concrete and Asphalt Joints
ASTM D 5893	Standard Specification for Cold Applied, Single Component, Chemically Curing Silicone Joint Sealant for Portland Cement Concrete Pavements
ASTM D 6690	Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt
ASTM D 7116	Standard Specification for Joint Sealants, Hot Applied, Jet Fuel Resistant Types for Portland Cement Concrete Pavements

**Federal Aviation Administration Advisory Circulars (AC)**

AC 150/5340-30	Design and Installation Details for Airport Visual Aids
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**END ITEM 605**

## Item 606 Adhesive Compounds, Two-Component for Sealing Wire and Lights in Pavement

### DESCRIPTION

- 606-1.1** This item shall consist of two (2) types of material; a liquid suitable for sealing electrical wire in saw cuts in pavement and for sealing light fixtures or bases in pavement, and a paste suitable for embedding light fixtures in the pavement as specified in the contract documents. Both types of material are two (2) component filled formulas. Materials supplied for use with asphalt and/or concrete pavements must be formulated so they are compatible with the asphalt and/or concrete.

### MATERIALS

- 606-2.1 Curing.** When pre-warmed to 77°F, mixed, and placed in accordance with manufacturer's directions, the materials shall cure at temperatures of 45°F or above without the application of external heat.
- 606-2.2 Storage.** The adhesive components shall not be stored at temperatures over 86°F, unless otherwise specified by the manufacturer.
- 606-2.3 Caution.** Installation and use shall be in accordance with the manufacturer's recommended procedures. Avoid prolonged or repeated contact with skin. In case of contact, wash with soap and flush with water. If taken internally, call doctor. Keep away from heat or flame. Avoid vapor. Use in well-ventilated areas. Keep in cool place. Keep away from children.
- 606-2.4 Characteristics.** When mixed and cured in accordance with the manufacturer's directions, the materials shall have the following properties shown in the following table.

### Property Requirements

Physical or Electrical Property	Minimum	Maximum	ASTM Method
<b>Tensile</b>			
Portland cement concrete	1,000 psi		D638
Asphalt concrete	500 psi		
<b>Elongation</b>			
Portland cement concrete		See note <sup>1</sup>	D638
Asphalt concrete	50%		D638
Coefficient of cubical expansion cu. cm/cu. cm/°C	0.00090	0.00120	D1168
Coefficient of linear expansion cm/cm/°C	0.000030	0.000040	D1168
Dielectric strength, short time test	350 volts/mil.		D149
Arc resistance	125 sec		
<b>Pull-off</b>			
Adhesion to steel	1,000 psi		
Adhesion to Portland cement concrete	200 psi		
Adhesion to asphalt concrete	No test available.		
Adhesion to aluminum	250 psi		

1. 20% or more (without filler) for formulations to be supplied for areas subject to freezing.

### SAMPLING, INSPECTION, AND TEST PROCEDURES

- 606-3.1 Tensile properties.** Tests for tensile strength and elongation shall be conducted in accordance with ASTM D638.
- 606-3.2 Expansion.** Tests for coefficients of linear and cubical expansion shall be conducted in accordance with, Method B, except that mercury shall be used instead of glycerine. The test specimen shall be mixed in the proportions specified by the manufacturer and cured in a glass tub approximately two (2) inch long by three-eighths (3/8) inch in diameter. The interior of the tube shall be precoated with a silicone mold release agent. The hardened sample shall be removed from the tube and aged at room temperature for one (1) week before conducting the test. The test temperature range shall be from 35°F to 140°F.
- 606-3.3 Test for dielectric strength.** Test for dielectric strength shall be conducted in accordance with ASTM D149 for sealing compounds to be furnished for sealing electrical wires in pavement.
- 606-3.4 Test for arc resistance.** Test for arc resistance shall be conducted for sealing compounds to be furnished for sealing electrical wires in pavement.
- 606-3.5 Test for adhesion to steel.** The ends of two (2) smooth, clean, steel specimens of convenient size of one (1) inch by one (1) inch by six (6) inches would be satisfactory when bonded together with adhesive mixture and allowed to cure at room temperature for a period of time to meet formulation requirements and then tested to failure on a Riehle, or similar, tensile tester. The thickness of adhesive to be tested shall be one-quarter (1/4) inch.
- 606-3.6 Adhesion to Portland cement concrete.**

- a. Concrete test block preparation.** The coarse aggregate shall consist of crushed rock having a minimum of 75% of the particles with at least one (1) fractured face and having a water absorption of not more than 1.5%. The fine aggregate shall consist of crushed sand manufactured from the same parent rock as the coarse aggregate. The concrete shall have a water-cement ratio of 5.5 gallons of water per bag of cement, a cement factor of  $6 \pm 0.5$  bags of cement per cubic yard of concrete, and a slump of 2-1/2 inch  $\pm$  1/2 inch. The ratio of fine aggregate to total aggregate shall be approximately 40% by solid volume. The air content shall be 5.0%  $\pm$  0.5%, and it shall be obtained by the addition to the batch of an air-entraining admixture such as Vinsol® resin. The mold shall be of metal and shall be provided with a metal base plate.

Means shall be provided for securing the base plate to the mold. The assembled mold and base plate shall be watertight and shall be oiled with mineral oil before use. The inside measurement of the mold shall be such that several one (1) inch by two (2) inch by three (3) inch test blocks can be cut from the specimen with a concrete saw having a diamond blade. The concrete shall be prepared and cured in accordance with ASTM C192.

The aggregate grading shall be as shown in the following table.

**Aggregate for Bond Test Blocks**

Type	Sieve Size	Percent Passing
Coarse Aggregate	3/4 inch	97 to 100
	1/2 inch	63 to 69
	3/8 inch	30 to 36
	No. 4	0 to 3
Fine Aggregate	No. 4	100
	No. 8	82 to 88
	No. 16	60 to 70
	No. 30	40 to 50
	No. 50	16 to 26
	No. 100	5 to 9

- b. **Bond test.** Prior to use, oven-dry the test blocks to constant weight at a temperature of 220°F to 230°F, cool to room temperature, 73.4°F ± 3°F, in a desiccator, and clean the surface of the blocks of film or powder by vigorous brushing with a stiff-bristled fiber brush. Two (2) test blocks shall be bonded together on the one (1) inch by three (3) inch sawed face with the adhesive mixture and allowed to cure at room temperature for a period of time to meet formulation requirements and then tested to failure in a Riehle, or similar, tensile tester. The thickness of the adhesive to be tested shall be one-quarter (1/4) inch.

- 606-3.7 Compatibility with asphalt mix.** Test for compatibility with asphalt in accordance with ASTM D5329.
- 606-3.8 Adhesive compounds.** The Contractor shall furnish the vendor's certified test reports for each batch of material delivered to the project. The report shall certify that the material meets specification requirements and is suitable for use with concrete or asphalt concrete pavements, whichever is specified. The report shall be provided to and accepted by the Resident Engineer before use of the material. In addition, the Contractor shall obtain a statement from the supplier or manufacturer that guarantees the material for one (1) year. The supplier or manufacturer shall furnish evidence that the material has performed satisfactorily on other projects.
- 606-3.9 Application.** Adhesive shall be applied on a dry, clean surface, free of grease, dust, and other loose particles. The method of mixing and application shall be in strict accordance with the manufacturer's recommendations. When used with Item 605 titled JOINT SEALANTS FOR PAVEMENTS, it shall not be applied until the adhesive has fully cured.

#### METHOD OF MEASUREMENT

- 606-4.1** The quantity of adhesive compound shall be measured for payment by the number of pounds or gallons of adhesive as specified, completed and accepted by the Resident Engineer. When required in the installation of an in-runway lighting system or portion thereof, no measurement will be made for direct payment of adhesive, as the cost of furnishing and installing shall be considered as a subsidiary obligation in the completion of the installation.

#### BASIS OF PAYMENT

- 606-5.1** Payment for accepted quantities of work performed by the Contractor and measured by the Resident Engineer shall be made at the contract unit price as specified in paragraph 606-4.1 of this section. Payment shall be full compensation for furnishing all materials, and for all preparation, delivering, and application of these materials, and for all labor, equipment, tools, and incidentals necessary to complete the work as specified.

#### REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

##### ASTM International (ASTM)

ASTM C 192	Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory
ASTM D 149	Standard Test Method for Dielectric Breakdown Voltage and Dielectric Strength of Solid Electrical Insulating Materials at Commercial Power Frequencies
ASTM D 638	Standard Test Method for Tensile Properties of Plastics

ASTM D 5329

Standard Test Methods for Sealants and Fillers, Hot-applied, for Joints and Cracks in Asphaltic and Portland Cement Concrete Pavements

**END OF ITEM 606**

## Item 610 Concrete for Miscellaneous Structures

### DESCRIPTION

- 610-1.1** This item shall consist of concrete and reinforcement, as specified in the contract documents, prepared and constructed in accordance with these specifications. This specification shall be used for all concrete other than airfield pavement which are cast-in-place.

Concrete provided under this item shall be a Class SI concrete meeting the requirements of the current Illinois Department of Transportation, Aeronautics Policy Memorandum (PM) 96-1 *Item 610, Structural Portland Cement Concrete: Job Mix Formula Approval & Production Testing*. The mix design shall be pre-approved by the Department prior to use. An Item 501 Cement Concrete Pavement mix can be used in lieu of a Class SI mix with the approval of the Department. The Contractor shall be responsible for obtaining the job mix formula meeting the requirements of this item.

### MATERIALS

- 610-2.1 General.** Only approved materials, conforming to the requirements of these specifications, shall be used in the work. Materials may be subject to inspection and tests at any time during their preparation or use. The source of all materials shall be approved by the Engineer before delivery or use in the work. Representative preliminary samples of the materials shall be submitted by the Contractor, when required, for examination and test. Materials shall be stored and handled to ensure preservation of their quality and fitness for use and shall be located to facilitate prompt inspection. All equipment for handling and transporting materials and concrete must be clean before any material or concrete is placed in them.

The use of pit-run aggregates shall not be permitted unless the pit-run aggregate has been screened and washed, and all fine and coarse aggregates stored separately and kept clean. The mixing of different aggregates from different sources in one (1) storage stockpile or alternating batches of different aggregates shall not be permitted.

- 610-2.2 Alkali-silica reaction.**
- a. **Aggregate groups.** Each combination of aggregates used in a mixture will be assigned to an aggregate group. The point at which the coarse aggregate and fine aggregate expansion values intersect in the following table will determine the group.

### Aggregate Groups

Coarse Aggregate Or Coarse Aggregate Blend  ASTM C1260 Expansion	Fine Aggregate Or Fine Aggregate Blend  ASTM C1260 Expansion		
	$\leq 0.16\%$	0.16% - 0.27%	$> 0.27\%$
$\leq 0.16\%$	Group I	Group II	Group III
0.16% - 0.27%	Group II	Group II	Group III
$> 0.27\%$	Group III	Group III	Group IV

**Mixture options.** Based upon the aggregate group, the following mixture options shall be used. However, the Department may prohibit a mixture option if field performance shows a deleterious alkali-silica reaction or Department testing indicates the mixture may experience a deleterious alkali-silica reaction.

### Reduction of Risk for Deleterious Alkali-Silica Reaction

Aggregate Group	Mixture Options				
	Option 1	Option 2	Option 3	Option 4	Option 5
Group I	Mixture options are not applicable. Use any cement or finely divided mineral.				
Group II	X <sup>1</sup>	X	X	X	X
Group III	X	Combine Option 2 with Option 3	Combine Option 2 with Option 3	X	X
Group IV	X	Combine Option 2 with Option 4	Invalid Option	Combine Option 2 with Option 4	X

1. "X" denotes valid option for aggregate group.

- (1) **Mixture option 1.** The coarse or fine aggregates shall be blended to place the material in a group that will allow the selected cement or finely divided mineral to be used. Coarse aggregate may only be blended with another coarse aggregate. Fine aggregate may only be blended with another fine aggregate. The blending of coarse with fine aggregate to place the material in another group will not be permitted.

When a coarse or fine aggregate is blended, the weighted expansion value shall be calculated separately for the coarse and fine aggregate as follows:

$$\text{Weighted Expansion Value} = (a/100 \times A) + (b/100 \times B) + (c/100 \times C) + \dots$$

Where: a, b, c... = percentage of aggregate in the blend; A, B, C... = expansion value for that aggregate.

- (2) **Mixture option 2.** A finely divided mineral shall be used as described in the following. In addition, a blended cement with a finely divided mineral may be added to a separate finely divided mineral to meet the following requirements, provided the finely divided minerals are the same material. However, adding together two (2) different finely divided minerals to obtain the specified minimum percentage of one (1) material will not be permitted. Refer to Mixture Option 5 to address this situation.

- (a) **Class F fly ash.** Class F fly ash shall be a minimum of 25.0% by weight of the cement and finely divided minerals summed together.

If the maximum total equivalent available alkali content exceeds 4.50% for the Class F fly ash, it may be used only if it complies with Mixture Option 5.

- (b) **Class C fly ash.** Class C fly ash shall be a minimum of 25.0% by weight of the cement and finely divided minerals summed together.

If the maximum total equivalent available alkali content exceeds 4.50% or the calcium oxide exceeds 26.50% for the Class C fly ash, it may be used only per Mixture Option 5.

- (c) **Ground granulated blast-furnace slag.** Ground granulated blast-furnace slag shall be a minimum of 25.0% by weight of the cement and finely divided minerals summed together.

If the maximum total equivalent available alkali content exceeds 1.00% for the ground granulated blast-furnace slag, it may be used only per Mixture Option 5.

- (d) **Microsilica or high reactivity metakaolin.** Microsilica solids or high reactivity metakaolin shall be a minimum 5.0% by weight of the cement and finely divided minerals summed together.

If the maximum total equivalent available alkali content exceeds 1.00% for the microsilica or high reactivity metakaolin, it may be used only if it complies with Mixture Option 5.

- (3) **Mixture option 3.** The cement used shall have a maximum total equivalent alkali content of 0.60%. When aggregate in Group II is involved and the Contractor desires to use a finely divided mineral, any finely divided mineral may be used with the cement unless the maximum total equivalent available alkali content exceeds 4.50% for the fly ash; or 1.00% for the ground granulated blast-furnace slag, microsilica, or high reactivity metakaolin. If the alkali content is exceeded, the finely divided mineral may be used only per Mixture Option 5.
- (4) **Mixture option 4.** The cement used shall have a maximum total equivalent alkali content of 0.45%. When aggregate in Group II or III is involved and the Contractor desires to use a finely divided mineral, any finely divided mineral may be used with the cement unless the maximum total equivalent available alkali content exceeds 4.50% for the fly ash; or 1.00% for the ground granulated blast-furnace slag, microsilica, or high reactivity metakaolin. If the alkali content is exceeded, the finely divided mineral may be used only per Mixture Option 5.
- (5) **Mixture option 5.** The proposed cement or finely divided mineral may be used if the ASTM C1567 expansion value is  $\leq 0.16\%$  when performed on the aggregate in the concrete mixture with the highest ASTM C1260 test result. The laboratory performing the ASTM C1567 test shall be approved by the Department according to the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 29-11 *Minimum Laboratory Requirements for Alkali-Silica Reactivity (ASR) Testing*. The ASTM C1567 test will be valid for two (2) years, unless the Engineer determines the materials have changed significantly.

For latex concrete, the ASTM C1567 test shall be performed without the latex.

The 0.20% autoclave expansion limit in ASTM C1567 shall not apply.

If during the two (2) year time period the Contractor needs to replace the cement, and the replacement cement has an equal or lower total equivalent alkali content, a new

ASTM C1567 test will not be required.

The Engineer reserves the right to verify a Contractor's ASTM C1567 test result. When the Contractor performs the test, a split sample may be requested by the Engineer. The Engineer may also independently obtain a sample at any time. The proposed cement or finely divided mineral will not be allowed for use if the Contractor or Engineer obtains an expansion value greater than 0.16%.



**610-2.3 Fine aggregate.** The fine aggregate shall consist of washed sand, washed stone sand, or a blend of washed sand and washed stone sand approved by the Engineer. Stone sand produced through an air separation system approved by the Engineer may be used in place of washed stone sand.

- a. Description.** The natural and manufactured materials used as fine aggregate are defined as follows.
- (1) Sand.** Sand shall be the fine granular material resulting from the natural disintegration of rock. Sand produced from deposits simultaneously with, and by the same operations as, gravel coarse aggregate may contain crushed particles in the quantity resulting normally from the crushing and screening of oversize particles.
  - (2) Stone sand.** Stone sand shall be produced by washing, or processing by air separation, the fine material resulting from crushing rock quarried from undisturbed, consolidated deposits, or crushing gravel. The acceptance and use of crushed gravel stone sand shall be according to the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 12-08 *Crushed Gravel Producer Self-Testing Program*.
- b. Quality.** The fine aggregate shall be Class A Quality, except that the minus No. 200 sieve ITP 11 requirement in the Fine Aggregate Quality Table shall not apply to washed stone sand or any blend of washed stone sand and washed sand approved by the Engineer.

#### Fine Aggregate Quality

Quality Test	Class
	A
Na <sub>2</sub> SO <sub>4</sub> Soundness 5 Cycle, Illinois Modified AASHTO T 104, % Loss max.	10
Minus No. 200 Sieve Material, Illinois Modified AASHTO T 11	3
Organic Impurities Check, Illinois Modified AASHTO T 21	Yes <sup>1</sup>
Deleterious Materials <sup>2,3</sup>	
Shale, % max.	3.0
Clay Lumps, % max.	1.0
Coal & Lignite, & Shells, % max.	1.0
Conglomerate, % max.	3.0
Other Deleterious, % max.	3.0
Total Deleterious, % max.	3.0

1. Applies only to sand. Sand exceeding the colorimetric test standard of 11 (Illinois Modified AASHTO T 21) will be checked for mortar making properties according to Illinois Modified ASTM C 87, and shall develop a compressive strength at the age of 14 days when using Type I or II Cement of not less than 95% of the comparable standard.
2. Applies only to sand.
3. Tests shall be run according to ITP 204.

- c. **Gradation requirements.** The washed sand for shall be Gradation FA 1 or FA 2. Washed stone sand, which includes any blend with washed sand, shall be Gradation FA 1, FA 2, or FA 20.

### Gradation Requirements

Sieve Size	Gradation Percent Passing		
	FA 1	FA 2	FA 20
3/8 inch	100	100	100
No. 4	97±3	97±3	97±3
No. 8			80±20
No. 16	65±20	65±20	50±15
No. 50	16±13	20±10	19±11
No. 100	5±5	5±5	10±7
No. 200			4±4

The blending, alternate use, and/or substitution of fine aggregates from different sources will not be permitted without the approval of the Engineer. Any blending shall be by interlocked mechanical feeders at the aggregate source or concrete plant. The blending shall be uniform, and the equipment shall be approved by the Engineer.

d. **Alkali reaction.**

- (1) Each fine aggregate will be tested by the Department for alkali reaction according to ASTM C1260. The test will be performed with Type I or II Portland cement having a total equivalent alkali content of 0.90% or greater. The Engineer will determine the assigned expansion value for each aggregate, and these values will be made available on the Department's Alkali-Silica Potential Reactivity Rating List. The Engineer may differentiate aggregate based on ledge, production method, gradation number, or other factors. An expansion value of 0.03% will be assigned to limestone or dolomite fine aggregates (manufactured stone sand). However, the Department reserves the right to perform the ASTM C1260 test.
- (2) In some instances, such as chert natural sand or other fine aggregates, testing according to ASTM C1260 may not provide accurate test results. In this case, the Department may only test according to ASTM C1293.
- (3) If an individual aggregate has an ASTM C1260 expansion value that is unacceptable to the Contractor, an ASTM C1293 test may be performed by the Contractor to evaluate the Department's ASTM C1260 test result. The laboratory performing the ASTM C1293 test shall be approved by the Department according to the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 29-11 *Minimum Laboratory Requirements for Alkali-Silica Reactivity (ASR) Testing*.

The ASTM C1293 test shall be performed with Type I or II Portland cement having a total equivalent alkali content of 0.80% or greater. The interior vertical wall of the ASTM C1293 recommended container (pail) shall be half covered with a wick of absorbent material consisting of blotting paper. If the testing laboratory desires to use an alternate container, wick of absorbent material, or amount of coverage inside the container with blotting paper, ASTM C 1293 test results with an alkali-reactive aggregate of known expansion characteristics shall be provided to the Engineer for review and approval. If the expansion is less than 0.040% after one (1) year, the aggregate will be assigned an ASTM C1260 expansion value of 0.08% that will be valid for two (2) years, unless the

Engineer determines the aggregate has changed significantly. If the aggregate is manufactured into multiple gradation numbers, and the other gradation numbers have the same or lower ASTM C1260 value, the ASTM C1293 test result may apply to multiple gradation numbers.

The Engineer reserves the right to verify a Contractor's ASTM C1293 test result. When the Contractor performs the test, a split sample shall be provided to the Engineer. The Engineer may also independently obtain a sample at any time. The aggregate will be considered reactive if the Contractor or Engineer obtains an expansion value of 0.040% or greater.

**610-2.4 Coarse aggregate.** The coarse aggregate for concrete shall be gravel, crushed stone, crushed gravel, crushed slag, crushed sandstone, or crushed concrete meeting the following requirements.

- a. Description.** The natural and manufactured materials used as coarse aggregate are defined as follows.
- (1) Gravel.** Gravel shall be the coarse granular material resulting from the reduction of rock by the action of the elements and having subangular to rounded surfaces. It may be partially crushed.
  - (2) Crushed stone.** Crushed stone shall be the angular fragments resulting from crushing undisturbed, consolidated deposits of rock by mechanical means. Crushed stone shall be divided into the following, when specified.
    - (a) Carbonate crushed stone.** Carbonate crushed stone shall be either dolomite or limestone. Dolomite shall contain 11.0% or more magnesium oxide (MgO). Limestone shall contain less than 11.0% magnesium oxide (MgO).
    - (b) Crystalline crushed stone.** Crystalline crushed stone shall be either metamorphic or igneous stone, including but is not limited to, quartzite, granite, rhyolite and diabase.
  - (3) Crushed gravel.** Crushed gravel shall be the product resulting from crushing, by mechanical means, and shall consist entirely of particles obtained by crushing gravel. The acceptance and use of crushed gravel shall be according to the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 12-08 *Crushed Gravel Producer Self-Testing Program*.
  - (4) Crushed slag.** Crushed slag shall be the graded product resulting from the processing of air-cooled blast furnace slag. Air-cooled blast furnace slag shall be the nonmetallic product, consisting essentially of silicates and alumino-silicates of lime and other bases, which is developed in a molten condition simultaneously with iron in a blast furnace. It shall be air-cooled and shall have a compact weight (ITP 19) of not less than 70 pounds per cubic foot. The acceptance and use of air-cooled blast furnace slag shall be according to the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 13-08, *Slag Producer Self-Testing Program*.
  - (5) Crushed sandstone.** Crushed sandstone shall be the angular fragments resulting from crushing, by mechanical means, a cemented sand composed predominantly of quartz grains. Sandstone shall have an Insoluble Residue of 50.0% or higher.
  - (6) Crushed concrete.** Crushed concrete shall be the angular fragments resulting from crushing Portland cement concrete by mechanical means. The acceptance and use of crushed concrete shall be according to Item 219 titled RECYCLED CONCRETE AGGREGATE BASE COURSE.
- b. Quality.** The coarse aggregate shall be Class A Quality.

### Coarse Aggregate Quality

Quality Test	Class
	A
Na <sub>2</sub> SO <sub>4</sub> Soundness 5 Cycle, Illinois Modified AASHTO T 104 <sup>1</sup> , % Loss max.	15
Los Angeles Abrasion, Illinois Modified AASHTO T 96, % Loss max.	45
Minus No. 200 Sieve Material, Illinois Modified AASHTO T 11	1.0 <sup>2</sup>
Deleterious Materials <sup>4</sup>	
Shale, % max.	1.0
Clay Lumps, % max.	0.25
Coal & Lignite, % max.	0.25
Soft & Unsound Fragments, % max.	4.0
Other Deleterious, % max.	4.0 <sup>3</sup>
Total Deleterious, % max.	5.0

1. Does not apply to crushed concrete.
2. For crushed aggregate, if the material finer than the No. 200 sieve consists of the dust from fracture, essentially free from clay or silt, this percentage may be increased to 2.5.
3. Includes deleterious chert. In gravel and crushed gravel aggregate, deleterious chert shall be the lightweight fraction separated in a 2.35 heavy media separation. In crushed stone aggregate, deleterious chert shall be the lightweight fraction separated in a 2.55 heavy media separation. Tests shall be run according to Illinois Modified AASHTO T 113.
4. Test shall be run according to ITP 203.

c. **Gradation requirements.** The coarse aggregate gradation shall be as follows.

### Gradation Requirements

Sieve Size	Gradation Percent Passing				
	CA 7	CA 11	CA 13	CA 14	CA 16
1-1/2 inch	100				
1 inch	95±5	100			
3/4 inch		92±8	100		
1/2 inch	45±15	45±15	97±3	90±10	100
3/8 inch			80±10	45±20	97±3
No. 4	5±5	6±6	30±15	3±3	30±15
No. 16		3±3	3±3		2±2

- (1) **Combining sizes.** Each size shall be stored separately, and care shall be taken to prevent them from being mixed until they are ready to be proportioned. Separate compartments shall be provided to proportion each size. If the coarse aggregate is furnished in separate sizes, they shall be combined in proportions to provide a uniformly graded coarse aggregate grading within the following limits.

### Gradation Requirements

Sieve Size	Gradation Percent Passing			
	CA 3 & CA 7	CA 3 & CA 11	CA 5 & CA 7	CA 5 & CA 11
2-1/2 inch	100	100		
2 inch	95±5	95±5		
1-3/4 inch			100	100
1-1/2 inch			98±2	98±2
1 inch	55±25	55±25	72±22	72±22
1/2 inch	20±10	20±10	22±12	22±12
No. 4	3±3	3±3	3±3	3±3

#### d. Alkali reaction.

- (1) Each coarse aggregate will be tested by the Department for alkali reaction according to ASTM C 1260. The test will be performed with Type I or II Portland cement having a total equivalent alkali content of 0.90% or greater. The Engineer will determine the assigned expansion value for each aggregate, and these values will be made available on the Department's Alkali-Silica Potential Reactivity Rating List. The Engineer may differentiate aggregate based on ledge, production method, gradation number, or other factors. An expansion value of 0.05% will be assigned to limestone or dolomite coarse aggregates. However, the Department reserves the right to perform the ASTM C 1260 test.
- (2) In some instances, testing coarse aggregate according to ASTM C 1260 may not provide accurate test results. In this case, the Department may only test according to ASTM C 1293.
- (3) If an individual aggregate has an ASTM C 1260 expansion value that is unacceptable to the Contractor, an ASTM C 1293 test may be performed by the Contractor to evaluate the Department's ASTM C 1260 test result. The laboratory performing the ASTM C 1293 test shall be approved by the Department according to the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 29-11 *Minimum Laboratory Requirements for Alkali-Silica Reactivity (ASR) Testing*.

The ASTM C 1293 test shall be performed with Type I or II Portland cement having a total equivalent alkali content of 0.80% or greater. The interior vertical wall of the ASTM C 1293 recommended container (pail) shall be half covered with a wick of absorbent material consisting of blotting paper. If the testing laboratory desires to use an alternate container, wick of absorbent material, or amount of coverage inside the container with blotting paper, ASTM C 1293 test results with an alkali-reactive aggregate of known expansion characteristics shall be provided to the Engineer for review and approval. If the expansion is less than 0.040% after one (1) year, the aggregate will be assigned an ASTM C 1260 expansion value of 0.08% that will be valid for two (2) years, unless the Engineer determines the aggregate has changed significantly. If the aggregate is manufactured into multiple gradation numbers, and the other gradation numbers have the same or lower ASTM C 1260 value, the ASTM C 1293 test result may apply to multiple gradation numbers.

The Engineer reserves the right to verify a Contractor's ASTM C 1293 test result. When the Contractor performs the test, a split sample shall be provided to the Engineer. The Engineer may also independently obtain a sample at any time. The aggregate will be

considered reactive if the Contractor or Engineer obtains an expansion value of 0.040% or greater

**610-2.5 Cement.** Cement shall conform to the requirements of ASTM C150 Type I. Other cement types may be allowed by Special Provision.

**610-2.6 Water.** Water used in mixing or curing shall be from potable water sources. Other sources shall be tested in accordance with AASHTO T 26 and must be approved by the Engineer prior to use.

**610-2.7 Cementitious materials.**

- a. **Fly ash.** Fly ash shall consist of the finely divided residue that results from the combustion of ground or powdered coal, transported from the combustion chamber by exhaust gas, collected by mechanical or electrical means, and stored in stockpiles or bins. Fly ash shall be according to AASHTO M 295, Type C or F and shall meet the requirements of the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 18-08, *Acceptance Procedure for Finely Divided Minerals Used in Concrete and Other Applications*. The source of the fly ash shall be identified by the Contractor and approved by the Resident Engineer in advance of modification operations so laboratory tests can be completed prior to beginning work.

When Class C fly ash is use, the amount of Portland cement replaced shall not exceed 30% by weight.

When Class F fly ash is use, the amount of Portland cement replaced shall not exceed 25% by weight.

- b. **Slag cement (ground granulated blast furnace (GGBF)).** Ground granulated blast-furnace slag shall consist of the glassy granular material formed when molten blast-furnace slag is rapidly chilled and then finely ground. Slag cement shall conform to AASHTO M 302, Grade 100 or Grade 120. GGBF shall be listed on the current Illinois Department of Transportation's published Qualified Producer List of *Finely Divided Materials*.

When GGBF slag is used, the amount of Portland cement replaced shall not exceed 35% by weight.

- c. **Microsilica (silica fume).** Microsilica is an amorphous silica of high silica content and purity possessing high pozzolanic activity.

The microsilica used in Portland cement concrete shall be according to AASHTO M 307.

The microsilica shall be supplied either in a dry, densified form or as a water-based slurry.

- d. **High-reactivity metakaolin (HRM).** High-reactivity metakaolin (HRM) is a reactive aluminosilicate pozzolan formed by calcining purified kaolinite at a specific temperature range.

The HRM used in Portland cement concrete shall be according to AASHTO M 321, except the fineness shall be a maximum 15% retained on the No. 325 sieve.

The HRM shall be supplied in a dry, undensified form.

**610-2.8 Admixtures.** Admixtures shall be furnished in liquid form ready for use. The admixtures shall be delivered in the manufacturer's original containers, bulk tank trucks or such containers or tanks as are acceptable to the Engineer. Delivery shall be accompanied by a ticket which clearly identifies the manufacturer and trade name of the material. Containers shall be readily identifiable as to manufacturer and trade name of the material they contain.

Concrete admixtures shall be listed on the current Illinois Department of Transportation's published Qualified Product List of *Concrete Admixtures*. For the admixture submittal, a report prepared by an independent laboratory accredited by the AASHTO Materials Reference Laboratory (AMRL) for Portland cement concrete shall be provided. The report shall show the

results of physical tests conducted no more than five (5) years prior to the time of submittal, according to applicable specifications.

Tests shall be conducted using materials and methods specified on a "test" concrete and a "reference" concrete, together with a certification that no changes have been made in the formulation of the material since the performance of the tests. Per the manufacturer's option, the cement content for all required tests shall either be according to applicable specifications or 565 pounds of cementitious material per cubic yard. Compressive strength test results for six (6) months and one (1) year will not be required.

Prior to the approval of an admixture, the Engineer reserves the right to request a sample for testing. The test and reference concrete mixtures tested by the Engineer will contain a cement content of 565 pounds of cementitious material per cubic yard. For freeze thaw testing, the Department will perform the test according to ITP 161. The flexural strength test will be performed according to AASHTO T 177. If the Engineer decides to test the admixture, the manufacturer shall submit AASHTO T 197 water content and set time test results on the standard cement used by the Department. The test and reference concrete mixture shall contain a cement content of 565 pounds of cementitious material per cubic yard. The manufacturer may select their lab or an independent lab to perform this testing. The laboratory is not required to be accredited by AASHTO.

The manufacturer shall include in the submittal the following information: the manufacturing range for specific gravity, the midpoint and manufacturing range for residue by oven drying, and manufacturing range of pH. The submittal shall also include an infrared spectrophotometer trace no more than five (5) years old. If an accelerating admixture contains calcium salts, the midpoint and manufacturing range for residue by oven drying will not be required.

For air-entraining admixtures, the specific gravity allowable manufacturing range shall be established by the manufacturer and the test method shall be according to ASTM C494. For residue by oven drying and pH, the allowable manufacturing range and test methods shall be according to ASTM C260.

For air entraining, water-reducing and accelerating admixtures, the pH allowable manufacturing range shall be established by the manufacturer and the test method shall be according to ASTM E 70. For specific gravity and residue by oven drying, the allowable manufacturing range and test methods shall be according to ASTM C494.

When test results are more than seven (7) years old, the manufacturer shall resubmit the infrared spectrophotometer trace and the report prepared by an independent laboratory accredited by AASHTO.

All admixtures, except chloride-based accelerators, shall contain a maximum of 0.3% chloride by weight as determined by an appropriate test method selected by the manufacturer. To verify the manufacturer test result, the Department will use AASHTO T 260, Procedure A, Method 1.

Random field samples may be taken by the Department to verify an admixture meets specification. A split sample will be provided to the manufacturer if requested. Admixtures that do not meet specification requirements or an allowable manufacturing range established by the manufacturer shall be replaced with new material.

Admixtures shall conform to the following.

- a. **Air-entraining admixtures.** Air-entraining admixtures shall according to AASHTO M 154. The specific gravity allowable manufacturing range shall be established by the manufacturer and the test method shall be according to ASTM C494. For residue by oven drying and pH, the allowable manufacturing range and test methods shall be according to ASTM C260 and shall consistently entrain the air content in the specified ranges under field conditions. The air-entrainment agent and any water reducer admixture shall be compatible.

- b. Water-reducing admixtures.** Water-reducing admixture shall meet the requirements of AASHTO M 194, Type A, B, or D. AASHTO M 194, Type F and G high range water reducing admixtures and ASTM C1017 flowable admixtures shall not be used.
- c. Other admixtures.** The use of set retarding and set-accelerating admixtures shall be approved by the Engineer. Retarding shall meet the requirements of AASHTO M 194, Type A, B, or D and set-accelerating shall meet the requirements of AASHTO M 194, Type C.

**610-2.9 Joint filler.** The sealant for the joints in the concrete pavement shall meet the requirements of Item 605 titled JOINT SEALANTS FOR PAVEMENTS, unless otherwise specified.

**610-2.10 Premolded joint material.** Premolded joint material for isolation and expansion joints shall conform the requirements of AASHTO M 213 or ASTM D1752 and shall be where specified in the contract documents. The filler for each joint shall be furnished in a single piece for the full depth and width required for the joint, unless otherwise specified by the Resident Engineer. When the use of more than one (1) piece is required for a joint, the abutting ends shall be fastened securely and held accurately to shape by stapling or other positive fastening means satisfactory to the Resident Engineer.

**610-2.11 Forms.** The forms shall be of wood or metal, straight and free from warp, and of sufficient strength to resist springing during the process of depositing the concrete against them. Wood forms shall consist of two (2) inch surface plank, except wood forms less than two (2) inches thick may be used for short radii. Metal forms shall be of an approved section and shall have a flat surface on the top. Forms shall be so designed that divider plates or other devices for holding the form in place will not cause planes of weakness in the concrete and subsequent cracking. The forms shall be of a depth of the curbing, median or paved ditch, and so designed as to permit secure fastening together at the tops.

**610-2.12 Steel reinforcement.** All fabrication shall be done at the mill or shop prior to shipment.

At the time of shipment, the surface of all reinforcement bars and welded wire reinforcement shall be free from loose mill scale, dirt, oil, grease, or other foreign substances. A light coating of rust, which may form during storage under acceptable conditions at the mill or warehouse, will not be deemed cause for rejection. Stocks of reinforcement bars or welded wire reinforcement either at the mill or warehouse, which have not been protected in an adequate manner during storage, will not be accepted.

At the time the bars or welded wire reinforcement are placed in the work, they shall be free from rust which pits the surface or scales off, dirt, oil, grease, or other foreign substances. A light coating of rust, which may form during storage on the work under acceptable conditions, will not be deemed cause to require cleaning. Thin powdery rust and tight rust is not considered detrimental and need not be removed.

Reinforcing shall consist of steel conforming to the requirements below.

#### Steel Reinforcement

Reinforcing Steel	ASTM A706 Grade 60,
Welded Steel Wire Fabric	AASHTO M 55, AASHTO M 221
Bar Mats	AASHTO M 54

**610-2.13 Materials for curing concrete.** Curing materials shall conform to one (1) of the following specifications below.

- a. Membrane curing compounds.** Liquid membrane-forming compounds for curing concrete shall conform to the requirements of ASTM C309, Type 2, Class A and the following.

The manufacturer shall provide the membrane curing compound manufacturing range for specific gravity and non-volatile content.



The material will be sampled at the manufacturer's plant by an authorized representative of the Department. The Engineer will test the sampled material and no material shall be used until it has been approved.

Each container shall be legibly marked with the name of the manufacturer, the type (Department designation) or type/class (ASTM designation), the manufacturer's batch or lot number, date of manufacture, and the Department's test identification number.

Approved material shall not be used after nine (9) months from the date of manufacture, unless sampled and tested for re-approval by the Engineer. Material more than 18 months old from the date of manufacture shall not be used.

Based on information provided in the safety data sheet (SDS), the Engineer reserves the right to reject the material due to health or safety concerns.

Specimens used for determining moisture loss will be made and tested according to AASHTO T 155.

It shall be white pigmented and there are no restrictions on dissolved solids.

- b. Burlap curing blankets and cotton mats.** These materials shall be according to AASHTO M 182 and shall be free from substances which may be deleterious to freshly placed concrete. Burlap shall meet the requirements for Class 3.

Blankets and mats shall be in a condition satisfactory to the Engineer. Any tears or holes shall be repaired.

- c. Waterproof paper blankets, white polyethylene sheeting, and burlap-polyethylene blankets.** These materials shall be white and according to ASTM C171, except moisture loss test specimens shall be made according to AASHTO T 155.

Blankets and sheeting shall be in a condition satisfactory to the Engineer. Any tears or holes shall be repaired

- 610-2.14 Calcium chloride.** Calcium chloride shall conform to AASHTO M 144.

### CONSTRUCTION METHODS

- 610-3.1 General.** The Contractor shall furnish all labor, materials, and services necessary for, and incidental to, the completion of all work as shown on the drawings and specified here. All machinery and equipment used by the Contractor on the work, shall be of sufficient size to meet the requirements of the work. All work shall be subject to the inspection and approval of the Engineer.

- 610-3.2 Concrete mixture.** The concrete shall develop a compressive strength of 3,500 pounds per square inch in 14 days as determined by test cylinders made in accordance with AASHTO T 23 and tested in accordance with AASHTO T 22. The concrete shall contain not less than 565 pounds of cementitious material per cubic yard when a central mix plant is used and 605 pounds of cementitious material per cubic yard when the concrete is truck mixed. The water cementitious ratio shall be between 0.32 and 0.44 by weight. The air content of the concrete shall be  $6.5\% \pm 1.5\%$  as determined by AASHTO T 152 or AASHTO T 196 and shall have a maximum slump of four (4) inches and minimum slump of two (2) inches as determined by AASHTO T 119.

- 610-3.3 Mixing.** Concrete may be mixed at the construction site, at a central point, or wholly or in part in truck mixers. The concrete shall be mixed and delivered in accordance with the requirements of AASHTO M 241.

The concrete shall be mixed only in quantities required for immediate use. Concrete shall not be mixed while the air temperature is below 40°F without the Engineer's approval. If approval is granted for mixing under such conditions, aggregates or water, or both, shall be heated and the

concrete shall be placed at a temperature not less than 50°F nor more than 100°F. The Contractor shall be held responsible for any defective work, resulting from freezing or injury in any manner during placing and curing, and shall replace such work at the expense of the Contractor.

Retempering of concrete by adding water or any other material is not permitted.

Haul time shall begin when the delivery ticket is stamped. The delivery ticket shall be stamped no later than five (5) minutes after the addition of the mixing water to the cement, or after the addition of the cement to the aggregate when the combined aggregates contain free moisture in excess of 2% by weight. If more than one (1) batch is required for charging a truck using a stationary mixer, the time of haul shall start with mixing of the first batch. Haul time shall end when the truck is emptied for incorporation of the concrete into the work.

The time elapsing from when water is added to the mix until it is deposited in place at the site of the work shall not exceed 30 minutes when the concrete is transported in non-agitating trucks.

The maximum haul time for concrete transported in truck mixers or truck agitators shall be according to the following.

#### Haul Time

Concrete Temperature at Point of Discharge °F	Haul Time	
	Hours	Minutes
50-64	1	30
>64 – without retarder	1	0
>64 – with retarder	1	30

To encourage start-up testing for mix adjustments at the plant, the first two (2) trucks will be allowed an additional 15 minutes haul time whenever such testing is performed.

For a mixture which is not mixed on the jobsite, a delivery ticket shall be required for each load. The following information shall be recorded on each delivery ticket: ticket number, name of producer and plant location, contract number, name of Contractor, stamped date and time batched, truck number, quantity batched, amount of admixtures in the batch, amount of water in the batch, and the Department mix design number.

For concrete mixed in jobsite stationary mixers, the above delivery ticket may be waived, but a method of verifying the haul time shall be established to the satisfaction of the Engineer.

**610-3.4 Forms.** Concrete shall not be placed until all the forms and reinforcements have been inspected and approved by the Resident Engineer. Forms shall be of suitable material and shall be of the type, size, shape, quality, and strength to build the structure as specified in the contract documents. The forms shall be true to line and grade and shall be mortar-tight and sufficiently rigid to prevent displacement and sagging between supports. The surfaces of forms shall be smooth and free from irregularities, dents, sags, and holes. The Contractor shall be responsible for their adequacy.

The internal form ties shall be arranged so no metal will show in the concrete surface or discolor the surface when exposed to weathering when the forms are removed. All forms shall be wetted with water or with a non-staining mineral oil, which shall be applied immediately before the concrete is placed. Forms shall be constructed so they can be removed without injuring the concrete or concrete surface.

**610-3.5 Placing reinforcement.** All reinforcement shall be accurately placed, as specified in the contract documents, and shall be firmly held in position during concrete placement. Bars shall be fastened together at intersections. The reinforcement shall be supported by approved metal chairs. Shop drawings, lists, and bending details shall be supplied by the Contractor when required.

- 610-3.6 Embedded items.** Before placing concrete, all embedded items shall be firmly and securely fastened in place as indicated. All embedded items shall be clean and free from coating, rust, scale, oil, or any foreign matter. The concrete shall be spaded and consolidated around and against embedded items. The embedding of wood shall not be allowed.
- 610-3.7 Concrete consistency.** The Contractor shall monitor the consistency of the concrete delivered to the project site; collect each batch ticket; check temperature; and perform slump tests on each truck at the project site as specified.
- 610-3.8 Placing concrete.** All concrete shall be placed during daylight hours, unless otherwise approved. The concrete shall not be placed until the depth and condition of foundations, the adequacy of forms and falsework, and the placing of the steel reinforcing have been approved by the Resident Engineer. Concrete shall be placed as soon as practical after mixing as specified in paragraph 610-3.3 titled MIXING. The method and manner of placing shall avoid segregation and displacement of the reinforcement. Troughs, pipes, and chutes shall be used as an aid in placing concrete when necessary. The concrete shall not be dropped from a height of more than five (5) feet. Concrete shall be deposited as nearly as practical in its final position to avoid segregation due to re-handling or flowing. Do not subject concrete to procedures which cause segregation. Concrete shall be placed on clean, damp surfaces, free from running water, or on a properly consolidated soil foundation.
- 610-3.9 Vibration.** Vibration shall follow the guidelines in American Concrete Institute (ACI) Committee 309R, Guide for Consolidation of Concrete. Furnish a spare, working, vibrator on the job site whenever concrete is placed. Consolidate concrete slabs greater than four (4) inches in depth with high frequency mechanical vibrating equipment supplemented by hand spading and tamping. Consolidate concrete slabs four (4) inches or less in depth by wood tampers, spading, and settling with a heavy leveling straightedge. Operate internal vibrators with vibratory element submerged in the concrete, with a minimum frequency of not less than 6,000 cycles per minute when submerged. Do not use vibrators to transport the concrete in the forms. Penetrate the previously placed lift with the vibrator when more than one (1) lift is required. Use external vibrators on the exterior surface of the forms when internal vibrators do not provide adequate consolidation of the concrete. Vibrators shall be manipulated to work the concrete thoroughly around the reinforcement and embedded fixtures and into corners and angles of the forms. The vibration at any point shall be of sufficient duration to accomplish compaction but shall not be prolonged to where segregation occurs. Concrete deposited under water shall be carefully placed in a compact mass in its final position by means of a tremie or other approved method and shall not be disturbed after placement.
- 610-3.10 Joints.** Joints shall be constructed as specified in the contract documents.
- 610-3.11 Finishing.** All exposed concrete surfaces shall be true, smooth, and free from open or rough areas, depressions, or projections. All concrete horizontal plane surfaces shall be brought flush to the proper elevation with the finished top surface struck-off with a straightedge and floated.
- 610-3.12 Curing and protection.** Curing shall be accomplished by one (1) of the following described methods. When water is required to wet the surface, it shall be applied as a fine spray so that it will not mar or pond on the surface. Except where otherwise specified, the curing period shall be at least 72 hours.
- a. Waterproof paper method.** The surface of the concrete shall be covered with waterproof paper as soon as the concrete has hardened sufficiently to prevent marring the surface. The surface of the concrete shall be wetted immediately before the paper is placed. The blankets shall be lapped at least 12 inches end to end, and these laps shall be securely weighted with a windrow of earth, or other approved method, to form a closed joint. The same requirements shall apply to the longitudinal laps where separate strips are used for curing edges, except the lap shall be at least nine (9) inches. The edges of the blanket shall be weighted securely with a continuous windrow of earth or any other means satisfactory to the Resident Engineer to provide an air-tight cover. Any torn places or holes in the paper shall be repaired immediately by patches cemented over the openings, using a bituminous

cement having a melting point of not less than 180°F. The blankets may be reused, provided they are air-tight and kept serviceable by proper repairs.

A longitudinal pleat shall be provided in the blanket to permit shrinkage where the width of the blanket is sufficient to cover the entire surface. The pleat will not be required where separate strips are used for the edges. Joints in the blanket shall be sewn or cemented together in such a manner that they will not separate during use.

- b. White burlap-polyethylene sheeting method.** The surface of the concrete shall be entirely covered with white polyethylene sheeting as soon as the concrete has hardened sufficiently to prevent marring the surface. The surface of the concrete shall be wetted immediately before the sheeting is placed. The sheeting used shall be such length (or width) that it will extend at least twice the thickness of the pavement beyond the edges of the slab. The sheeting shall be placed so that the entire surface and both edges of the slab are completely covered. The sheeting shall be placed and weighted securely with a continuous windrow of earth or any other means satisfactory to the Resident Engineer to provide an air-tight cover. Adjoining sheets shall overlap not less than 12 inches and the laps shall be securely weighted with earth, or any other means satisfactory to the Engineer, to provide an air-tight cover. The covering shall be maintained fully saturated and in position for seven (7) days after the concrete has been placed. Any tears or holes in the sheeting shall be repaired. When sheets are no longer serviceable as a single unit, the Contractor may select from such sheets and reuse those which will serve for further applications, provided two (2) sheets are used as a single unit; however, the double sheet units will be rejected when the Resident Engineer deems that they no longer provide an air tight cover.
- c. Wetted burlap method.** The surface of the concrete shall be entirely covered with wetted burlap blankets as soon as the concrete has hardened sufficiently to prevent marring the surface. The blankets shall overlap six (6) inches. At least two (2) layers of wetted burlap shall be placed on the finished surface. The burlap shall be kept saturated by means of a mechanically operated sprinkling system. In place of the sprinkling system, at the Contractor's option, two (2) layers of burlap covered with impermeable covering shall be used. The burlap shall be kept saturated with water. Plastic coated burlap may be substituted for one (1) layer of burlap and impermeable covering. The blankets shall be placed so that they are in contact with the edges of the concrete, and that portion of the material in contact with the edges shall be kept saturated with water. The material shall be maintained fully saturated and in position for seven (7) days. When the forms are stripped, the vertical walls shall also be kept moist. It shall be the responsibility of the Contractor to prevent ponding of the curing water on the subbase.
- d. Membrane curing method.** Membrane curing will not be permitted between November 1 and April 15. Membrane curing will not be permitted where a protective coat, concrete sealer, or waterproofing is to be applied, or at areas where rubbing or a normal finish is required, or at construction joints other than those necessary in pavement or base course.

After all finishing work to the concrete surface has been completed, it shall be sealed with membrane curing compound of the type specified within ten (10) minutes. The seal shall be maintained for the specified curing period. The edges of the concrete shall, likewise, be sealed within ten (10) minutes after the forms are removed. Two (2) separate applications, applied at least one (1) minute apart, each at the rate of not less than one (1) gallon per 250 square feet will be required upon the surfaces and edges of the concrete. These applications shall be made with the mechanical equipment specified. The curing compound shall be agitated immediately before and during the application.

At locations where the coating is discontinuous or where pin holes show or where the coating is damaged due to any cause and on areas adjacent to sawed joints, immediately after sawing is completed, an additional coating of membrane curing compound shall be applied at the above specified rate. The equipment used may be of the same type as that used for coating variable widths of pavement. Before the additional coating is applied

adjacent to sawed joints, the cut faces of the joint shall be protected by inserting a suitable flexible material in the joint or placing an adhesive width of impermeable material over the joint, or by placing the permanent sealing compound in the joint. Material, other than the permanent sealing compound, used to protect cut faces of the joint, shall remain in place for the duration of the curing period. In lieu of applying the additional coating, the area of the sawed joint may be cured according to any other method permitted.

When rain occurs before an application of membrane curing compound has dried, and the coating is damaged, the Engineer may require another application be made in the same manner and at the same rate as the original coat. The Engineer may order curing by another method specified, if unsatisfactory results are obtained with membrane curing compound.

- e. **Wetted cotton mat method.** After the surface of concrete has been textured or finished, it shall be covered immediately with dry or damp cotton mats. The cotton mats shall be placed in a manner which will not mar the concrete surface. A texture resulting from the cotton mat material is acceptable. The cotton mats shall then be wetted immediately and thoroughly soaked with a gentle spray of water.

The cotton mats shall be maintained in a wetted condition until the concrete has hardened sufficiently to place soaker hoses without marring the concrete surface. The soaker hoses shall be placed on top of the cotton mats at a maximum four (4) foot spacing. The cotton mats shall be kept wet with a continuous supply of water for the remainder of the curing period. Other continuous wetting systems may be used if approved by the Engineer.

After placement of the soaker hoses, the cotton mats shall be covered with white polyethylene sheeting or burlap-polyethylene blankets.

Soaker hoses or a continuous wetting system will not be required if the alternative method keeps the cotton mats wet. Periodic wetting of the cotton mats is acceptable.

The curing covering for each day's paving shall be removed to permit testing of the pavement surface with a profilograph or straightedge, as directed by the Resident Engineer.

Immediately after testing, the surface of the pavement shall be wetted thoroughly, and the curing coverings replaced. The top surface and the edges of the concrete shall not be left unprotected for a period of more than one-half (1/2) hour.

When the official National Weather Service forecast for the construction area predicts a low of 32°F, or lower, or if the actual temperature drops to 32°F, or lower, concrete less than 72 hours old shall be provided at least the following protection.

### Materials for Curing

Minimum Temperature °F	Protection
25-32	Two (2) layers of polyethylene sheeting, one (1) layer of polyethylene and one (1) layer of burlap, or two (2) layers of waterproof paper.
Below 25	6 inches of straw covered with one (1) layer of polyethylene sheeting or waterproof paper.

These protective covers shall remain in place until the concrete is at least 96 hours old. When straw is required on pavement cured with membrane curing compound, the compound shall be covered with a layer of burlap, polyethylene sheeting, or waterproof paper before the straw is applied.

After September 15, there shall be available to the work within four (4) hours, sufficient clean, dry straw to cover at least two (2) days production. Additional straw shall be provided as needed to afford the protection required. Regardless of the precautions taken, the Contractor shall be

responsible for protection of the concrete placed and any concrete damaged by cold temperatures shall be removed and replaced.

- 610-3.13 Cold weather placing.** When concrete is placed at temperatures below 40°F when measured in accordance with ASTM C1064, the Contractor shall provide satisfactory methods and means to protect the mix from injury by freezing. The aggregates, or water, or both, shall be heated to place the concrete at temperatures between 50°F and 90°F.

After the concrete has been placed, the Contractor shall provide sufficient protection to enclose and protect the structure and maintain the temperature of the mix at not less than 50°F until at least 60% of the designed strength has been attained. Additional cold weather concreting recommendations can be found in ACI 306R, *Cold Weather Concreting*. If concrete is to be placed under cold weather conditions, the Contractor shall submit the proposed materials and methods for review and approval by the Engineer. The proposed materials and methods shall meet the requirements of Illinois Department of Transportation, Aeronautics Policy Memorandum (PM) 2001-1, *Requirements for Cold Weather Concreting*.

- 610-3.14 Hot weather placing.** Concrete shall be properly placed and finished with procedures previously submitted. The concrete-placing temperature shall not exceed 90°F when measured in accordance with ASTM C1064. Cooling of the mixing water and aggregates, or both, may be required to obtain an adequate placing temperature. A retarder meeting the requirements of paragraph 610-2.8 titled ADMIXTURES may be used to facilitate placing and finishing. Steel forms and reinforcement shall be cooled prior to concrete placement when steel temperatures are greater than 120°F. Conveying and placing equipment shall be cooled if necessary, to maintain proper concrete-placing temperature. Additional hot weather concreting recommendations can be found in ACI 305R, *Hot Weather Concreting*. If concrete is to be placed under hot weather conditions, the Contractor shall submit the proposed materials and methods for review and approval by the Engineer.

#### QUALITY ASSURANCE (QA)

- 610-4.1 Quality assurance sampling and testing.** The Resident Engineer will sample the concrete in accordance with AASHTO R 60 and paragraph 610-3.2 titled CONCRETE MIXTURE. Concrete for each day's placement will be accepted on the basis of the compressive strength. If more than 100 cubic yards of the mix is placed in a given day, additional tests at a frequency of one (1) per 100 cubic yards shall be taken for compressive strength, slump, and air. Testing shall comply with Illinois Department of Transportation, Aeronautics Policy Memorandum (PM) 96-1, *Item 610, Structural Portland Cement Concrete: Job Mix Formula Approval & Production Testing*.

The Contractor shall provide adequate facilities for the initial curing of cylinders.

- 610-4.2 Defective work.** Any defective work that cannot be satisfactorily repaired as determined by the Resident Engineer, shall be removed and replaced at the Contractor's expense. Defective work includes, but is not limited to, uneven dimensions, honeycombing and other voids on the surface or edges of the concrete.

#### METHOD OF MEASUREMENT

- 610-5.1** Concrete for miscellaneous structures shall considered incidental to the contract and no separate measurement shall be made.

#### BASIS OF PAYMENT

- 610-6.1** Concrete shall be considered incidental and no separate payment shall be made.

## REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

### ASTM International (ASTM)

ASTM A 706	Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM C 87	Standard Test Method for Effect of Organic Impurities in Fine Aggregate on Strength of Mortar
ASTM C 150	Standard Specification for Portland Cement
ASTM C 171	Standard Specification for Sheet Materials for Curing Concrete
ASTM C 260	Standard Specification for Air-Entraining Admixtures for Concrete
ASTM C 309	Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C 494	Standard Specification for Chemical Admixtures for Concrete
ASTM C 1017	Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete
ASTM C 1064	Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete
ASTM C 1260	Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)
ASTM C 1293	Standard Test Method for Determination of Length Change of Concrete Due to Alkali-Silica Reaction
ASTM D 1752	Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction

### American Association of State Highway and Transportation Officials (AASHTO)

AMRL	AASHTO Materials Reference Laboratory
AASHTO M 54	Standard Specification for Welded Deformed Steel Bar Mats for Concrete Reinforcement
AASHTO M 55	Standard Method of Test for Steel Welded Wire Reinforcement, Plain, for Concrete
AASHTO M 144	Standard Specification for Calcium Chloride
AASHTO M 154	Standard Specification for Air-Entraining Admixtures for Concrete
AASHTO M 182	Standard Specification for Burlap Cloth Made from Jute or Kenaf and Cotton Mats
AASHTO M 194	Standard Specification for Chemical Admixtures for Concrete
AASHTO M 213	Standard Method of Test for Mass [Weight] of Coating on Aluminum-Coated Iron or Steel Articles
AASHTO M 221	Standard Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete
AASHTO M 241	Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing

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AASHTO M 295	Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
AASHTO M 302	Standard Specification for Slag Cement for Use in Concrete and Mortars
AASHTO M 307	Standard Specification for Silica Fume Used in Cementitious Mixtures
AASHTO M 321	Standard Specification for High-Reactivity Pozzolans for Use in Hydraulic-Cement Concrete, Mortar, and Grout
AASHTO R 60	Standard Practice for Sampling Freshly Mixed Concrete
AASHTO T 22	Standard Method of Test for Compressive Strength of Cylindrical Concrete Specimens
AASHTO T 23	Standard Method of Test for Making and Curing Concrete Test Specimens in the Field
AASHTO T 26	Standard Method of Test for Quality of Water to Be Used in Concrete
AASHTO T 119	Standard Method of Test for Slump of Hydraulic Cement Concrete
AASHTO T 152	Standard Method of Test for Air Content of Freshly Mixed Concrete by the Pressure Method
AASHTO T 155	Standard Method of Test for Water Retention by Liquid Membrane-Forming Curing Compounds for Concrete
AASHTO T 177	Standard Method of Test for Flexural Strength of Concrete (Using Simple Beam with Center-Point Loading)
AASHTO T 196	Standard Method of Test for Air Content of Freshly Mixed Concrete by the Volumetric Method
AASHTO T 197	Standard Method of Test for Time of Setting of Concrete Mixtures by Penetration Resistance
AASHTO T 260	Standard Method of Test for Sampling and Testing for Chloride Ion in Concrete and Concrete Raw Materials

#### **American Concrete Institute (ACI)**

ACI 305R	Hot Weather Concreting
ACI 306R	Cold Weather Concreting
ACI 309R	Guide for Consolidation of Concrete

#### **Illinois Department of Transportation, Bureau of Materials Illinois Laboratory Test Procedure (ITP)**

##### *Manual of Test Procedures for Materials*

AASHTO T 11	Illinois Modified, Standard Method of Test for Materials Finer Than 75- $\mu$ m (No. 200) Sieve in Mineral Aggregates by Washing
ITP 19	Bulk Density ("Unit Weight") and Voids in Aggregate

##### *Manual of Aggregate Quality Test Procedures*

AASHTO T 21	Illinois Modified, Standard Method of Test for Organic Impurities in Fine Aggregates for Concrete
AASHTO T 96	Illinois Modified, Standard Method of Test for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
AASHTO T 104	Illinois Modified, Standard Method of Test for Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate

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AASHTO T 113 Illinois Modified, Standard Method of Test for Lightweight Pieces in Aggregate

ITP 161 Resistance of Concrete to Rapid Freezing and Thawing

ITP 203 Deleterious Particles in Coarse Aggregate

**Illinois Department of Transportation, Bureau of Materials Policy Memoranda (PM)**

PM 12-08 Crushed Gravel Producer Self-Testing Program

PM 13-08 Slag Producer Self-Testing Program

PM 29-11 Minimum Laboratory Requirements for Alkali-Silica Reactivity (ASR) Testing

**Illinois Department of Transportation, Aeronautics Policy Memoranda (PM)**

PM 96-1 Item 610, Structural Portland Cement Concrete: Job Mix Formula Approval & Production Testing

**Illinois Department of Transportation, Bureau of Materials Qualified Product List**

Concrete Admixtures

Finely Divided Minerals

**END OF ITEM 610**

## Item 620 Runway and Taxiway Marking

### DESCRIPTION

- 620-1.1** This item shall consist of the preparation and painting of numbers, markings, and stripes on the surface of runways, taxiways, and aprons as specified in the contract documents or as directed by the Resident Engineer. The terms “paint” and “marking material” as well as “painting” and “application of markings” are interchangeable throughout this specification.

### MATERIALS

- 620-2.1 Materials acceptance.** The Contractor shall furnish manufacturer’s certified test reports, for materials shipped to the project. The certified test reports shall include a statement that the materials meet the specification requirements. This certification along with a copy of the paint manufacturer’s surface preparation; marking materials, including adhesion, flow promoting and/or floatation additive, and application requirements must be submitted and approved by the Resident Engineer (RE) prior to the initial application of markings. The reports can be used for material acceptance or the RE may perform verification testing. The reports shall not be interpreted as a basis for payment. The Contractor shall notify the RE upon arrival of a shipment of materials to the site. All material shall arrive in sealed containers that are easily quantifiable for inspection by the RE.
- 620-2.2 Marking materials.** The plans and specifications will specify paint type(s), colors and glass beads to be used for the project. When more than one paint type is specified, the plans will clearly indicate paint type, paint color and bead type required for each marking.

**Table 1 Marking Materials Application Rates**

Paint		Glass Beads		
Type	Application Rate	Type I, Gradation A <sup>1</sup> , Minimum	Type III, Minimum	Type IV, Gradation A <sup>1</sup> , Minimum
Waterborne Type I or II	115 ft <sup>2</sup> /gal	7.0 lb/gal	10 lb/gal	–
Waterborne Type III	90 ft <sup>2</sup> /gal	7.0 lb/gal	8.0 lb/gal	–
Waterborne Type III	55 ft <sup>2</sup> /gal	–	6.0 lb/gal	5.0 lb/gal
Epoxy	90 ft <sup>2</sup> /gal	15 lb/gal	20	16 lb/gal
Temporary Marking Waterborne Type I or II	230 ft <sup>2</sup> /gal	No beads	No Beads	No Beads

1. Glass bead application rate for Red and Pink paint shall be reduced by 2 lb/gal (0.24 kg/l) for Type I and Type IV beads.

**Table 2: Acceptable Paint Color**

Paint Color	Fed Std. No 595 Color Number
White	37925
Red	31136
Yellow	33538 or 33655
Black	37038
Pink	1 part 31136 to 2 parts 37925
Green	34108

A 30-day waiting period (or in accordance with manufacturer recommendations) is required for all types of paint used for permanent pavement marking on new pavements or applied surface treatments. The final application shall occur after the waiting period has passed. The final marking application shall be at a rate equal to 100% of the full application rate with glass beads.

When markings are required before paving operations are complete, temporary marking, if specified, shall be applied at 30% to 50% of the specified application rates.

When painting Porous Friction Course, the paint shall be applied to the pavement in two (2) coats from opposite directions. The first coat should be applied at a rate equal to 50% of the full application rate without glass beads. The second coat should be applied from the opposite direction at a rate equal to 100% of the full application rate with glass beads.

**620-2.3 Paint.** Paint shall be waterborne, epoxy, methacrylate, solvent-base, or preformed thermoplastic as specified in the contract documents. Paint colors shall comply with Federal Standard No. 595.

**a. Waterborne.** Paint shall meet the requirements of Federal Specification TT-P-1952F, Type I, Type II, or Type III. The non-volatile portion of the vehicle for all paint types shall be composed of a 100% acrylic polymer as determined by infrared spectral analysis. The acrylic resin used for Type III shall be 100% cross linking acrylic as evidenced by infrared peaks at wavelengths 1568, 1624, and 1672 cm<sup>-1</sup> with intensities equal to those produced by an acrylic resin known to be 100% cross linking.

**b. Epoxy.** Paint shall be a two component, minimum 99% solids type system conforming to the following:

**(1) Pigments.** Component A. Percent by Weight.

**(a) White:**

- Titanium Dioxide, ASTM D476, type II shall be 18% minimum (16.5% minimum at 100% purity).

**(b) Yellow and Colors:**

- Titanium Dioxide, ASTM D476, type II shall be 14% to 17%.
- Epoxy resin shall be 75% to 79%.
- Organic yellow, other colors, and tinting as required to meet color standard.

**(2) Epoxy content.** Component A: The weight per epoxy equivalent, when tested in accordance with ASTM D1652 shall be the manufacturer's target  $\pm 50$ .

**(3) Amine number.** Component B: When tested in accordance with ASTM D2074 shall be the manufacturer's target  $\pm 50$ .

(4) **Prohibited materials.** The manufacturer shall certify that the product does not contain mercury, lead, hexavalent chromium, halogenated solvents, nor any carcinogen as defined in 29 CFR 1910.1200 in amounts exceeding permissible limits as specified in relevant federal regulations.

(5) **Daylight directional reflectance.**

(a) **White:** The daylight directional reflectance of the white paint shall not be less than 75% (relative to magnesium oxide) when tested in accordance with ASTM E2302.

(b) **Yellow:** The daylight directional reflectance of the yellow paint shall not be less than 55% (relative to magnesium oxide) when tested in accordance with ASTM E2302.

The x and y values shall be consistent with the federal Hegman yellow color standard chart for traffic yellow standard 33538, or shall be consistent with the tolerance listed below:

x	.462	.470	.479	.501
y	.438	.455	.428	.452

(6) **Accelerated weathering.**

(a) **Sample preparation.** Apply the paint at a wet film thickness of 0.013-inch to four 3 × 6-inch aluminum panels prepared as described in ASTM E2302. Air dry the sample 48 hours under standard conditions.

(b) **Testing conditions.** Test in accordance with ASTM G154 using both Ultraviolet (UV-B) Light and condensate exposure, 72 hours total, alternating four (4) hour UV exposure at 140°F, and four (4) hours condensate exposure at 104°F.

(c) **Evaluation.** Remove the samples and condition for 24 hours under standard conditions. Determine the directional reflectance and color match using the procedures in paragraph 5 above. Evaluate for conformance with the color requirements.

(7) **Volatile organic content.** Determine the volatile organic content in accordance with 40 CFR Part 60 Appendix A, Method 24.

(8) **Dry opacity.** Use ASTM E2302. The wet film thickness shall be 0.015 inch. The minimum opacity for white and colors shall be 0.92.

(9) **Abrasion resistance.** Subject the panels prepared in paragraph 620-2.3 b (6) to the abrasion test in accordance with ASTM D968, Method A, except that the inside diameter of the metal guide tube shall be from 0.747 to 0.750 inch. Five liters (17.5 lb) of unused sand shall be used for each test panel. The test shall be run on two test panels. Both baked and weathered paint films shall require not less than 150 liters (525 lb) of sand for the removal of the paint films.

(10) **Hardness, shore.** Hardness shall be at least 80 when tested in accordance with ASTM D2240.

c. **Methacrylate.** Paint shall be a two component, minimum 99% solids-type system conforming to the following:

(1) **Pigments.** Component A. Percent by weight.

(a) **White:**

- Titanium Dioxide, ASTM D476, type II shall be 10% minimum.
- Methacrylate resin shall be 18% minimum.

(b) **Yellow and Colors:**

- Titanium Dioxide, ASTM D476, type II shall be 1% minimum. Organic yellow, other colors, and tinting as required to meet color standard.
- Methacrylate resin shall be 18% minimum.

(2) **Prohibited materials.** The manufacturer shall certify that the product does not contain mercury, lead, hexavalent chromium, halogenated solvents, nor any carcinogen as defined in 29 CFR 1910.1200 in amounts exceeding permissible limits as specified in relevant federal regulations.

(3) **Daylight directional reflectance:**

(a) **White:** The daylight directional reflectance of the white paint shall not be less than 80% (relative to magnesium oxide), when tested in accordance with ASTM E2302.

(b) **Yellow:** The daylight directional reflectance of the yellow paint shall not be less than 55% (relative to magnesium oxide), when tested in accordance with ASTM E2302. The x and y values shall be consistent with the federal Hegman yellow color standard chart for traffic yellow standard 33538, or shall be consistent with the tolerance listed below:

x	.462	.470	.479	.501
y	.438	.455	.428	.452

(4) **Accelerated weathering.**

(a) **Sample preparation.** Apply the paint at a wet film thickness of 0.013-inch to four 3 × 6-inch aluminum panels prepared as described in ASTM E2302. Air dry the sample 48 hours under standard conditions.

(b) **Testing conditions.** Test in accordance with ASTM G154 using both Ultraviolet (UV-B) Light and condensate exposure, 72 hours total, alternating four (4) hour UV exposure at 140°F, and four (4) hours condensate exposure at 104°F.

(c) **Evaluation.** Remove the samples and condition for 24 hours under standard conditions. Determine the directional reflectance and color match using the procedures in paragraph 3 above. Evaluate for conformance with the color requirements.

(5) **Volatile organic content.** Determine the volatile organic content in accordance with 40 CFR Part 60 Appendix A, Method 24.

(6) **Dry opacity.** Use ASTM E2302. The wet film thickness shall be 0.015 inch (0.38 mm). The minimum opacity for white and colors shall be 0.92.

(7) **Abrasion resistance.** Subject the panels prepared in paragraph 620-2.3 c (4) to the abrasion test in accordance with ASTM D968, Method A, except that the inside diameter of the metal guide tube shall be from 0.747 to 0.750 inch. Five liters (17.5 lb) of unused sand shall be used for each test panel. The test shall be run on two test panels. Both baked and weathered paint films shall require not less than 150 liters (525 lb) of sand for the removal of the paint films.

(8) **Hardness, shore.** Hardness shall be at least 60 when tested in accordance with ASTM D2240.

(9) **Additional requirements for methacrylate splatter profiled pavement marking.** Pavement markings of this type shall comply with all above requirements for methacrylate paint, except as noted below:

(a) The thickness of the marking will be irregular ranging from 0.000 to 0.250 inches, applied in a splatter pattern which comprises a minimum of 80% of the visible line (when traveling at 5 mph the line appears to be solid.).

- (b) The hardness shall be 48 Shore D minimum.
- d. **Solvent-Base.** Paint shall meet the requirements of Commercial Item Description A-A-2886B Type I, Type II, and Type III.
- e. **Preformed Thermoplastic Airport Pavement Markings.** Markings must be composed of ester modified resins in conjunction with aggregates, pigments, and binders that have been factory produced as a finished product. The material must be impervious to degradation by aviation fuels, motor fuels, and lubricants.
- (1) The markings must be able to be applied in temperatures as low as 35°F without any special storage, preheating, or treatment of the material before application.
- (a) The markings must be supplied with an integral, non-reflectorized black border.
- (b) Multicolored markings must consist of interconnected individual pieces of preformed thermoplastic pavement marking material, which through a variety of colors and patterns, make up the desired design. The individual pieces in each large marking segment (typically more than 20 feet long) must be factory assembled with a compatible material and interconnected so that in the field it is not necessary to assemble the individual pieces within a marking segment. Obtaining multicolored effect by overlaying materials of different colors is not acceptable due to resulting inconsistent marking thickness and inconsistent application temperature in the marking/substrate interface.
- (c) The marking material must set up rapidly, permitting the access route to be re-opened to traffic after application.
- (d) The marking material shall have an integral color throughout the thickness of the marking material.
- (2) **Graded glass beads.**
- (a) The material must contain a minimum of 30% intermixed graded glass beads by weight. The intermixed beads shall conform to Federal Specification TT-B-1325D, Type I, gradation A and Federal Specification TT-B-1325D, Type IV.
- (b) The material must have factory applied coated surface beads in addition to the intermixed beads at a rate of one (1) lb ( $\pm 10\%$ ) per 10 square feet. These factory-applied coated surface beads shall have a minimum of 90% true spheres, minimum refractive index of 1.50, and meet the following gradation.

### Preformed Thermoplastic Bead Gradation

Sieve Size	Percent Passing
No. 12	98 - 100
No. 14	96.5 - 100
No. 16	75 - 98
No. 18	37 - 72
No. 20	28 - 37
No. 30	23 - 33
No. 50	5 - 11
No. 80	0 - 3

(3) **Heating indicators.** The material manufacturer shall provide a method to indicate that the material has achieved satisfactory adhesion and proper bead embedment during application and that the installation procedures have been followed.

(4) **Pigments.** Percent by weight.

(a) **White:** Titanium Dioxide, ASTM D476, type II shall be 10% minimum.

(b) **Yellow and Colors:** Titanium Dioxide, ASTM D476, type II shall be 1% minimum. Organic yellow, other colors, and tinting as required to meet color standard

(5) **Prohibited materials.** The manufacturer shall certify that the product does not contain mercury, lead, hexavalent chromium, halogenated solvents, nor any carcinogen as defined in 29 CFR 1910.1200 in amounts exceeding permissible limits as specified in relevant federal regulations.

(6) **Daylight directional reflectance.**

(a) **White:** The daylight directional reflectance of the white paint shall not be less than 75% (relative to magnesium oxide), when tested in accordance with ASTM E2302.

(b) **Yellow:** The daylight directional reflectance of the yellow paint shall not be less than 45% (relative to magnesium oxide), when tested in accordance with ASTM E2302. The x and y values shall be consistent with the federal Hegman yellow color standard chart for traffic yellow standard 33538, or shall be consistent with the tolerance listed below:

x	.462	.470	.479	.501
y	.438	.455	.428	.452

(7) **Skid resistance.** The surface, with properly applied and embedded surface beads, must provide a minimum resistance value of 45 BPN when tested according to ASTM E303.

The markings must be capable of conforming to pavement contours, breaks, and faults through the action of airport traffic at normal pavement temperatures. The markings must be capable of fully conforming to grooved pavements, including pavement grooving per current Federal Aviation Administration Advisory Circular (AC) 150/5320-12, *Measurement, Construction, and Maintenance of Skid Resistant Airport Pavement Surfaces*. The markings shall have resealing characteristics, such that it is capable of fusing with itself and previously applied thermoplastics when heated with a heat source per manufacturer's recommendation.

(8) **Thickness.** The material must be supplied at a nominal thickness of 65 mil (1.7 mm).

(9) **Environmental resistance.** The material must be resistant to deterioration due to exposure to sunlight, water, salt, or adverse weather conditions and impervious to aviation fuels, gasoline, and oil.

(10) **Retroreflectivity.** The material, when applied in accordance with manufacturer's guidelines, must demonstrate a uniform level of nighttime retroreflection when tested in accordance to ASTM E1710.

(11) **Packaging.** Packaging shall protect the material from environmental conditions until installation.

(12) **Preformed thermoplastic airport pavement marking requirements.**

(a) The markings must be a resilient thermoplastic product with uniformly distributed glass beads throughout the entire cross-sectional area. The markings must be resistant to the detrimental effects of aviation fuels, motor fuels and lubricants, hydraulic fluids, deicers, anti-icers, protective coatings, etc. Lines, legends, and symbols must be capable of being affixed to asphalt and/or Portland cement

concrete pavements by the use of a large radiant heater. Colors shall be available as required.

**620-2.4 Reflective media.** Glass beads for white and yellow paint shall meet the requirements for Federal Specification TT-B-1325D Type I, Gradation A; Type III; or Type IV, Gradation A as specified in the contract documents.

Glass beads for red and pink paint shall meet the requirements for Type I, Gradation A or Type IV, Gradation A as specified. Glass beads shall be treated with all compatible coupling agents recommended by the manufacturers of the paint and reflective media to ensure adhesion and embedment.

Glass beads shall not be used in black and green paint.

Type III glass beads shall not be used in red and pink paint.

For Type IV, Gradation A beads used with TT-P-1952F, Type III paint, the contractor shall also provide flow promoting, and/or flotation additives in accordance with manufacturer recommendations.

### CONSTRUCTION METHODS

**620-3.1 Weather limitations.** Painting shall only be performed when the surface is dry, the ambient temperature and the pavement surface temperature meet the manufacturer's recommendations, and new pavement (or surface application) has time to cure in accordance with paragraph 620-2.1. Painting operations shall be discontinued when the ambient or surface temperatures does not meet the manufacturer's recommendations. Markings shall not be applied when the wind speed exceeds 10 mph unless windscreens are used to shroud the material guns. Markings shall not be applied when weather conditions are forecasts to not be within the manufacturers' recommendations for application and dry time.

**620-3.2 Equipment.** Equipment shall include the apparatus necessary to properly clean the existing surface, a mechanical marking machine, a bead dispensing machine, and such auxiliary hand-painting equipment as may be necessary to satisfactorily complete the job.

The mechanical marker shall be an atomizing spray-type or airless type marking machine with automatic glass bead dispensers suitable for application of traffic paint. It shall produce an even and uniform film thickness and appearance of both paint and glass beads at the required coverage and shall apply markings of uniform cross-sections and clear-cut edges without running or spattering and without over spray. The marking equipment for both paint and beads shall be calibrated daily.

**620-3.3 Preparation of surfaces.** Immediately before application of the paint, the surface shall be dry and free from dirt, grease, oil, laitance, or other contaminants that would reduce the bond between the paint and the pavement. Use of any chemicals or impact abrasives during surface preparation shall be approved in advance by the Engineer. After the cleaning operations, sweeping, blowing, or rinsing with pressurized water shall be performed to ensure the surface is clean and free of grit or other debris left from the cleaning process.

**a. Preparation of new pavement surfaces.** The area to be painted shall be cleaned by broom, blower, water blasting, or by other methods approved by the Resident Engineer to remove all contaminants, including PCC curing compounds, minimizing damage to the pavement surface.

**b. Preparation of pavement to remove existing markings.** Existing pavement markings shall be removed by rotary grinding, water blasting, or by other methods approved by the Resident Engineer minimizing damage to the pavement surface. The removal area may need to be larger than the area of the markings to eliminate ghost markings. After removal of markings on asphalt pavements, apply a fog seal or seal coat to 'block out' the removal area to eliminate 'ghost' markings.



- c. Preparation of pavement markings prior to remarking.** Prior to remarking existing markings, loose existing markings must be removed minimizing damage to the pavement surface, with a method approved by the Resident Engineer. After removal, the surface shall be cleaned of all residue or debris.

Prior to the application of markings, the Contractor shall certify in writing that the surface is dry and free from dirt, grease, oil, laitance, or other foreign material that would prevent the bond of the paint to the pavement or existing markings. This certification along with a copy of the paint manufacturer's application and surface preparation requirements must be submitted to the Resident Engineer prior to the initial application of markings.

- 620-3.4 Layout of markings.** The proposed markings shall be laid out in advance of the paint application. The locations of markings to receive glass beads shall be as specified in the contract documents. The locations of markings to receive silica sand shall be shown on the plans.

- 620-3.5 Application.** A period of 30 days shall elapse between placement of surface course or seal coat and application of the permanent paint markings. Paint shall be applied at the locations and to the dimensions and spacing as specified in the contract documents. Paint shall not be applied until the layout and condition of the surface has been approved by the Resident Engineer.

The edges of the markings shall not vary from a straight line more than one-half (1/2) inch in 50 feet, and marking dimensions and spacing shall be within the following tolerances:

#### Marking Dimensions and Spacing Tolerance

Dimension and Spacing	Tolerance
36 inch or less	±1/2 inch
greater than 36 inch to 6 feet	±1 inch
greater than 6 feet to 60 feet	±2 inch
greater than 60 feet	±3 inch

The paint shall be mixed in accordance with the manufacturer's instructions and applied to the pavement with a marking machine at the rate shown in Table 1 in paragraph 620-2.2. The addition of thinner will not be permitted.

Glass beads shall be distributed upon the marked areas at the locations specified in the contract documents to receive glass beads immediately after application of the paint. A dispenser shall be furnished that is properly designed for attachment to the marking machine and suitable for dispensing glass beads. Glass beads shall be applied at the rate shown in Table 1 in paragraph 620-2.2. Glass beads shall not be applied to black paint or green paint. Glass beads shall adhere to the cured paint or all marking operations shall cease until corrections are made. Different bead types shall not be mixed. Regular monitoring of glass bead embedment and distribution should be performed.

- 620-3.6 Application – preformed thermoplastic airport pavement markings.** To ensure minimum single-pass application time and optimum bond in the marking/substrate interface, the materials must be applied using a variable speed self-propelled mobile heater with an effective heating width of no less than 16 feet and a free span between supporting wheels of no less than 18 feet. The heater must emit thermal radiation to the marking material in such a manner that the difference in temperature of two (2) inches wide linear segments in the direction of heater travel must be within 5% of the overall average temperature of the heated thermoplastic material as it exits the heater. The material must be able to be applied at ambient and pavement temperatures down to 35°F without any preheating of the pavement to a specific temperature. The material must be able to be applied without the use of a thermometer. The pavement shall be clean, dry, and free of debris. A non-volatile organic content (non-VOC) sealer with a maximum applied viscosity of 250 centipoise must be applied to the pavement shortly before the markings are applied. The supplier must enclose application instructions with each box/package.

- 620-3.7 Control strip.** Prior to the full application of airfield markings, the Contractor shall prepare a control strip in the presence of the Engineer. The Contractor shall demonstrate the surface preparation method and all striping equipment to be used on the project. The marking equipment must achieve the prescribed application rate of paint and population of glass beads (per Table 1, paragraph 620-2.2) that are properly embedded and evenly distributed across the full width of the marking and, if required, meet the retro-reflectance requirements in 620-3.8. Prior to acceptance of the control strip, markings must be evaluated during darkness to ensure a uniform appearance.
- 620-3.8 Retro-reflectance.** At Part 139 Certificated Airports, reflectance shall be measured with a portable retro-reflectometer meeting ASTM E1710 (or equivalent) by the Resident Engineer. Each measurement shall be a total of six (6) readings taken over a six (6) square foot area with three (3) readings taken from each direction. The average shall be equal to or above the minimum levels of all readings which are within 30% of each other. For entire runways or taxiways to be marked, irrespective of phasing, the RE will take a minimum of 1 measurement per 5,000 linear foot of each runway or taxiway to be marked. For other projects, a minimum of 2 measurements per project with at least 1 of the measurements taken on a taxiway center stripes if required for the project.

### Minimum Retro-Reflectance Values

Material	Retro-reflectance mcd/m <sup>2</sup> /lux		
	White	Yellow	Red
Initial Type I	300	175	35
Initial Type III	600	300	35
Initial Thermoplastic	225	100	35
All materials, remark when less than <sup>1</sup>	100	75	10

1. Prior to remarking determine if removal of contaminants on markings will restore retro-reflectance

- 620-3.9 Protection and cleanup.** After application of the markings, all markings shall be protected from damage until dry. All surfaces shall be protected from excess moisture and/or rain and from disfiguration by spatter, splashes, spillage, or drippings. The Contractor shall remove from the work area all debris, waste, loose reflective media, and by-products generated by the surface preparation and application operations to the satisfaction of the Resident Engineer. The Contractor shall dispose of these wastes in strict compliance with all applicable state, local, and federal environmental statutes and regulations.

### METHOD OF MEASUREMENT

- 620-4.1** The quantity of runway, taxiway and other various pavement markings, temporary marking, removals, and surface preparation shall be measured for payment by the number of square feet as specified, completed, and accepted by the Resident Engineer. Separate measurement shall be made for the various types of paint. No separate measurement or payment will be made for reflective media. Temporary marking includes surface preparation, application and complete removal of the temporary marking.

When the project is constructed essentially to the lines, grades, or dimensions shown on the Plans, and the Contractor and the Resident Engineer have agreed in writing on form AER 981, *Agreement on Accuracy of Plan Quantities*, that the plan quantities are accurate, no further measurement will be required and payment will be made for the quantities shown in the contract for the various items involved. If an error in plan quantity is discovered after the work has been started, an appropriate adjustment will be made.

When the contract documents have been altered or when disagreement exists between the Contractor and the Engineer as to the accuracy of the plan quantities, either party shall, before any work is started which would affect the measurement, have the right to request in writing and thereby cause the quantities involved to be measured as herein specified.

### **BASIS OF PAYMENT**

- 620-5.1** Payment for accepted quantities of work performed by the Contractor and measured by the Resident Engineer shall be at the contract unit price as specified in paragraph 620-4.1 of this section. Payment shall be full compensation for furnishing all materials and for all labor, equipment, tools, and incidentals necessary to complete the item as specified.

### **REFERENCES**

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

#### **ASTM International (ASTM)**

ASTM D 476	Standard Classification for Dry Pigmentary Titanium Dioxide Products
ASTM D 638	Standard Test Method for Tensile Properties of Plastics
ASTM D 695	Standard Test Method for Compressive Properties of Rigid Plastics
ASTM D 711	Standard Test Method for No-Pick-Up Time of Traffic Paint
ASTM D 1152	Standard Specification for Methanol (Methyl Alcohol)
ASTM D 1199	Standard Specification for Calcium Carbonate Pigments
ASTM D 1640	Standard Test Methods for Drying, Curing, or Film Formation of Organic Coatings
ASTM D 1652	Standard Test Method for Epoxy Content of Epoxy Resins
ASTM D 2074	Standard Test Method for Total, Primary, Secondary, and Tertiary Amine Values of Fatty Amines by Alternative Indicator Method
ASTM D 2240	Standard Test Method for Rubber Property - Durometer Hardness
ASTM D 2369	Standard Test Method for Volatile Content of Coatings
ASTM D 3960	Standard Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings
ASTM D 4060	Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser
ASTM D 7234	Standard Test Method for Pull-Off Adhesion Strength of Coatings on Concrete Using Portable Pull-Off Adhesion Testers
ASTM E 303	Standard Test Method for Measuring Surface Frictional Properties Using the British Pendulum Tester
ASTM G 154	Standard Practice for Operating Fluorescent Ultraviolet (UV) Lamp Apparatus for Exposure of Nonmetallic Materials

#### **Code of Federal Regulations (CFR)**

40 CFR Part 60	Appendix A-7, Method 24, Determination of volatile matter content, water content, density, volume solids, and weight solids of surface coatings
29 CFR Part 1910.1200	Hazard Communication

**Federal Aviation Administration Advisory Circulars (AC)**

AC 150/5340-1	Standards for Airport Markings
AC 150/5320-12	Measurement, Construction, and Maintenance of Skid Resistant Airport Pavement Surfaces

**Federal Specifications (FED SPEC)**

FED SPEC TT-B-1325	Beads (Glass Spheres) Retro-Reflective
FED SPEC TT-P-1952	Paint, Traffic and Airfield Marking, Waterborne
FED STD 141	Federal Test Method Standard: Paint, Varnish, Lacquer and Related Materials: Methods of Inspection, Sampling and Testing
FED STD 370	Federal Test Method Standard: Instrumental Photometric Measurements of Retroreflective Materials and Retroreflective Devices
FED STD 595	Colors used in Government Procurement

**END OF ITEM 620**

## Item 621 Saw-Cut Grooves

### DESCRIPTION

- 621-1.1** This item consists of constructing saw-cut grooves to minimize hydroplaning during wet weather, providing a skid resistant surface as specified in the contract documents or as directed by the Resident Engineer.

### CONSTRUCTION METHODS

- 621-2.1 Procedures.** The Contractor shall submit to the Resident Engineer the grooving sequence and method of placing guidelines to control grooving operation. Transverse grooves saw-cut in the pavement must form a one-quarter (1/4) inch (+1/16 inch, -0 inch) wide by one-quarter (1/4) inch  $\pm$ 1/16 inch deep by 1-1/2 inch (-1/8 inch, +0 inch) center-to-center configuration. The grooves must be continuous for the entire runway length. They must be saw-cut transversely (perpendicular to centerline) in the runway and high-speed taxiway pavement to not less than ten (10) feet from the runway pavement edge to allow adequate space for equipment operation.

The saw-cut grooves must meet the following tolerances. The tolerances apply to each day's production and to each piece of grooving equipment used for production. The Contractor is responsible for all controls and process adjustments necessary to meet these tolerances. The Contractor shall routinely spot check for compliance each time the equipment aligns for a grooving pass.

- a. **Alignment tolerance.** The grooves shall not vary more than  $\pm$ 1-1/2 inch in alignment for 75 feet along the runway length, allowing for realignment every 500 feet along the runway length.
- b. **Groove tolerance.**
  - (1) **Depth.** The standard depth is one-quarter (1/4) inch. At least 90% of the grooves must be at least 3/16 inch, at least 60% of the grooves must be at least one-quarter (1/4) inch, and not more than 10% of the grooves may exceed 5/16 inch.
  - (2) **Width.** The standard width is one-quarter (1/4) inch. At least 90% of the grooves must be at least 3/16 inch, at least 60% of the grooves must be at least one-quarter (1/4) inch, and not more than 10% of the grooves may exceed 5/16 inch.
  - (3) **Center-to-center spacing.** The standard spacing is 1-1/2 inch. Minimum spacing 1-3/8 inch. Maximum spacing 1-1/2 inch.

Saw-cut grooves must not be closer than three (3) inches or more than nine (9) inches from transverse joints in concrete pavements. Grooves must not be closer than six (6) inches and no more than 18 inches from in-pavement light fixtures. Grooves may be continued through longitudinal construction joints. Where neoprene compression seals have been installed and the compression seals are recessed sufficiently to prevent damage from the grooving operation, grooves may be continued through the longitudinal joints. Where neoprene compression seals have been installed and the compression seals are not recessed sufficiently to prevent damage from the grooving operation, grooves must not be closer than three (3) inches or more than five (5) inches from the longitudinal joints. Where lighting cables are installed, grooving through longitudinal or diagonal saw kerfs shall not be allowed.

- 621-2.2 Environmental requirements.** Grooving operations will not be permitted when freezing conditions prevent the immediate removal of debris and/or drainage of water from the grooved area. Discharge and disposal of waste slurry shall be the Contractor's responsibility.
- 621-2.3 Control strip.** Groove a control strip in an area of the pavement outside of the trafficked area, as approved by the Engineer. The area shall be 60 feet long by two (2) lanes wide. Demonstrate the setup and alignment process, the grooving operation, and the waste slurry disposal.
- 621-2.4 Existing pavements.** Bumps, depressed areas, bad or faulted joints, and badly cracked and/or spalled areas in the pavement shall not be grooved until such areas are adequately repaired or replaced.
- 621-2.5 New pavements.** New asphalt and cement concrete pavements shall be allowed to cure for a minimum of 30 days before grooving, to allow the material to become stable enough to prevent closing of the grooves under normal use. All grade corrections must be completed prior to grooving. Spalling along or tearing or raveling of the groove edges shall not be allowed.
- If it can be demonstrated that grooves are stable with no spalling along or tearing or raveling of the groove edges, then grooving sooner than 30 days can be allowed with the approval of the Engineer.
- 621-2.6 Grooving machine.** Provide a grooving machine that is power driven, self-propelled, specifically designed and manufactured for pavement grooving, and has a self-contained and integrated continuous slurry vacuum system as the primary method for removing waste slurry. The grooving machine shall be equipped with diamond-saw cutting blades, and capable of making at least 18 inches in width of multiple parallel grooves in one (1) pass of the machine. Thickness of the cutting blades shall be capable of making the required width and depth of grooves in one (1) pass of the machine. The cutting head shall not contain a mixture of new and worn blades or blades of unequal wear or diameter. Match the blade type and configuration with the hardness of the existing airfield pavement. The wheels on the grooving machine shall be of a design that will not scar or spall the pavement. Provide the machine with devices to control depth of groove and alignment.
- The Contractor shall submit a complete list of grooving equipment to be used on the job for approval of the Engineer before start of the work.
- 621-2.7 Water supply.** Water for the grooving operation shall be provided by the Contractor.
- 621-2.8 Clean-up.** During and after installation of saw-cut grooves, the Contractor must remove from the pavement all debris, waste, and by-products generated by the operations to the satisfaction of the Resident Engineer. Cleanup of waste material must be continuous during the grooving operation. Flush debris produced by the machine to the edge of the grooved area or pick it up as it forms. The dust coating remaining shall be picked up or flushed to the edge of the area if the resultant accumulation is not detrimental to the vegetation or storm drainage system. Accomplish all flushing operations in a manner to prevent erosion on the shoulders or damage to vegetation. Waste material must be disposed of in an approved manner. Waste material must not be allowed to enter the airport storm sewer system. The Contractor must dispose of these wastes in strict compliance with all applicable state, local, and federal environmental statutes and regulations
- 621-2.9 Repair of damaged pavement.** Grooving must be stopped, and damaged pavement repaired at the Contractor's expense when directed by the Resident Engineer.

## ACCEPTANCE

- 621-3.1 Acceptance testing.** Grooves will be accepted based on results of zone testing. All acceptance testing necessary to determine conformance with the groove tolerances specified will be performed by the Resident Engineer.

Instruments for measuring groove width and depth must have a range of at least 0.5 inch and a resolution of at least 0.005 inch. Gauge blocks or gauges machined to standard grooves width, depth, and spacing may be used.

Instruments for measuring center-to-center spacing must have a range of at least three (3) inches and a resolution of at least 0.02 inch.

The Resident Engineer will measure grooves in five (5) zones across the pavement width. Measurements will be made at least three (3) times during each day's production. Measurements in all zones will be made for each cutting head on each piece of grooving equipment used for each day's production.

The five (5) zones are as follows:

Zone 1	Centerline to 5 feet left or right of the centerline.
Zone 2	Five (5) feet to 25 feet left of the centerline.
Zone 3	Five (5) feet 25 feet right of the centerline.
Zone 4	25 feet to edge of grooving left of the centerline.
Zone 5	25 feet to edge of grooving right of the centerline.

At a random location within each zone, five (5) consecutive grooves sawed by each cutting head on each piece of grooving equipment will be measured for width, depth, and spacing. The five (5) consecutive measurements must be located about the middle blade of each cutting head  $\pm 4$  inches. Measurements will be made along a line perpendicular to the grooves.

- a. Width or depth measurements less than 0.170 inch shall be considered less than 3/16 inch.
- b. Width or depth measurements more than 0.330 inch shall be considered more than 5/16 inch.
- c. Width or depth measurements more than 0.235 inch shall be considered more than one-quarter (1/4) inch.

Production must be adjusted when more than one (1) groove on a cutting head fails to meet the standard depth, width, or spacing in more than one (1) zone.

#### **METHOD OF MEASUREMENT**

- 621-4.1** The quantity of grooving shall be measured for payment by the number of square yards as specified, completed, and accepted by the Resident Engineer.

When the project is constructed essentially to the lines, grades, or dimensions shown on the Plans, and the Contractor and the Resident Engineer have agreed in writing on form AER 981, *Agreement on Accuracy of Plan Quantities*, that the plan quantities are accurate, no further measurement will be required and payment will be made for the quantities shown in the contract for the various items involved. If an error in plan quantity is discovered after the work has been started, an appropriate adjustment will be made.

When the contract documents have been altered or when disagreement exists between the Contractor and the Engineer as to the accuracy of the plan quantities, either party shall, before any work is started which would affect the measurement, have the right to request in writing and thereby cause the quantities involved to be measured as herein specified.

#### **BASIS OF PAYMENT**

- 621-5.1** Payment for accepted quantities of work performed by the Contractor and measured by the Resident Engineer shall be made at the contract unit price as specified in paragraph 621-4.1 of this section. Payment shall be full compensation for furnishing all materials, and for all preparation, delivering, and application of these materials, and for all labor, equipment, tools, and incidentals necessary to complete the item as specified.

**REFERENCES**

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

**Federal Aviation Administration Advisory Circulars (AC)**

AC 150/5320-12      Measurement, Construction, and Maintenance of Skid Resistant Airport Pavement Surfaces

**END OF ITEM 621**



## Item 680 Tie Down and Ground Rod

### DESCRIPTION

- 680-1.1** This item shall consist of installing and removing tie downs and ground rods as specified in the contract documents or as directed by the Resident Engineer.

All steel and manufactured goods provided for this item must meet the Buy American provisions contained in this contract.

### MATERIALS

- 680-2.1 Mooring eyes.** The materials to be used for the mooring eyes shall be as specified in the contract documents. Mooring eyes shall be certified as being load tested to withstand an ultimate load of 9,000 pounds in bending and shall conform to ASTM A536. Mooring eyes shall be Neenah R-3490, East Jordan 5996, or an approved equal.
- 680-2.2 Concrete.** The concrete for tie downs shall conform to the requirements of Item 610 titled CONCRETE FOR MISCELLANEOUS STRUCTURES.
- 680-2.3 Ground rods.** Ground rods shall be copper-clad steel. The ground rods shall be of the length and diameter specified on the plans, but in no case be less than ten (10) feet long and five-eighths (5/8) inch in diameter.
- 680-2.4 Reinforcing steel.** Reinforcing steel bars shall be intermediate or structural grade deformed-type bars and shall be per ASTM A706 Grade 60 and shall be of 100% domestic origin.

### CONSTRUCTION METHODS

- 680-3.1** Anchors shall be constructed in accordance with the contract documents. When the contract documents specify augured-in-place anchors, the Contractor shall augur them in a manner that will minimize loosening or displacement of existing soil.

### METHOD OF MEASUREMENT

- 680-4.1** The quantity of tie downs and ground rods shall be measured for payment by the number of each unit installed as specified, completed, and accepted by the Resident Engineer.

### BASIS OF PAYMENT

- 680-5.1** Payment for accepted quantities of work performed by the Contractor and measured by the Resident Engineer shall be at the contract unit price as specified in paragraph 680-4.1 of this section. Payment shall be full compensation for furnishing all materials and for all preparation and installation, including restoration of existing surfaces, and for all labor equipment, tools and incidentals necessary to complete the work as specified.

**REFERENCES**

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

**ASTM International (ASTM)**

ASTM A 536	Standard Specification for Ductile Iron Castings
ASTM A 706	Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement

**END OF ITEM 680**

## Item 690 Sand Mix Crack Repair

### DESCRIPTION

- 690-1.1** This item shall consist of cleaning out designated cracks of one (1) inch minimum width and placement and compaction of a bituminous sand mix in the void as specified in the contract documents or as directed by the Resident Engineer.

### MATERIALS

- 690-2.1** **Filler.** The bituminous sand mix shall conform to the requirements in the following table.

Sieve Size	Gradation Percent Passing
	FA 2
3/8	100
No. 4	97±3
No. 16	65±20
No. 50	20±10
No. 100	5±5
Asphalt	4-7

The ingredients shall be heated and combined in such a manner as to produce an asphalt mix, which, when discharged from the mixer, shall not exceed 350°F.

The bituminous sand mix shall be approved by the Department prior to placement of any material.

- 690-2.2** **Emulsified asphalt tack coat.** The emulsified asphalt tack coat shall conform to the requirements of Item 603 titled EMULSIFIED ASPHALT TACK COAT.

### EQUIPMENT

- 690-3.1** **Crack cleaning equipment.** The crack cleaning equipment shall consist of hand tools, compressors and nozzles with sufficient air pressure to dislodge dirt, laitance and loose asphalt material and rock to prepare the crack for sealing. All machines, tools, equipment and methods used in the performance of work required by these specifications will be subject to the approval of the Engineer and Owner. The equipment or method used shall result in no damage to existing surfaces. Prior to placement of the bituminous sand mixture, the cracks and joints shall be blown out with compressed air at a pressure of at least 90 pounds per square inch with 150 cubic feet per minute at the nozzle.

### CONSTRUCTION METHODS

- 690-4.1** **Preparation of cracks.** No crack filler material shall be placed until the cracks have been cleaned of all loose dirt, joint material and debris.

A tack coat shall be applied to the cleaned joint prior to installation of the bituminous sand mix. Cleaning will not proceed in advance of filling by more than one (1) working day, except as otherwise approved by the Engineer.

The crack shall be filled with the bituminous mixture and the top lift compacted with a self-propelled vibratory "pup" roller as approved by the Resident Engineer.

Mixture shall be placed in courses no greater than three (3) inches and compacted by approved hand tools.

Mixture for cracks and joints delivered to the work site which has cooled to 200°F shall be considered unsatisfactory to the work and shall not be used.

#### **METHOD OF MEASUREMENT**

- 690-5.1** The quantity of sand mix crack repair shall be measured for payment by the number of linear feet as specified, completed, and accepted by the Resident Engineer.

#### **BASIS OF PAYMENT**

- 690-6.1** Payment for accepted quantities of work performed by the Contractor and measured by the Resident Engineer shall be at the contract unit price as specified in paragraph 690-5.1 of this section. Payment shall be full compensation for all cleaning, preparation and disposal of all loose materials; and for all materials, labor, equipment, tools and incidentals necessary to complete the work as specified.

#### **END OF ITEM 690**

## Item 691 Reflective Crack Control Treatment

### DESCRIPTION

- 691-1.1** This item shall consist of constructing reflective crack control treatment of the type as specified in the contract documents or as directed by the Resident Engineer.

### MATERIALS

- 691-2.1 Reflective crack control system A.** The reinforcing fabric shall be a nonwoven polypropylene or other approved plastic fabric and conform to the following.

Property	Value
Weight (ASTM D3776) oz./sq yd, min.	4.0
Grab Tensile Strength (ASTM D4632) lb., min.	90.0
Grab Elongation at Break (ASTM D4632) %, min. - max.	40-100
Asphalt Retention gal/sq yd, min.	0.20

The asphalt binder shall be PG 58-22 or PG 64-22 meeting the requirements of AASHTO M 320.

- 691-2.2 Reflective crack control system B.** Waterproofing membrane interlayer shall incorporate a high strength fabric embedded in a layer of self-adhesive suitably plasticized asphalt with the following properties:

Property	Value	Test Method
Thickness	0.065 in., min.	ASTM E96
Permeance-Perms	0.10 max.	Procedure B
Tensile Strength	50 lb/in., min.	ASTM D882 (modified for 1 inch opening)
Puncture Resistance (fabric)	200 lb, min.	ASTM E154
Pliability-1/2 inch - mandrel	No cracks in fabric or plasticized bitumen	ASTM D146

The primer to be used with System B shall be supplied by the manufacturer of the membrane and shall be compatible with the membrane.

- 691-2.3 Reflective crack control system C.**

- a. Asphalt.** The grade of asphalt binder for the asphalt-rubber mixture shall be according to AASHTO M 320 and shall be either PG 52-28, PG 58-28, or PG 58-22.
- b. Emulsified asphalt.** Emulsified asphalt for tack coat shall be SS-1, SS-1h, SS-1hP, SS1-vh, RS-1, RS-2, CSS-1, CSS-1h, CSS-1hP, CRS-1, CRS-2, or HFE-90 and shall be according to Item 603 titled EMULSIFIED ASPHALT TACK COAT.

- c. **Vulcanized rubber.** The granulated crumb rubber shall be 100% vulcanized and meet the following gradation requirements.

Sieve Size	Percent Passing
No. 8	100
No. 10	99±1
No. 30	5±5
No. 400	2±2

The specific gravity of the material shall be 1.15±0.02 and shall be free from fabric, wire, or other contaminated materials, except that up to 4% calcium carbonate may be included to prevent the rubber particles from sticking together.

Vulcanized rubber will be accepted by certificate of analysis (COA) from the rubber supplier.

- d. **Diluent.** The diluent shall be a solvent with an initial boiling point (IBP) of +350 when tested according to ASTM D86.
- e. **Crumb rubber blend.** The rubber shall be a blend of 40% powdered devulcanized rubber and 60% ground vulcanized rubber scrap specially selected to have a high natural rubber content. The blend shall meet the following specifications.

Sieve Size	ASTM D1151 Percent Passing
No. 10	100
No. 30	60-80
No. 50	35-70
No. 100	10-25

The natural rubber content shall be a minimum of 30% by weight according to ASTM D297. The devulcanized rubber content of the blend shall be 40% by weight and shall be determined by a mill test as follows.

When 1.4 – 1.8 ounces of rubber retained on the 30 mesh sieve are added to the tight six (6) inch rubber mill, the material should bond on the mill roll in one (1) pass, and should usually be retained on the mill roll. This will indicate the presence of a suitable quantity of devulcanized rubber. The crumb rubber blend will be accepted by certificate of analysis (COA) from the rubber supplier.

- f. **Extender oil.** Extender oil shall be compatible with all materials used and be a high flash, high viscosity resinous aromatic rubber extender oil.
- g. **Cover aggregate.** Aggregates for cover material shall be CA 14 or CA 15 for Class A use.

### Gradation Requirements

Sieve Size	Gradation Percent Passing	
	CA 14	CA 15
1/2 inch	90±10	100
3/8 inch	45±20	75±15
No. 4	3±3	7±7
No. 16		2±2

- 691-2.4 Reflective crack control system D.** The stress relief membrane shall be 36 inches wide and 0.15 inches thick and shall be a system of materials manufactured in a composite three-layer fashion with the following properties.

Stress Relief Membrane		
Property	Value	Test Method
Cold Flex	No cracking or separation of fabric	ASTM D146 (modified)
Tensile Strength (Peak)	4,000 psi min.	ASTM D412 (modified)
Elongation (at Peak Tensile)	10% min.	ASTM D412 (modified)
Weight	0.76 lb/ sq. ft.	
Density (mastic)	69 lb/cu. ft. min.	ASTM D70
Thickness	0.15 in.	ASTM D1777
Resistance to Puncture	5,000 psi	ASTM D3786
Absorption (mastic)	1% max.	ASTM D517
Brittleness	Passes	ASTM D517
Softening Point (mastic)	220° F	ASTM D36

The bottom layer of the composite shall be a low strength, nonwoven, geotextile and shall be according to AASHTO M 288. The bottom geotextile shall be designed to fully bond with the existing pavement with the help of an emulsified asphalt tack coat. It shall be capable of accommodating sufficiently large stresses at the joint/crack without breaking its bond with the slab. The middle layer of the composite shall be a viscoelastic membrane designed to prevent water entry into the pavement through the cracks and/or joints in the pavement. It also acts as a stress absorbing member interlayer between the overlay and the underlying pavement. The top layer shall be a high strength woven geotextile with a tensile strength of 4,000 pounds per square inch at 5% strain according to ASTM D4595. The top geotextile shall be designed to fully bond with the overlay and provide high stiffness and reinforcement to the overlay.

The two (2) applications of tack coat to be used with System D shall be according to the following.

- a. The emulsified asphalt tack coat for applying the membrane to the pavement surface shall be PG 64-22, PG 58-28, or PG 52-28 meeting the requirements of AASHTO M 320.
- b. The emulsified asphalt tack coat applied to the top of the membrane prior to the asphalt overlay shall be SS-1, SS-1h, SS-1hP, SS1-vh, RS-1, RS-2, CSS-1, CSS-1h, CSS-1hP, CRS-1, CRS-2, or HFE-90 meeting the requirements of Item 603 titled EMULSIFIED ASPHALT TACK COAT. Cutback asphalts shall not be used.

The stress relief membrane shall be stored in an inside enclosure with temperatures not exceeding 120°F. Any material that becomes wet prior to installation shall be removed from the jobsite and discarded.

The manufacturer shall furnish a certificate of analysis (COA) with each shipment of stress relief membrane, stating the amount of product furnished, and that the material complies with these requirements.

## CONSTRUCTION METHODS

- 691-3.1 Surface preparation.** The surface on which reflective crack control system is to be constructed shall be clean and dry. Base failures shall be repaired. Cracks, spalls, potholes, or other depressions shall be sealed with an approved crack sealer or filled with mixture for cracks, joints, and flangeways according to Item 101 titled PREPARATION/REMOVAL OF EXISTING PAVEMENTS.

When, in the opinion of the Resident Engineer, the existing pavement surface cannot be rendered sufficiently smooth by crack sealing and patching, a leveling binder shall be placed prior to construction of the reflective crack control system. The leveling binder shall be constructed in accordance with Item 403 titled ASPHALT MIX PAVEMENT BASE COURSE.

**691-3.2 Placing asphalt mix.** When an asphalt mix leveling binder, binder course, or surface course is placed on top of any reflective crack control system, the mixture shall be placed at a maximum temperature of 300°F.

**691-3.3 Reflective crack control system A.** The area to be covered with fabric shall be sprayed uniformly with asphalt binder at a rate of 0.25 to 0.30 gallons per square yard as directed by the Resident Engineer. Asphalt binder application shall be accomplished with a pressure distributor for all surfaces, except where the distributor does not have room to operate, hand spraying will be allowed. The width of the spray application shall be no more than 6 inches wider than the fabric and no less than the fabric width plus two (2) inches. The asphalt binder shall not be applied at a temperature greater than 325°F to avoid damage to the fabric.

After the asphalt binder has been sprayed, the fabric shall be unrolled, or hand placed onto the asphalt binder without delay. Every effort must be made to lay the fabric as smoothly as possible to avoid wrinkles. Wrinkles large enough to cause laps of the fabric shall be cut and laid out flat. The fabric shall be broomed or squeegeed to remove air bubbles and make complete contact with the road surface.

The fabric shall overlap the adjacent fabric panel a minimum of two (2) inches. Additional asphalt binder shall be applied by hand to make the joints where overlap is greater than two (2) inches. The transverse joints shall be made in such a manner to avoid pickup by the paver. The direction of paving shall be in the direction of fabric placement.

When placed as a strip treatment, the strip shall be 24 inches wide.

**691-3.4 Reflective crack control system B.** The primer to be used with the waterproofing membrane shall be supplied by the manufacturer of the membrane and shall be compatible with the membrane.

The waterproofing membrane interlayer shall be placed as shown on the plans. Placement of the membrane shall be done only when the temperature is above 40°F and the pavement surfaces are dry and free of dirt and debris.

The surface shall be primed according to the manufacturer's recommendations prior to placement of the membrane. The primer shall be placed at a minimum rate of 300 square feet per gallon, shall extend one (1) inch wider than the membrane, and shall be allowed to dry until tack free before applying the membrane. Primer shall be placed on both cement concrete and asphalt mix pavement surfaces.

Any spall greater than three (3) inches in diameter, which will cause a failure of the material to bond to the pavement or will leave a cavity under the material shall be corrected prior to the placement of the waterproofing membrane interlayer.

The membrane shall be installed in nominal 12-inch widths minimum and shall be centered over the joint or crack within a one (1) inch tolerance. Laps will be permitted in the membrane with a minimum overlap of 2-1/2 inches. The membrane shall be installed straight and wrinkle-free with no curled or uplifted edges. Any wrinkles over three-eighths (3/8) inch width shall be slit and folded down.

All membrane shall be surface dry before placement of the asphalt mix overlay. Paving may begin immediately after membrane placement.

**691-3.5 Reflective crack control system C.** Immediately prior to application of a tack coat, the surface shall be thoroughly cleaned by sweeping.

When placed as a strip treatment, the strip shall be 24 inches wide. Also, when placed as a strip treatment, a self-propelled distributor will not be required for applying the tack coat nor the



asphalt-rubber, nor will a self-propelled spreader be required to place the cover aggregate. Equipment which meets the approval of the Engineer and applies a uniform application of tack coat, asphalt rubber, and cover aggregate may be used.

- a. **Emulsified asphalt tack coat.** A tack coat of emulsified asphalt shall be in accordance with Item 603 titled EMULSIFIED ASPHALT TACK COAT and applied at a residual rate of 0.05 pounds per square foot.
- b. **Asphalt-rubber mixture.** For the asphalt-rubber mixture, the Contractor has the choice of using either a vulcanized rubber in asphalt with a diluent (Mixture 1) or a crumb rubber blend in asphalt which has been treated with an extender oil (Mixture 2).

- (1) **Mixture 1.** The percentage of vulcanized rubber shall be  $33\% \pm 4\%$  by weight of the asphalt cement in Mixture 1.

The temperature of the asphalt shall be between 350°F and 400°F before addition of the vulcanized rubber. The material shall be carefully combined and mixed and reacted for a period of time as required by the Engineer which shall be based on laboratory testing by the asphalt-rubber supplier or contracting agency.

The temperature of the asphalt-rubber mixture shall be above 325°F during the reaction period.

After the reaction between asphalt binder and rubber has occurred, the viscosity of the hot asphalt-rubber mixture may be adjusted for spraying and/or better "wetting" of the cover material by the addition of a diluent. The diluent shall not exceed 7.5% by volume of the hot asphalt-rubber mixture.

If a job delay results after the full reaction has occurred, the material may be allowed to cool and be slowly reheated to an acceptable spraying temperature just prior to application. However, because of the polymer reversion that can occur when crumb rubber is held for prolonged high temperatures, the material shall not be reheated to temperatures above 325 °F. Additional diluent up to a maximum of 3% by volume of the hot asphalt-rubber mixture may be used after reheating of the material.

- (2) **Mixture 2.** The percentage of crumb rubber blend shall be  $25\% \pm 4\%$  by weight of the asphalt binder. Prior to adding the crumb rubber blend, the asphalt and extender oil shall be mixed in such quantities to produce an absolute viscosity of 600 poises at 140°F when tested according to the requirements of AASHTO T 202. The asphalt oil blend shall first be heated to 400°F minimum and be thoroughly mixed before beginning incorporation of the crumb rubber blend. The crumb rubber blend shall be added as quickly as possible and the mix shall be given adequate circulation and agitation during the addition-mixing process to provide for proper dispersion. As soon as the mixing of the rubber is complete, Mixture 2 may be applied. However, if the material is not to be used within one (1) hour of mixing, the temperature shall be reduced to below 325°F and reheated on the project site.

- c. **Application of asphalt-rubber material.** Placement of the asphalt-rubber shall be made only under the following conditions.

- (1) The pavement surface temperature is not less than 60°F and rain is not imminent;
- (2) The pavement surface is clean and dry;
- (3) The wind conditions are such that excessive blowing of the spray bar fans is not occurring, and
- (4) All construction equipment such as asphalt-rubber distributor, aggregate spreader, haul trucks with cover aggregate, and rollers are in position and ready to commence placement operations.

The asphalt-rubber mixture shall be applied at a temperature of 290°F to 325°F at a rate of 0.6±0.05 gallons per square yard. Transverse joints shall be constructed by placing building paper across and over the end of the previous asphalt-rubber application. Once the spraying has progressed beyond the paper, the paper shall be removed immediately and disposed of as directed by the Resident Engineer. All longitudinal joints shall be lapped a minimum of four (4) inches.

- d. Application of cover material.** Cover material shall be applied immediately to the asphalt-rubber after spreading at a rate of 30 to 40 pounds per square yard. If steel slag is used for cover material, the spread quantity shall be increased in proportion to its higher specific gravity.

At the time of application to the asphalt-rubber, cover aggregate shall not contain any free moisture.

- e. Rolling.** At least three (3) pneumatic-tired rollers shall be provided to accomplish the required embedment of the cover material. At some project locations or where production rates indicate, fewer rollers may be utilized as directed by the Resident Engineer.

Sufficient rollers shall be used for the initial rolling to cover the width of the aggregate spread with one (1) pass. The first pass shall be made immediately behind the aggregate spreader, and if the spreading is stopped for any reason, the spreader shall be moved ahead or off to the side so that all cover material may be immediately rolled. Four (4) complete coverages with rollers shall be made with all rolling completed within two (2) hours after the application of the cover material.

- f. Opening the completed asphalt-rubber membrane interlayer to traffic.** Except when it is necessary that hauling equipment must be on the newly applied membrane, traffic of all types shall be kept off the membrane until it has had time to set properly. The speed of all hauling equipment shall not exceed 15 miles per hour when traveling over a membrane which is not adequately set. The minimum traffic free period shall be at least two (2) hours.

- g. Removing loose cover aggregate.** Following placement of the system, the loose cover aggregate shall be removed with a mechanical sweeper without dislodging any embedded aggregate.

- h. Placement of asphalt mix pavement.** The placement of the asphalt mix overlay shall be delayed as directed by the Resident Engineer for sufficient time to allow for adequate evaporation of the diluent or extender oil. A minimum of two (2) hours shall elapse.

**691-3.6 Reflective crack control system D.** The stress relief membrane shall be applied when the surface temperature is a minimum of 50°F and rising.

- a. Emulsified asphalt tack coat placement for membrane.** The emulsified asphalt tack coat shall be applied to the existing surface using one (1) of the following methods.

- (1)** A hand-held wand with a nozzle that produces a fan shaped spray to apply the tack coat evenly according to the rate specified by the manufacturer.
- (2)** A hand-held wand without a spray nozzle. The tack coat shall be spread with a squeegee according to the rate specified by the manufacturer.
- (3)** A distributor bar attached to a distributor truck, for longitudinal applications only. The distributor bar nozzles shall be set at 20 degrees to the axis of the bar and the tack coat shall be applied according to the rate specified by the manufacturer. Application of the tack coat directly from a distributor bar attached to a distributor truck will not be permitted for transverse applications.

The maximum width of the tack coat application shall be such that the tack coat extends a maximum of 1-1/2 inches on both sides of the stress relief membrane strip.

- b. Stress relief membrane placement.** The open grid woven polyester side of the material shall be placed up with the nonwoven side placed into the tack. The stress relief membrane shall be centered over the crack or joint on the existing surface and with a minimum of six (6) inches of the membrane extending beyond the edges of the joint.

The material shall be laid smooth with no uplifted edges. The stress relief membrane shall be placed and rolled immediately with a riding static drum roller or a rubber tire roller. A maximum of three (3) minutes shall pass between the first and second rolling efforts.

The stress relief membrane shall be butted where transverse and longitudinal joints meet or where two (2) rolls must be joined. When required, the stress relief membrane shall be cut with a razor knife from the woven polyester side.

The stress relief membrane shall be placed at least two (2) hours in advance of paving operations. If application must immediately precede the paving operation, hot-poured joint sealer may be required as a tack coat to bond the stress relief membrane to the existing surface.

- c. Traffic exposure.** Exposing the membrane to traffic shall be minimized. Small amounts of washed sand may be used to blot excess tack coat when necessary to facilitate movement of traffic or construction equipment over the membrane prior to placement of the overlay. Damaged membranes shall be removed and replaced.
- d. Paving tack coat/paving.** Paving operations shall only begin when the membrane is thoroughly bonded to the existing surface. The membrane may be exposed to moisture and rain prior to the application of the overlay however, the stress relief membrane must be dry at the time the overlay is placed.

An emulsified asphalt tack coat shall be applied prior to paving over the membrane. Asphalt mix or dry washed sand may be broadcast ahead of the paver if the membrane is sticking to the tires of the paving equipment. The minimum total asphalt overlay thickness shall be 2 inches compacted.

When using a vibratory roller for compaction, it shall be set to the lowest amplitude and highest frequency settings.

#### METHOD OF MEASUREMENT

- 691-4.1** The quantity of reflective crack control treatment shall be measured for payment by the number of square yards as specified, completed, and accepted by the Resident Engineer.
- 691-4.2** The quantity of strip reflective crack control treatment shall be measured for payment by the number of linear feet as specified, completed, and accepted by the Resident Engineer. It shall be measured along the joint or crack.

#### BASIS OF PAYMENT

- 691-5.1** Payment for accepted quantities of work performed by the Contractor and measured by the Resident Engineer shall be at the contract unit price as specified in paragraphs 691-4.1 and 691-4.2 of this section. Payment shall be full compensation for furnishing all materials, for all preparation and for all labor, equipment, tools, and incidentals necessary to complete the item as specified.

## REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

### ASTM International (ASTM)

ASTM D 36	Standard Test Method for Softening Point of Bitumen (Ring-and-Ball Apparatus)
ASTM D 70	Standard Test Method for Density of Semi-Solid Bituminous Materials (Pycnometer Method)
ASTM D 86	Standard Test Method for An American National Standard Distillation of Petroleum Products at Atmospheric Pressure
ASTM D 146	Standard Test Methods for Sampling and Testing Bitumen-Saturated Felts and Woven Fabrics for Roofing and Waterproofing
ASTM D 297	Standard Test Methods for Rubber Products-Chemical Analysis
ASTM D 412	Tensile Strength Properties of Rubber and Elastomers
ASTM D 517	Standard Specification for Asphalt Plank
ASTM D 882	Standard Test Method for Tensile Properties of Thin Plastic Sheeting
ASTM D 1151	Standard Practice for Effect of Moisture and Temperature on Adhesive Bonds
ASTM D 1777	Standard Test Method for Thickness of Textile Materials
ASTM D 3776	Standard Test Methods for Mass Per Unit Area (Weight) of Fabric
ASTM D 3786	Standard Test Method for Bursting Strength of Textile Fabrics-Diaphragm Bursting Strength Tester Method
ASTM D 4595	Standard Test Method for Tensile Properties of Geotextiles by the Wide-Width Strip Method
ASTM D 4632	Standard Test Method for Grab Breaking Load and Elongation of Geotextiles
ASTM E 96	Standard Test Methods for Water Vapor Transmission of Materials
ASTM E 154	Standard Test Methods for Water Vapor Retarders used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover

### American Association of State Highway and Transportation Officials (AASHTO)

AASHTO M 288	Standard Specification for Geosynthetic Specification for Highway Applications
AASHTO M 320	Standard Specification for Performance-Graded Asphalt Binder
AASHTO T 202	Standard Method of Test for Viscosity of Asphalts by Vacuum Capillary Viscometer

**END OF ITEM 691**

## Part 10 – Fencing

### Item 160 Wire Fence with Wood Posts (Class A and B Fences)

#### DESCRIPTION

- 160-1.1** This item shall consist of furnishing materials and constructing new wire fences and gates with wood posts as specified in the contract documents or directed by the Resident Engineer. The class of fence to be erected shall be specified as either Class A, woven wire fencing surmounted by two (2) strands of barbed wire; or Class B, woven wire fencing surmounted by four (4) strands of barbed wire.

All steel and manufactured goods provided for this item must meet the Buy American provisions contained in this contract.

#### MATERIALS

- 160-2.1 Fabric.** The woven wire (zinc-coated) fence shall be seven (7) bar, 26-inch field fence with top and bottom wires No. 10 American wire gauge (AWG), and filler and stay wires No. 12-1/2 AWG. Stay wires shall be spaced six (6) inches apart. All wires shall be smooth galvanized steel wire, conforming to AASHTO M 279. The Design Number of the fence fabric shall be either 939-6-11, Grade 60 or 939-6-12 1/2, Grade 125. The metallic coating shall be either Type A or Type Z, Class 3. All wires shall be twice dipped and shall be spaced as specified in the contract documents.

**160-2.2 Barbed wire.**

- a. **Zinc-coated.** Zinc-coated barbed wire shall be two (2) strand twisted No. 12-1/2-AWG galvanized steel wire with four (4) point barbs of No. 14 AWG galvanized steel wire. All wire shall conform to AASHTO M 280, Design Number 12-4-5-14R. The metallic coating shall be Type A. The barbs shall be spaced approximately five (5) inches apart. Galvanized barbed wire shall be according to the specifications for zinc-coated (galvanized) steel barbed wire, AASHTO M 280, Class 3 with a minimum coating of 0.80 ounces per square foot of wire surface
- b. **Copper-covered.** Copper-covered steel barbed wire shall conform to AASHTO M 280, Type A.
- c. **Aluminum-coated.** Aluminum-coated steel-barbed wire shall be two (2) strand twisted No. 12-1/2 AWG. The four (4) point barbs of No. 14 AWG aluminum-coated steel wire shall be spaced approximately five (5) inches apart. The steel wire shall have a tensile strength of between 60,000 and 80,000 pounds per square inch, and the aluminum coating shall have a minimum weight of 0.30 ounces per square foot of wire surface on the No. 12-1/2 AWG line wires and 0.25 ounces per square foot of wire surface on the No. 14 AWG barbs.

**160-2.3 Posts.**

- a. **Species.** The posts shall be of Southern Pine or Douglas fir.
- b. **Quality.** Posts shall be peeled, sound, straight-grained, knots and projections trimmed flush with the surface, and free from decay, cracks, and splits. Shakes shall not be in excess of one-quarter (1/4) inch wide and three (3) feet long. Knots in the posts shall not exceed 1-1/2 inches in size. Checks (lengthwise separations of the wood in a generally radial direction) are permitted, provided they are not harmful.

- c. Dimensions.** All posts shall be the length specified in the contract documents. Posts shall have the minimum top diameters specified in the contract documents. Sawn and split posts are acceptable instead of round posts if the required diameter round posts could be turned from the sawn or split posts.
  - d. Manufacture.** Outer bark shall be completely removed from all posts including depressions. Inner bark shall be removed from all post surfaces to be treated, except inner bark may remain in depressions. The amount of wood shaved off in the removal of inner bark shall be held to a minimum.
  - e. Treatment.** Posts shall be conditioned by air seasoning, steaming, or heating in oil in a manner that prevents injurious checking, splitting, or warping before treating. All timber shall be thoroughly seasoned and dry (22% maximum moisture content) before applying preservative treatment. The treatment, care and preservative shall be in accordance with AASHTO M 133.
- 160-2.4 Gates.** Gate frames shall consist of galvanized steel pipe. The fabric shall be of the same type material as used in the fence.
- 160-2.5 Braces.** Cleats, gate stops, and braces shall be of the size specified in the contract documents. They shall be of the same species and quality specified for the posts or approved by the Engineer, and they shall be free from knots larger than one-third (1/3) the width of the piece. Gate stops shall be made of posts of suitable length. Braces may be made of posts of suitable length or of sawed lumber. All cleats, gate stops, and any braces in contact with the ground and for a distance of at least six (6) inches above the ground shall be treated by the hot and cold bath process, specified herein for posts. The wire used for cable for bracing shall be No. 9 AWG smooth galvanized soft wire.
- 160-2.6 Staples.** The staples shall be No. 9 AWG galvanized steel wire, one (1) inch long for hardwood posts and 1-1/2-inch long for use in softwood posts.
- 160-2.7 Ground rods.** Ground rods shall be copper-clad steel. The ground rods shall be of the length and diameter specified on the plans, but in no case be less than eight (8) feet long and five-eighths (5/8) inch in diameter.
- 160-2.8 Marking.** Each roll of fabric shall carry a tag showing the kind of base metal, kind of coating, the gauge of the wire, the length of fencing in the roll, and the name of the manufacturer. Posts, wire, and other fittings shall be identified as to manufacturer, kind of base metal, and kind of coating.

### CONSTRUCTION METHODS

- 160-3.1 General.** The fence shall be constructed as specified in the contract documents using new materials. All work shall be performed in a workmanlike manner, satisfactory to the Resident Engineer. The Contractor shall layout the fence line as specified in the contract documents. The Contractor shall span the opening below the fence with barbed wire at all locations where it is not practical to conform the fence to the general contour of the ground surface because of natural or manmade features such as drainage ditches. The new fence shall be permanently tied to the terminals of existing fences as specified in the contract documents or as directed by the Resident Engineer. The finished fence shall be plumb, taut, true to line and ground contour, and complete in every detail. The Contractor shall stake down the fence at several points between posts as specified in the contract documents or as directed by the Resident Engineer.

The Contractor shall arrange the work so construction of the new fence immediately follows the removal of existing fences. The length of unfenced section at any time shall not exceed 300 feet. The work shall progress in this manner, and at the close of the working day, the newly constructed fence shall be tied to the unremoved existing fence.

**160-3.2 Clearing fence line.** The site of the fence shall be sufficiently clear of obstructions, and surface irregularities. The fence line shall be graded so that the fence will conform to the general contour of the ground. The fence line shall be cleared on each side of the centerline of the fence. This clearing shall consist of the removal of all stumps, brush, rocks, trees, or other obstructions that will interfere with proper construction of the fence. Stumps within the cleared area of the fence line shall be grubbed or excavated. The bottom of the fence shall be placed a uniform distance above ground as specified in the contract documents. When specified or as directed by the Resident Engineer, the existing fences which interfere with the new fence location shall be removed by the Contractor as part of the construction work, unless removal is listed as a separate item in the bid schedule. All holes remaining after post and stump removal shall be refilled with suitable soil, gravel, or other material and shall be compacted with tampers.

The work shall include the handling and disposal of all material cleared, of excess excavation and the removal of spoiled material regardless of the type, character, composition, or condition of such material encountered.

**160-3.3 Installing posts.** Posts shall be set with large ends down, plumb, and in a straight line on the side on which the wire is to be fastened. Posts shall be set full depth and shall not be cut off to eliminate rock or other excavation. Where rock is encountered, it shall be removed, to provide full-depth and full-size holes. The bottom of all posts shall be cut off square. The diameter of the holes shall be at least six (6) inches larger than the diameter of the posts. When cleats are used on posts, the holes shall be dug large enough to accommodate the cleat. After posts are placed and lined, the holes shall be backfilled with suitable material that shall be properly compacted by the use of tampers. The posts adjacent to end, corner, anchor, and gate posts shall be set and braced with braces and wire, as specified in the contract documents. No extra compensation shall be made for rock excavation.

**160-3.4 Anchoring.** Corner, end, gate, and adjacent intermediate posts shall be anchored, by gaining and spiking cleats to the sides of the posts, as specified in the contract documents. No cleats will be required on other intermediate posts or on anchor posts.

**160-3.5 Installing braces.** End, corner, anchor, and gate posts shall be braced by using a post of sufficient length or a piece of sawed lumber of the proper size, together with a wire cable. The wooden brace shall be gained and securely spiked into the end, corner, anchor, or gate posts and into the next intermediate posts about six (6) inches from the top of the respective posts. A cable made of a double strand of galvanized soft wire shall be looped around the end, corner, anchor, or gate post near the ground and around the next intermediate post about 12 inches from the top. After the cable has been stapled in this position, it shall be twisted until tight. The staples used to hold the cable shall be not less than 1-1/2 inch long. The tool used for twisting the cable shall be left in place to permit later adjustment of bracing if found necessary. Anchor posts shall be set at approximately 500 feet intervals and braced to the adjacent posts. Posts shall be braced before the wire fencing is placed.

**160-3.6 Installing fabric.** All barbed wire and woven wire shall be placed on the side of the posts away from the airport or as directed by the Resident Engineer at the height specified in the contract documents. Longitudinal wires shall be installed parallel and drawn uniformly taut. The vertical stay wires of the woven wire fencing shall be straight and vertical. At end and gate posts the woven wire and barbed wire shall be wrapped once around the post; each longitudinal wire shall be stapled at least three (3) times and the ends of these wires shall be tied with a snug, tight twist. Each longitudinal wire shall be stapled to each intermediate post with one (1) steel wire staple; at the corner and anchor posts, two (2) or more staples shall be used. The top strand of barbed wire of all fences shall be stapled with two (2) staples in each post. All staples shall be set diagonally with the grain of the wood and driven up tight. After the fence has been erected, the tops of the wood posts shall be sawed off with a 1-to-3 pitch. The bottom wire of the wire fencing shall clear the ground by not more than four (4) inches or less than one (1) inch at any place.

- 160-3.7 Splicing wire.** Splices in barbed and woven wire will be permitted if made with an approved galvanized bolt-clamp splice or a wire splice made such that the end of the wires shall be carried three (3) inches past the splice tool and wrapped around the other wire away from the tool for at least six (6) turns in opposite directions. After the tool is removed, the space occupied by it shall be closed by pulling the ends together. The unused ends of the wires shall be cut close to make a neat, workmanlike job. Woven wire shall be spliced only at posts.
- 160-3.8 Installing gates.** The gates shall be hung on gate fittings, as specified in the contract documents. Fittings on the gate posts shall be clamped, screwed, or bolted to prevent slipping. Gates shall be so erected as to swing in the direction indicated and shall be provided with gate stops, as specified. Gates shall be erected at locations specified in the contract documents.
- 160-3.9 Existing fence connections.** Wherever the new fence joins an existing fence, either at a corner or at the intersection of straight fence lines, a corner or anchor post shall be set at the junction and braced and anchored the same as herein described for corner posts.
- If the connection is made at other than the corner of the new fence, the last span of the old fence shall contain a brace span.
- 160-3.10 Electrical grounds.** Continuous fence shall be grounded at intervals not exceeding 200 feet. There shall be a ground not exceeding 35 feet from a gate in each section of the fence adjacent to a gate. There shall be a minimum of one (1) ground in any partial section of fence, constructed separately but in conjunction with main fence.
- Fence under a power line shall be grounded by three (3) grounds, one (1) directly under the crossing and one (1) on each side 25 to 35 feet away. A single ground shall be placed directly under each telephone wire or cable crossing. Each barbed wire and the top and bottom wires of the woven fence shall be fastened to the metal post by a mechanical means to assure a tight connection for positive grounding. When metal line posts are used in lieu of wood line posts, this grounding is not required.
- The ground shall be accomplished with a copper clad rod eight (8) feet long and a minimum of five-eighths (5/8) inches in diameter driven vertically until the top is six (6) inches below the ground surface. A No. 6 AWG solid copper conductor shall be clamped to the rod and to the fence in such a manner that each element of the fence is grounded. Installation of ground rods shall not constitute a pay item and shall be considered incidental to fence construction. The Contractor shall comply with FAA-STD-019, *Lightning and Surge Protection, Grounding, Bonding and Shielding Requirements for Facilities and Electronic Equipment, paragraph 4.2.3.8, Lightning Protection for Fences and Gates*, when fencing is adjacent to FAA facilities.
- 160-3.11 Fence and gate removal.** This work shall consist of the removal and disposal of existing wire fence and gates. The fence shall be removed completely including posts and foundations. The fence posts shall be pulled not cut off. All holes shall be filled and compacted. The removed material shall be disposed of off airport property.
- 160-3.12 Fence and gate relocation.** The Contractor will remove all fences, gates, posts (metal and/or wood), concrete, fence fabric, clips and other miscellaneous fittings associated with the fence to be relocated. The fence shall then be constructed, and all reusable materials will be reassembled in the proposed location shown on the construction plans. The existing gate, corner and anchor posts will be replaced with new posts; the old posts will be disposed of off airport property. The new posts will be considered incidental to this pay item and no additional compensation will be provided for the new posts or the disposal of the old posts off airport property.
- 160-3.13 Restoration.** All areas disturbed by work shall be restored to its original condition. The restoration shall include any necessary sodding, top soiling, fertilizing, liming, seeding, sprigging, mulching, or other landscaping as specified in the contract documents. All such work shall be performed in accordance with Part 12 titled TURFING. The Contractor shall be held responsible for maintaining all disturbed surfaces and replacements until final acceptance. The



cost of restoration shall be considered incidental to the contract and as a subsidiary obligation of the Contractor.

#### METHOD OF MEASUREMENT

- 160-4.1** The quantity of fence, Class A (Wood Posts) or Class B (Wood Posts), installed, relocated, or removed shall be measured for payment by the number of linear feet as specified, completed, and accepted by the Resident Engineer. It shall be measured from center to center of end posts or corner posts, excluding the length occupied by gate openings. Separate measurement shall be made for the various types and sizes.
- 160-4.2** The quantity of gates installed, relocated, or removed shall be measured for payment by the number of each unit as specified, completed, and accepted by the Resident Engineer. Separate measurement shall be made for the various types and sizes.

#### BASIS OF PAYMENT

- 160-5.1** Payment for accepted quantities of work performed by the Contractor and measured by the Resident Engineer shall be made at the contract unit price as specified in paragraphs 160-4.1 and 160-4.2 of this section. Payment shall be full compensation for furnishing all materials and for preparation, erection, and installation of these materials, and for all labor, equipment, tools and incidentals necessary to complete the work as specified.

#### REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

##### **American Association of State Highway and Transportation Officials (AASHTO)**

AASHTO M 133	Standard Specification for Preservatives and Pressure Treatment Processes for Timber
AASHTO M 279	Standard Specification for Metallic-Coated, Steel Woven Wire Fence Fabric
AASHTO M 280	Standard Specification for Metallic-Coated (Carbon) Steel Barbed Wire

##### **Federal Aviation Administration Standard (FAA STD)**

FAA-STD-019	Lightning and Surge Protection, Grounding, Bonding and Shielding Requirements for Facilities and Electronic Equipment
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**END OF ITEM 160**

## Item 161 Wire Fence with Steel Posts (Class C and D Fence)

### DESCRIPTION

- 161-1.1** This item shall consist of furnishing materials and constructing new wire fences and gates with steel posts as specified in the contract documents or directed by the Resident Engineer. The class of fence to be erected shall be specified as either Class C, woven wire fencing surmounted by two (2) strands of barbed wire; or Class D, woven wire fencing surmounted by four (4) strands of barbed wire.

All steel and manufactured goods provided for this item must meet the Buy American provisions contained in this contract.

### MATERIALS

- 161-2.1 Fabric.** The woven wire (zinc-coated) fencing shall be seven (7) bar, 26-inch field fence with top and bottom wires No. 10 American wire gauge (AWG), and filler and stay wires No. 12-1/2 AWG. Stay wires shall be spaced six (6) inches apart. All wire shall be smooth galvanized steel wire conforming to AASHTO M 279. The Design Number of the fence fabric shall be either 939-6-11, Grade 60 or 939-6-12 1/2, Grade 125. The metallic coating shall be either Type A or Type Z, Class 3. All wires shall be twice dipped and spaced as specified in the contract documents.

**161-2.2 Barbed wire.**

- a. **Zinc-coated.** Zinc-coated barbed wire shall be two (2) strand twisted No. 12-1/2-AWG galvanized steel wire with four (4) point barbs of No. 14-AWG galvanized steel wire. All wire shall conform to AASHTO M 280, Design Number 12-4-5-14R. The metallic coating shall be Type A. The barbs shall be spaced approximately five (5) inches apart. Galvanized barbed wire shall be according to the specifications for zinc coated (galvanized) steel barbed wire, AASHTO M 280, Class 3 with a minimum coating of 0.80 ounces per square foot of wire surface.
- b. **Copper-covered.** Copper-covered steel barbed wire shall conform to AASHTO M 280, Type A.
- c. **Aluminum-coated.** Aluminum-coated steel barbed wire shall be two (2) strand twisted No. 12-1/2 AWG. The four (4) point barbs of No. 14 AWG aluminum-coated steel wire shall be spaced approximately five (5) inches apart. The steel wire shall have a tensile strength of between 60,000 and 80,000 pounds per square inch and the aluminum coating shall have a minimum weight of 0.30 ounces per square foot of wire surface on the No. 12-1/2 AWG line wire and 0.25 ounces per square foot of wire surface on the No. 14 AWG barbs.

- 161-2.3 Posts, gates, rails, and braces.** Metal posts shall be the shapes and dimensions as specified in the contract documents. Line posts shall include a firmly attached, tapered anchor plate having an area of at least 18 square inches. The anchor plate shall be fabricated from minimum 12-gauge thickness steel. Steel pipe for metal posts shall be steel pipe, Type A, Type B, or Type C in accordance with the table below. Structural shapes for posts shall be fabricated from steel according to the requirements of AASHTO M 281, Grades A or B. All structural shapes shall be galvanized according to AASHTO M 111 using zinc of any grade according to the requirements of ASTM B6. The zinc coating shall be at least 2.0 ounces per square foot of surface.

Square hollow structural tubing shall be according to ASTM A500, Grade B or ASTM A501. The tubing shall be galvanized inside and outside according to AASHTO M 111, using zinc of any

grade according to the requirements of ASTM B6. The coating shall be at least 2.0 ounces per square foot of surface.

### Fence Post Requirements

Post Type	Gate Frames		Corner, End or Pull Posts		Line Posts		Braces	
	Diameter (inches)	Weight (lb/ft.)	Diameter (inches)	Weight (lb/ft.)	Diameter (inches)	Weight (lb/ft.)	Diameter (inches)	Weight (lb/ft.)
Type A	1.66 O.D.	2.27	2.375 O.D.	3.65	1.315 O.D.	1.68	1.66 O.D.	2.27
Type B	1.66 O.D.	1.83	2.375 O.D.	3.11	1.315 O.D.	1.34	1.66 O.D.	1.83
Type C	1.66 O.D.	1.82	2.375 O.D.	3.09	1.315 O.D.	1.33	1.66 O.D.	1.82
Tubing	---	---	---	---	1 sq.	1.41	---	---
Angle	---	---	2-1/2 x 2-1/2 x 1/4	4.1	---	---	2-1/2 x 2-1/2 x 1/4	3.19
Structural Shapes	---	---	---	4.1 min.	---	1.33 min.	---	3.1 min.

### Gate Post Requirements

Post Type	Single gate up to 4 ft. Double gate up to 8 ft.		Single gate over 4 ft. to 8 ft. Double gate over 8 ft. to 16 ft.		Single gate over 8 ft. to 12 ft. Double gate over 16 ft. to 24 ft.	
	Diameter (inches)	Weight (lb/ft.)	Diameter (inches)	Weight (lb/ft.)	Diameter (inches)	Weight (lb/ft.)
Type A	2.375"	3.65	2.875"	5.79	3.5"	7.58
Type B	2.375"	3.11	2.875"	4.64	---	1.34
Type C	2.375"	3.09	2.875"	3.78	---	1.33
Tubing	2-1/2 sq.	4.32	3 sq.	5.78	3 sq.	8.8
Angle	2-1/2 x 2-1/2 x 1/4	4.1	3 x 3 x 5/16	6.1	3-1/2 x 3-1/2 x 3/8	8.5
Structural Shapes	---	4.1 min.	---	6.1 min.	---	8.5 min.

- 161-2.4 Gates.** Gate frames shall consist of galvanized steel pipe and shall conform to the specifications for the same material under paragraph 161-2.3 titled POSTS, GATES, RAILS, AND BRACES. The fabric shall be of the same type material as used in the fence.
- 161-2.5 Concrete.** The concrete for fence post footings shall conform to the requirements of Item 610 titled CONCRETE FOR MISCELLANEOUS STRUCTURES.
- 161-2.6 Ground rods.** Ground rods shall be copper-clad steel. The ground rods shall be of the length and diameter specified on the plans, but in no case be less than eight (8) feet long and five-eighths (5/8) inch in diameter.
- 161-2.7 Marking.** Each roll of fabric shall carry a tag showing the kind of base metal, kind of coating, the gauge of the wire, the length of fencing in the roll, and the name of the manufacturer. Posts, wire, and other fittings shall be identified as to manufacturer, kind of base metal, and kind of coating.

## CONSTRUCTION METHODS

**161-3.1 General.** The fence shall be constructed as specified in the contract documents using new materials. All work shall be performed in a workmanlike manner satisfactory to the Resident Engineer. The Contractor shall layout the fence line as specified in the contract documents. The Contractor shall span the opening below the fence with barbed wire at all locations where it is not practical to conform the fence to the general contour of the ground surface because of natural or manmade features such as drainage ditches. The new fence shall be permanently tied to the terminals of existing fences as specified in the contract documents or as directed by the Resident Engineer. The finished fence shall be plumb, taut, true to line and ground contour, and complete in every detail. The Contractor shall stake down the fence at several points between posts as specified in the contract documents or as directed by the Resident Engineer.

The Contractor shall arrange the work so that construction of the new fence will immediately follow the removal of existing fences. The length of unfenced section at any time shall not exceed 300 feet. The work shall progress in this manner and at the close of the working day the newly constructed fence shall be tied to the existing fence.

**161-3.2 Clearing fence line.** The site of the fence shall be sufficiently cleared of obstructions, and surface irregularities. The fence line shall be graded so that the fence will conform to the general contour of the ground. The fence line shall be cleared on each side of the centerline of the fence. This clearing shall consist of the removal of all stumps, brush, rocks, trees, or other obstructions that will interfere with proper construction of the fence. Stumps within the cleared area of the fence shall be grubbed or excavated. The bottom of the fence shall be placed a uniform distance above ground, as specified in the contract documents. When specified or as directed by the Resident Engineer, the existing fences which interfere with the new fence location shall be removed by the Contractor as a part of the construction work unless such removal is listed as a separate item in the bid schedule. All holes remaining after post and stump removal shall be refilled with suitable soil, gravel, or other suitable material and compacted with tampers.

The work shall include the handling and disposal of all material cleared, excavated or removed, regardless of the type, character, composition, or condition of such material encountered.

**161-3.3 Installing posts.** All posts shall be spaced as specified in the contract documents. Corner, brace, anchor, end, and gate posts shall be set in concrete. The top of the concrete shall be slightly above the ground surface, trowel finished, and sloped to drain. Post holes of full depth and size for the concrete shall be provided. All line posts may be either driven or set in dug holes to a depth of 27 inches. All post setting shall be done carefully and to true alignment. Dirt removed for placing posts, anchor bars, flanges, etc., shall be replaced, tamped, and leveled. When posts are driven, care shall be exercised to prevent marring or buckling of the posts. Damaged posts shall be replaced at the Contractor's expense. No extra compensation will be made for rock excavation.

**161-3.4 Installing braces.** All corner, anchor, end, and gate posts shall be braced as specified in the contract documents. Anchor posts shall be set at approximately 500-foot intervals and braced to the adjacent posts.

**161-3.5 Installing fabric.** All barbed wire and woven wire shall be placed on the side of the post away from the airport, or as directed by the Resident Engineer, at the height specified in the contract documents. The woven wire shall be carefully stretched and hung without sag and with true alignment. Care shall be taken not to stretch the wire so tightly that it will break in cold weather or pull up corner and brace posts. All horizontal wires shall be fastened securely to each post by fasteners or clips designed for use with the posts furnished. The woven wire shall be wrapped around end, corner, and gate posts, and the ends of all horizontal wires shall be tied with snug, tight twists. The wire shall be secured to prevent slipping up and down the post. Barbed wire strands shall be stretched, and each strand secured to each post to prevent slipping out of line or becoming loose. At end, corner, and gate posts the barbed wire shall be securely wrapped and anchored once about the post from outside and secured against slipping by tying the ends with snug, tight twists. However, on spans of less than 100 feet both ends of the span need not

be wrapped around the posts. The bottom wire of the woven wire fencing shall clear the ground by not more than four (4) inches or less than one (1) inch at any place.

- 161-3.6 Splicing wire.** Splices in barbed and woven wire will be permitted if made with an approved galvanized bolt-clamp splice or a wire splice made such that the ends of each wire shall be carried three (3) inches past the splice tool and wrapped around the other wire for at least six (6) turns in opposite directions. After the tool is removed, the space occupied by it shall be closed by pulling the ends together. The unused ends of the wire shall be cut close to make a neat, workmanlike job. Woven wire shall be spliced only at posts.
- 161-3.7 Installing gates.** The gates shall be hung on gate fittings as specified in the contract documents. They shall be attached in such a manner that the gate cannot be lifted off the hinges. Gates shall be erected to swing in the direction indicated and shall be provided with gate stops, as specified or as specified in the contract documents. Gates shall be erected at locations specified in the contract documents.
- 161-3.8 Existing fence connections.** Wherever the new fence joins an existing fence, either at a corner or at the intersection of straight fence lines, a corner or anchor post shall be set at the junction and braced and anchored the same as herein described for corner posts.
- If the connection is made at other than the corner of the new fence, the last span of the old fence shall contain a brace span.
- 161-3.9 Electrical grounds.** Continuous fence shall be grounded at intervals not exceeding 200 feet. There shall be a ground not exceeding 35 feet from a gate in each section of the fence adjacent to a gate. There shall be a minimum of one (1) ground in any partial section of fence, constructed separately but in conjunction with main fence.
- The ground shall be accomplished with a copper clad rod eight (8) feet long and a minimum of five-eighths (5/8) inches in diameter driven vertically until the top is six (6) inches below the ground surface. A No. 6 AWG solid copper conductor shall be clamped to the rod and to the fence in such a manner that each element of the fence is grounded. Installation of ground rods shall not constitute a pay item and shall be considered incidental to fence construction. The Contractor shall comply with FAA-STD-019, *Lightning and Surge Protection, Grounding, Bonding and Shielding Requirements for Facilities and Electronic Equipment, paragraph 4.2.3.8, Lightning Protection for Fences and Gates*, when fencing is adjacent to FAA facilities.
- 161-3.10 Fence and gate removal.** This work shall consist of the removal and disposal of existing chain-link fence and gates. The fence shall be removed completely including posts and foundations. The fence posts shall be pulled not cut off. All holes shall be filled and compacted. The removed material shall be disposed of off airport property.
- 161-3.11 Fence and gate relocation.** The Contractor will remove all fences, gates, posts (metal and/or wood), concrete, fence fabric, clips and other miscellaneous fittings associated with the fence to be relocated. The fence shall then be constructed, and all reusable materials will be reassembled in the proposed location shown on the construction plans. The existing gate, corner and anchor posts will be replaced with new posts; the old posts will be disposed of off airport property. The new posts will be considered incidental to this pay item and no additional compensation will be provided for the new posts or the disposal of the old posts off airport property.
- 161-3.12 Restoration.** All areas disturbed by work shall be restored to its original condition. The restoration shall include any necessary sodding, top soiling, fertilizing, liming, seeding, sprigging, mulching, or other landscaping as specified in the contract documents. All such work shall be performed in accordance with Part 12 titled TURFING. The Contractor shall be held responsible for maintaining all disturbed surfaces and replacements until final acceptance. The cost of restoration shall be considered incidental to the contract and as a subsidiary obligation of the Contractor.

### METHOD OF MEASUREMENT

- 161-4.1** The quantity of fence, Class C (Steel Posts), or Class D (Steel Posts), installed, relocated, or removed shall be measured for payment by the number of linear feet as specified, completed and accepted by the Resident Engineer. It shall be measured along the top of the fence from center to center of end posts or corner posts, excluding the length occupied by gate openings. Separate measurement shall be made for the various types and sizes.
- 161-4.2** The quantity of gates installed, relocated, or removed shall be measured for payment by the number of each unit as specified, completed and accepted by the Resident Engineer. Separate measurement shall be made for the various types and sizes.

### BASIS OF PAYMENT

- 161-5.1** Payment for accepted quantities of work performed by the Contractor and measured by the Resident Engineer shall be made at the contract unit price as specified in paragraphs 161-4.1 and 161-4.2 in this section. Payment shall be full compensation for furnishing all materials and for all preparation, erection, and installation of these materials, and for all labor, equipment, tools, and incidentals necessary to complete the work as specified.

### REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

#### ASTM International (ASTM)

ASTM A 500	Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A 501	Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
ASTM B 6	Standard Specification for Zinc

#### American Association of State Highway and Transportation Officials (AASHTO)

AASHTO M 111	Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
AASHTO M 279	Standard Specification for Metallic-Coated, Steel Woven Wire Fence Fabric
AASHTO M 280	Standard Specification for Metallic-Coated (Carbon) Steel Barbed Wire
AASHTO M 281	Standard Specification for Steel Fence Posts and Assemblies, Hot-Wrought

#### Federal Aviation Administration Standard (FAA STD)

FAA-STD-019	Lightning and Surge Protection, Grounding, Bonding and Shielding Requirements for Facilities and Electronic Equipment
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#### Federal Specification (FED SPEC)

FED SPEC RR-F-191/Gen	Fencing, Wire, and Post Metal (and Gates, Chain-link Fence Fabric, and Accessories) (General Specification)
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### END OF ITEM 161

## Item 162 Chain-Link Fence

### DESCRIPTION

- 162-1.1** This item shall consist of furnishing and erecting a chain-link fence in accordance with these specifications, the details shown on the plans, and in conformity with the lines and grades as specified in the contract documents or directed by the Resident Engineer. All steel and manufactured goods provided for this item must meet the Buy American provisions contained in this contract.

### MATERIALS

- 162-2.1 Fabric.** The fabric shall conform to one (1) of the following.
- a. The fabric shall be woven in 2-inch mesh with 0.148-inch diameter wire meeting one (1) of the following requirements of AASHTO M 181.
    - (1) Type I, Class D (zinc-coated steel)
    - (2) Type II (aluminum-coated steel)
    - (3) Type III (aluminum alloy)
    - (4) Type IV, Class B (polyvinyl chloride (PVC)-coated steel). When vinyl-coated fabric is used, the posts, fence framework, gates, tension wire, fabric ties, and fittings shall be vinyl-coated according to the same requirements as the coating of the fabric. All nonaluminum material shall be galvanized prior to vinyl coating.
  - b. Fabric shall be according to ASTM F1345, woven in two (2) inch mesh with 0.148-inch diameter wire protected by Class 2 mischmetal coating. The weight of Zn - 5A1 - MM alloy coating shall be at least 1.0 ounces per square foot of uncoated wire surface.
- 162-2.2 Barbed wire.**
- a. **Zinc-coated.** Zinc-coated barbed wire shall be two (2)-strand twisted No. 12-1/2 American wire gauge (AWG) galvanized steel wire with four (4) point barbs of No. 14 AWG galvanized steel wire. All wire shall conform to AASHTO M 280, Design Number 12-4-5-14R. The metallic coating shall be Type A. The barbs shall be spaced approximately five (5) inches apart. Galvanized barbed wire shall be according to the specifications for zinc coated (galvanized) steel barbed wire, AASHTO M 280, Class 3 with a minimum coating of 0.80 ounces per square foot of wire surface.
  - b. **Aluminum-coated.** Aluminum-coated steel barbed wire shall be two (2) strand twisted No. 12-1/2 AWG. The four (4) point barbs of No. 14 AWG aluminum-coated steel wire shall be spaced approximately five (5) inches apart. The steel wire shall have a tensile strength of between 60,000 and 80,000 pounds per square inch and the aluminum coating shall have a minimum weight of 0.30 ounces per square foot of wire surface on the No. 12-1/2 AWG line wire and 0.25 ounces per square foot of wire surface on the No. 14 AWG barbs.
- 162-2.3 Posts, rails, and braces.** Metal posts, rail, braces, and gate frames shall be the shape and dimension as shown on the plans and shall meet the bending strength and dimension tolerance of AASHTO M 181.

Pipe and rolled shapes shall be according to ASTM F1043. Square hollow structural steel tubing shall be according to ASTM A500 Grade B or ASTM A501, with ASTM F1043, Type A internal and external coating.

### Fence Post Requirements

Post Type	Gate Frames		Corner, End or Pull Posts		Line Posts		Braces	
	Diameter (inches)	Weight (lb/ft.)	Diameter (inches)	Weight (lb/ft.)	Diameter (inches)	Weight (lb/ft.)	Diameter (inches)	Weight (lb/ft.)
Type A	1.66 O.D.	2.27	2.375 O.D.	3.65	1.90 O.D.	2.72	1.66 O.D.	2.27
Type B	1.66 O.D.	1.83	2.375 O.D.	3.11	1.90 O.D.	2.28	1.66 O.D.	1.83
Type C	1.66 O.D.	1.82	2.375 O.D.	3.09	1.90 O.D.	2.26	1.66 O.D.	1.82
Tubing	---	---	---	---	2-1/2 sq.	4.32	---	---
Angle	---	---	2-1/2 x 2-1/2 x 1/4	4.1	---	---	2-1/2 x 2-1/2 x 1/4	3.19
Roll Formed	---	---	3-1/2 x 3-1/2	As Specified	---	---	1-5/8 x 1-1/4	As Specified
H	---	---	---	---	1.875 x 1.625	2.72	1.31 x 1.5	2.25

### Gate Post Requirements

Post Type	Single gate up to 4 ft. Double gate up to 8 ft.		Single gate over 4 ft. to 8 ft. Double gate over 8 ft. to 16 ft.		Single gate over 8 ft. to 12 ft. Double gate over 16 ft. to 24 ft.	
	Diameter (inches)	Weight (lb/ft.)	Diameter (inches)	Weight (lb/ft.)	Diameter (inches)	Weight (lb/ft.)
Type A	2.375 O.D.	3.65	2.875 O.D.	5.79	3.5 O.D.	7.58
Type B	2.375 O.D.	3.11	2.875 O.D.	4.64	3.5 O.D.	5.707
Tubing	2-1/2 sq.	4.32	3 sq.	5.78	3 sq.	8.8

**162-2.4 Gates.** Gate frames shall consist of galvanized steel pipe and shall conform to the specifications for the same material under paragraph 162-2.3 titled POSTS, RAILS, AND BRACES. The fabric shall be of the same type material as used in the fence.

**162-2.5 Wire ties and tension wires.** Wire ties and tension wire for use in conjunction with a given type of fabric shall be of the same material and coating weight identified with the fabric type. Tension wire shall conform to AASHTO M 181, Type I, Class 2, or Type II.

**162-2.6 Fabric ties.** The fabric ties to be used with other than vinyl-coated fabric shall be stainless steel hog rings minimum diameter of 0.120 inches, No. 9 AWG aluminum wire or No. 9 AWG galvanized steel wire with 1.2 ounces per square foot zinc coating. The fabric ties to be used with vinyl fabric shall be of the same material as the fabric.

**162-2.7 Miscellaneous fittings and hardware.** Miscellaneous steel fittings and hardware for use with zinc-coated, aluminum-coated, or mischmetal coated steel fabric shall be of commercial grade steel or better quality, wrought or cast as appropriate to the fitting or hardware, and sufficient in strength to provide a balanced design when used in conjunction with fabric, posts, and wires of the quality specified. All miscellaneous fittings shall be made of malleable cast iron or pressed



steel and shall be galvanized according to AASHTO M 232. Barbed wire support arms shall withstand a load of 250 pounds applied vertically to the outermost end of the arm.

- 162-2.8 Bolts and nuts.** All bolts and nuts shall be according to ASTM A307 and shall be zinc-coated according to AASHTO M 232 or ASTM B695, Class 50 with galvanizing not to exceed six (6) mils.
- 162-2.9 Concrete.** The concrete for fence post footings shall conform to the requirements of Item 610 titled CONCRETE FOR MISCELLANEOUS STRUCTURES
- 162-2.10 Ground rods.** Ground rods shall be copper-clad steel. The ground rods shall be of the length and diameter specified on the plans, but in no case be less than eight (8) feet long and five-eighths (5/8) inch in diameter.
- 162-2.11 Marking.** Each roll of fabric shall carry a tag showing the kind of base metal, kind of coating, the gauge of the wire, the length of fencing in the roll, and the name of the manufacturer. Posts, wire, and other fittings shall be identified as to manufacturer, kind of base metal, and kind of coating.

### CONSTRUCTION METHODS

- 162-3.1 General.** The fence shall be constructed in accordance with the contract documents using new materials. All work shall be performed in a workmanlike manner satisfactory to the Resident Engineer. The Contractor shall layout the fence line as specified in the contract documents. The Contractor shall span the opening below the fence with barbed wire at all locations where it is not practical to conform the fence to the general contour of the ground surface because of natural or manmade features such as drainage ditches. The finished fence shall be plumb, taut, true to line and ground contour, and complete in every detail. The new fence shall be permanently tied to the terminals of existing fences as specified in the contract documents or as directed by the Resident Engineer. The Contractor shall stake down the fence at several points between posts as specified in the contract documents or as directed by the Resident Engineer.

The Contractor shall arrange the work so that construction of the new fence will immediately follow the removal of existing fences. The length of unfenced section at any time shall not exceed 300 feet. The work shall progress in this manner and at the close of the working day the newly constructed fence shall be tied to the existing fence.

- 162-3.2 Clearing fence line.** The site of the fence shall be sufficiently cleared of obstructions, and surface irregularities. The fence line shall be graded so that the fence will conform to the general contour of the ground. The fence line shall be cleared on each side of the centerline of the fence. This clearing shall consist of the removal of all stumps, brush, rocks, trees, or other obstructions that will interfere with proper construction of the fence. Stumps within the cleared area of the fence shall be grubbed or excavated. The bottom of the fence shall be placed a uniform distance above ground, as specified in the contract documents. When specified in the contract documents or as directed by the Resident Engineer, the existing fences which interfere with the new fence location shall be removed by the Contractor as a part of the construction work unless such removal is listed as a separate item in the bid schedule. All holes remaining after post and stump removal shall be refilled with suitable soil, gravel, or other suitable material and compacted with tampers.

The work shall include the handling and disposal of all material cleared, of excess excavation and the removal of spoiled material regardless of the type, character, composition, or condition of such material encountered.

- 162-3.3 Installing posts.** All posts shall be set in concrete at the required dimension and depth and at the spacing specified in the contract documents. Posts should be spaced not more than ten (10) feet apart and should be set a minimum of 36 inches in concrete footings. If the frost depth is greater than 36 inches, the posts should be set accordingly. The posts holes shall be in proper alignment so that there is a minimum of three (3) inches of concrete on all sides of the posts.

The concrete shall be thoroughly compacted around the posts by tamping or vibrating and shall have a smooth finish slightly higher than the ground and sloped to drain away from the posts. All posts shall be set plumb and to the required grade and alignment. No materials shall be installed on the posts, nor shall the posts be disturbed in any manner within seven (7) days after the individual post footing is completed.

Should rock be encountered at a depth less than the planned footing depth, a hole two (2) inches larger than the greatest dimension of the posts shall be drilled to a depth of 12 inches. After the posts are set, the remainder of the drilled hole shall be filled with grout, composed of one (1) part Portland cement and two (2) parts mortar sand. Any remaining space above the rock shall be filled with concrete in the manner described above.

In lieu of drilling, the rock may be excavated to the required footing depth. No extra compensation shall be made for rock excavation.

**162-3.4 Installing top rails.** The top rail shall be continuous and shall pass through the post tops. The coupling used to join the top rail lengths shall allow for expansion.

**162-3.5 Installing braces.** Horizontal brace rails, with diagonal truss rods and turnbuckles, shall be installed at all terminal posts.

**162-3.6 Installing fabric.** The wire fabric shall be firmly attached to the posts and braced as specified in the contract documents. All wire shall be stretched taut and shall be installed to the required elevations. The fence shall generally follow the contour of the ground, with the bottom of the fence fabric no less than one (1) inch or more than four (4) inches from the ground surface. Grading shall be performed where necessary to provide a neat appearance.

At locations of small natural swales or drainage ditches and where it is not practical to have the fence conform to the general contour of the ground surface, longer posts may be used and multiple strands of barbed wire stretched to span the opening below the fence. The vertical clearance between strands of barbed wire shall be six (6) inches or less. Openings below the fence may also be spanned with barbed wire fastened to stakes.

**162-3.7 Installing gates.** The gates shall be hung on gate fittings as specified in the contract documents. The lower hinge (ball and socket type) shall be placed on top of the concrete in which the gate post is set. The sockets for the cane or foot bolts shall be set in concrete so that the plunger pin will fit perfectly in the socket when the gate is in a closed position. Gates shall be so erected as to swing in the direction indicated and shall be provided with gate stops as specified in the contract documents. Gate keepers shall be provided to hold gates when in open position and shall be located and installed as directed by the Resident Engineer. All hardware shall be thoroughly secured, properly adjusted and left in perfect working order. Hinges and diagonal bracing in gates shall be adjusted so that gates will hang level.

**162-3.8 Existing fence connections.** Wherever the new fence joins an existing fence, either at a corner or at the intersection of straight fence lines, a corner or anchor post shall be set at the junction and braced and anchored the same as herein described for corner posts.

If the connection is made at other than the corner of the new fence, the last span of the old fence shall contain a brace span.

**162-3.9 Electrical grounds.** Continuous fence shall be grounded at intervals not exceeding 500 feet. There shall be a ground within 100 feet of gates in each section of the fence adjacent to the gate.

Fence under a power line shall be grounded by three (3) grounds, one (1) directly under the crossing and one (1) on each side 25 to 50 feet away. A single ground shall be located directly under each telephone wire or cable crossing.

The ground shall be accomplished with a copper clad rod eight (8) feet long and a minimum of five-eighths (5/8) inches in diameter driven vertically until the top is six (6) inches below the ground surface. A No. 6 AWG solid copper conductor shall be clamped to the rod and to the

fence in such a manner that each element of the fence is grounded. Installation of ground rods shall not constitute a pay item and shall be considered incidental to fence construction. The Contractor shall comply with FAA-STD-019, *Lightning and Surge Protection, Grounding, Bonding and Shielding Requirements for Facilities and Electronic Equipment, paragraph 4.2.3.8, Lightning Protection for Fences and Gates*, when fencing is adjacent to FAA facilities.

- 162-3.10 Fence and gate removal.** This work shall consist of the removal and disposal of existing wire fence and gates. The fence shall be removed completely including posts and foundations. The fence posts shall be pulled not cut off. All holes shall be filled and compacted. The removed material shall be disposed of off airport property.
- 162-3.11 Fence and gate relocation.** The Contractor will remove all fences, gates, posts (metal and/or wood), concrete, fence fabric, clips and other miscellaneous fittings associated with the fence to be relocated. The fence shall then be constructed, and all reusable materials will be reassembled in the proposed location shown on the construction plans. The existing gate, corner and anchor posts will be replaced with new posts; the old posts will be disposed of off airport property. The new posts will be considered incidental to this pay item and no additional compensation will be provided for the new posts or the disposal of the old posts off airport property.
- 162-3.12 Restoration.** All areas disturbed by work shall be restored to its original condition. The restoration shall include any necessary sodding, top soiling, fertilizing, liming, seeding, sprigging, mulching, or other landscaping as specified in the contract documents. All such work shall be performed in accordance with Part 12 titled TURFING. The Contractor shall be held responsible for maintaining all disturbed surfaces and replacements until final acceptance. The cost of restoration shall be considered incidental to the contract and as a subsidiary obligation of the Contractor.

#### METHOD OF MEASUREMENT

- 162-4.1** The quantity of chain-link fence installed, relocated, or removed shall be measured for payment by the number of linear feet as specified, completed, and accepted by the Resident Engineer. It shall be measured along the top of the fence from center to center of end posts or corner posts, excluding the length occupied by gate openings. Separate measurement shall be made for the various sizes.
- 162-4.2** The quantity of gates installed, relocated, or removed shall be measured for payment by the number of each unit as specified, completed, and accepted by the Resident Engineer. Separate measurement shall be made for the various types and sizes.

#### BASIS OF PAYMENT

- 162-5.1** Payment for accepted quantities of work performed by the Contractor and measured by the Resident Engineer shall be made at the contract unit price as specified in paragraphs 162-4.1 and 162-4.2 of this section. Payment shall be full compensation for furnishing all materials and for all preparation, erection, and installation of these materials, and for all labor, equipment, tools, and incidentals necessary to complete the work as specified.

**REFERENCES**

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

**ASTM International (ASTM)**

ASTM A 307	Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength
ASTM A 500	Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A 501	Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
ASTM B 695	Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel
ASTM F 1043	Standard Specification for Strength and Protective Coatings on Steel Industrial Fence Framework
ASTM F 1345	Standard Specification for Zinc 5% Aluminum-Mischmetal Alloy Coated Steel Chain-Link Fence Fabric

**American Association of State Highway and Transportation Officials (AASHTO)**

AASHTO M 181	Standard Specification for Chain-Link Fence
AASHTO M 232	Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
AASHTO M 280	Standard Specification for Metallic-Coated (Carbon) Steel Barbed Wire

**Federal Aviation Administration Standard (FAA STD)**

FAA-STD-019	Lightning and Surge Protection, Grounding, Bonding and Shielding Requirements for Facilities and Electronic Equipment
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**END OF ITEM 162**

## Item 163 Wildlife Deterrent Fence Skirt

### DESCRIPTION

- 163-1.1** This item shall consist of furnishing and installing chain-link fence fabric underground along an existing chain link fence or wildlife fabric fence, constructing concrete pads at existing fence gates as specified in the contract documents or directed by the Resident Engineer.

All steel and manufactured goods provided for this item must meet the Buy American provisions contained in this contract.

### MATERIALS

- 163-2.1 Chain-link skirt fabric.** The fabric shall be woven with a No. 9 American wire gauge (AWG) galvanized steel wire in a two (2) inch mesh, be five (5) feet wide, and conform to one (1) of the following.
- a. The fabric shall be woven in two (2) inch mesh with 0.148-inch diameter wire meeting one (1) of the following requirements of AASHTO M 181.
    - (1) Type I, Class D (zinc-coated steel)
    - (2) Type II (aluminum-coated steel)
    - (3) Type III (aluminum alloy)
  - b. Fabric shall be according to ASTM F1345, woven in two (2) inch mesh with 0.148- inch diameter wire protected by Class 2 mischmetal coating. The weight of Zn - 5A1 - MM alloy coating shall be at least 1.0 ounces per square foot of uncoated wire surface.
- 163-2.2 Barbed wire.** Zinc-coated barbed wire shall be two (2) strand twisted No. 12-1/2 AWG galvanized steel wire with four (4) point barbs of No. 14 AWG galvanized steel wire. All wire shall conform to AASHTO M 280, Design Number 12-4-5-14R. The metallic coating shall be Type A. The barbs shall be spaced approximately five (5) inches apart. Galvanized barbed wire shall be according to the specifications for zinc coated (galvanized) steel barbed wire, AASHTO M 280, Class 3 with a minimum coating of 0.80 ounces per square foot of wire surface.
- 163-2.3 Wire ties and tension wires.** Wire ties and tension wire for use in conjunction with a given type of fabric shall be the same material as the fabric type. The tension wire shall be No. 7 AWG coiled spring wire coated similarly to the respective wire fabric being used and shall conform to AASHTO M 181, Type I, Class 2, or Type II.
- 163-2.4 Fabric ties.** The fabric ties to be used with other than vinyl-coated fabric shall be stainless steel hog rings minimum diameter of 0.120 inches, No. 9 AWG aluminum wire or No. 9 AWG galvanized steel wire with 1.2 ounces per square foot zinc coating. The fabric ties to be used with vinyl fabric shall be of the same material as the fabric.
- 163-2.5 Miscellaneous fittings and hardware.** Miscellaneous steel fittings and hardware for use with zinc-coated, aluminum-coated, or mischmetal coated steel fabric shall be of commercial grade steel or better quality, wrought or cast as appropriate to the fitting or hardware, and sufficient in strength to provide a balanced design when used with fabric, posts, and wires of the specified quality. All miscellaneous fittings shall be made of malleable cast iron or pressed steel and shall be galvanized according to AASHTO M 232.

- 163-2.6 Concrete.** The concrete for pads at gates shall conform to the requirements of Item 610 titled CONCRETE FOR MISCELLANEOUS STRUCTURES.
- 163-2.7 Ground rods.** Ground rods shall be copper-clad steel. The ground rods shall be of the length and diameter specified on the plans, but in no case be less than eight (8) feet long and five-eighths (5/8) inch in diameter.
- 163-2.8 Marking.** Each roll of fabric shall carry a tag showing the kind of base metal, kind of coating, the gauge of the wire, the length of fencing in the roll, and the name of the manufacturer. Posts, wire, and other fittings shall be identified as to manufacturer, kind of base metal, and kind of coating.
- 163-2.9 Weed control material.** A commercially available weed control material shall be applied at the manufacturer's recommended rate.

### CONSTRUCTION METHODS

- 163-3.1 General.** The fence shall be constructed in accordance with the contract documents using new materials. All work shall be performed in a workmanlike manner satisfactory to the Resident Engineer. The Contractor shall layout the fence line as specified in the contract documents.
- The Contractor shall arrange the work so that construction of the new fence will immediately follow the removal of existing fences. The length of unfenced section at any time shall not exceed 300 feet. The work shall progress in this manner and at the close of the working day the newly constructed fence shall be tied to the existing fence.
- 163-3.2 Clearing fence line.** The site of the fence shall be sufficiently cleared of obstructions, and surface irregularities. The fence line shall be graded so that the fence will conform to the general contour of the ground. The fence line shall be cleared on each side of the centerline of the fence. This clearing shall consist of the removal of all stumps, brush, rocks, trees, or other obstructions that will interfere with the proper construction of the fence. Stumps within the cleared area of the fence shall be grubbed or excavated. When specified in the contract documents or as directed by the Resident Engineer, the existing fences which interfere with the new fence location shall be removed by the Contractor as a part of the construction work unless such removal is listed as a separate item in the bid schedule. All holes remaining after post and stump removal shall be refilled with suitable soil, gravel, or other suitable material and compacted with tampers.
- The work shall include the handling and disposal of all material cleared, of excess excavation and the removal of spoiled material regardless of the type, character, composition, or condition of such material encountered.
- 163-3.3 Installing chain-link skirt fabric.** Excavate ground to the depth required for proper installation of the fabric. Obtain Resident Engineer's approval of depth of excavation before placing the chain-link fabric. Place the fabric and lap splice it to existing fence fabric and tie with wire ties at two (2) foot spacing. Cut fabric around fence post footing to allow proper placement. Backfill with native soil to original grade and compact. Gate concrete pads shall be installed at each gate as specified in the contract documents or as directed by the Resident Engineer.
- 163-3.4 Weed control application.** Weed control material shall be applied over an area five (5) feet wide, measured from the fence centerline, and over the wildlife fence. Apply weed control material as recommended by the manufacturer's instructions and in compliance with state and local regulations.
- 163-3.5 Electrical grounds.** Continuous fence shall be grounded at intervals not exceeding 500 feet. There shall be a ground within 100 feet of gates in each section of the fence adjacent to the gate.
- Fence under a power line shall be grounded by three (3) grounds, one (1) directly under the crossing and one (1) on each side 25 to 50 feet away. A single ground shall be located directly under each telephone wire or cable crossing.

The ground shall be accomplished with a copper clad rod eight (8) feet long and a minimum of five-eighths (5/8) inches in diameter driven vertically until the top is six (6) inches below the ground surface. A No. 6 AWG solid copper conductor shall be clamped to the rod and to the fence in such a manner that each element of the fence is grounded. Installation of ground rods shall not constitute a pay item and shall be considered incidental to fence construction. The Contractor shall comply with FAA-STD-019, *Lightning and Surge Protection, Grounding, Bonding and Shielding Requirements for Facilities and Electronic Equipment, paragraph 4.2.3.8, Lightning Protection for Fences and Gates*, when fencing is adjacent to FAA facilities.

- 163-3.6 Restoration.** All areas disturbed by work shall be restored to its original condition. The restoration shall include any necessary sodding, top soiling, fertilizing, liming, seeding, sprigging, mulching, or other landscaping as specified in the contract documents. All such work shall be performed in accordance with Part 12 titled TURFING. The Contractor shall be held responsible for maintaining all disturbed surfaces and replacements until final acceptance. The cost of restoration shall be considered incidental to the contract and as a subsidiary obligation of the Contractor.

#### METHOD OF MEASUREMENT

- 163-4.1** The quantity of chain-link skirt shall be measured for payment by the number of linear feet of fence in place as specified, completed, and accepted by the Resident Engineer. It shall be measured along the top of the fence from center to center of end posts or corner posts, excluding the length occupied by gate openings. Separate measurement shall be made for the various sizes

#### BASIS OF PAYMENT

- 163-5.1** Payment for accepted quantities of work performed by the Contractor and measured by the Resident Engineer shall be made at the contract unit price as specified in paragraphs 163-4.1 through 163-4.3 in this section. Payment shall be full compensation for furnishing materials, all labor (including preparation, excavation, backfill, fill, and installation), equipment, tools, and incidentals necessary to complete the work as specified.

#### REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

##### ASTM International (ASTM)

ASTM F 1345	Standard Specification for Zinc 5% Aluminum-Mischmetal Alloy Coated Steel Chain-Link Fence Fabric
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##### American Association of State Highway and Transportation Officials (AASHTO)

AASHTO M 181	Standard Specification for Chain-Link Fence
AASHTO M 232	Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
AASHTO M 280	Standard Specification for Metallic-Coated (Carbon) Steel Barbed Wire

##### Federal Aviation Administration Standard (FAA STD)

FAA-STD-019	Lightning and Surge Protection, Grounding, Bonding and Shielding Requirements for Facilities and Electronic Equipment
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#### END OF ITEM 163

**Item 164 Wildlife Exclusion Fence****DESCRIPTION**

- 164-1.1** This item shall consist of furnishing materials and installing new wire wildlife exclusion fences and gates with wood posts, furnishing and installing chain-link fence fabric underground along the wire fence line, and constructing concrete pads at fence gates as specified in the contract documents. The fence to be erected shall be woven wire or chain-link fencing surmounted by three (3) strands of barbed wire, as specified.

All steel and manufactured goods provided for this item must meet the Buy American provisions contained in this contract.

**MATERIALS****164-2.1 Fabric.**

- a. Woven wire fence (zinc-coated).** The woven wire fence shall be 23 bar, 120 inch field fence with top and bottom wires No. 12-1/2 American wire gauge (AWG), and filler and stay wires No. 12-1/2 AWG. Stay wires shall be spaced six (6) inches apart. All wires shall be smooth galvanized steel wire, conforming to AASHTO M 279. The Design Number of the fence fabric shall be either 939-6-11, Grade 60 or 939-6-12 1/2, Grade 125. The metallic coating shall be either Type A or Type Z, Class 3. All wires shall be twice dipped and shall be spaced as specified in the contract documents.
- b. Chain-link fence.** The fabric shall conform to one (1) of the following.
- (1) The fabric shall be woven in two (2) inch mesh with 0.148-inch diameter wire meeting one (1) of the following requirements of AASHTO M 181.
- (a) Type I, Class D (zinc-coated steel)
- (b) Type II (aluminum-coated steel)
- (c) Type III (aluminum alloy)
- (d) Type IV, Class B (polyvinyl chloride (PVC)-coated steel). When vinyl-coated fabric is used, the posts, fence framework, gates, tension wire, fabric ties, and fittings shall be vinyl-coated according to the same requirements as the coating of the fabric. All nonaluminum material shall be galvanized prior to vinyl coating.
- (2) Fabric shall be according to ASTM F1345, woven in two (2) inch mesh with 0.148-inch diameter wire protected by Class 2 mischmetal coating. The weight of Zn - 5A1 - MM alloy coating shall be at least 1.0 ounces per square foot of uncoated wire surface.
- c. Chain-link skirt.** The fabric shall be woven with a No. 9 AWG galvanized steel wire in a two (2) inch mesh, be five (5) feet wide, and conform to one (1) of the following.
- (1) The fabric shall be woven in two (2) inch mesh with 0.148-inch diameter wire meeting one (1) of the following requirements of AASHTO M 181.
- (a) Type I, Class D (zinc-coated steel)
- (b) Type II (aluminum-coated steel)
- (c) Type III (aluminum alloy)



- (2) Fabric shall be according to ASTM F1345, woven in two (2) inch mesh with 0.148-inch diameter wire protected by Class 2 mischmetal coating. The weight of Zn - 5A1 - MM alloy coating shall be at least 1.0 ounces per square foot of uncoated wire surface.

**164-2.2 Barbed wire (zinc-coated).** Zinc-coated barbed wire shall be two (2) strand twisted No. 12-1/2 AWG galvanized steel wire with four (4) point barbs of No. 14 AWG galvanized steel wire. All wire shall conform to AASHTO M 280, Design Number 12-4-5-14R. The metallic coating shall be Type A. The barbs shall be spaced approximately five (5) inches apart. Galvanized barbed wire shall be according to the specifications for zinc coated (galvanized) steel barbed wire, AASHTO M 280, Class 3 with a minimum coating of 0.80 ounces per square foot of wire surface. The barbs shall be spaced approximately five (5) inches apart.

### 164-2.3 Posts.

#### a. Wood posts.

- (1) **Species.** The posts shall be of southern pine or Douglas fir.
- (2) **Quality.** Posts shall be peeled, sound, knots and projections trimmed flush with the surface, straight-grained, free from decay, cracks, and splits. Shakes shall not be in excess of one-quarter (1/4) inch wide and three (3) feet long. Checks (lengthwise separations of the wood in a generally radial direction) are permitted, provided they are not harmful.
- (3) **Dimensions.** All posts shall be the length specified in the contract documents. Posts shall have the minimum top diameters specified in the contract documents. Sawn and split posts are acceptable instead of round posts if the required diameter round posts could be turned from the sawn or split posts.
- (4) **Manufacture.** Outer bark shall be completely removed from all posts including depressions. Inner bark shall be removed from all post surfaces to be treated, except inner bark may remain in depressions. The amount of wood shaved off in the removal of inner bark shall be held to a minimum.
- (5) **Treatment.** Posts shall be conditioned by air seasoning, steaming, or heating in oil in a manner that prevents injurious checking, splitting, or warping before treating. All timber shall be thoroughly seasoned and dry (22% maximum moisture content) before applying preservative treatment. The treatment, care and preservative shall be in accordance AASHTO M 133.

#### b. Steel posts, rails, and braces.

- (1) **Woven wire fence.** Metal posts shall be the shapes and dimensions as specified in the contract documents. Line posts shall include a firmly attached, tapered anchor plate having an area of at least 18 square inches. The anchor plate shall be fabricated from minimum 12-gauge thickness steel. Steel pipe for metal posts shall be steel pipe, Type A, Type B, or Type C in accordance with the table below. Structural shapes for posts shall be fabricated from steel according to the requirements of AASHTO M 281, Grades A or B. All structural shapes shall be galvanized according to AASHTO M 111 using zinc of any grade according to the requirements of ASTM B6. The zinc coating shall be at least 2.0 ounces per square foot of surface.

Square hollow structural tubing shall be according to ASTM A500, Grade B or ASTM A501. The tubing shall be galvanized inside and outside according to AASHTO M111, using zinc of any grade according to the requirements of ASTM B6. The coating shall be at least 2.0 ounces per square foot of surface.

### Woven Wire Fence Post Requirements

Post Type	Gate Frames		Corner, End or Pull Posts		Line Posts		Braces	
	Diameter (inches)	Weight (lb/ft.)	Diameter (inches)	Weight (lb/ft.)	Diameter (inches)	Weight (lb/ft.)	Diameter (inches)	Weight (lb/ft.)
Type A	1.66 O.D.	2.27	2.375 O.D.	3.65	1.315 O.D.	1.68	1.66 O.D.	2.27
Type B	1.66 O.D.	1.83	2.375 O.D.	3.11	1.315 O.D.	1.34	1.66 O.D.	1.83
Type C	1.66 O.D.	1.82	2.375 O.D.	3.09	1.315 O.D.	1.33	1.66 O.D.	1.82
Tubing	---	---	---	---	1 sq.	1.41	---	---
Angle	---	---	2-1/2 x 2-1/2 x 1/4	4.1	---	---	2-1/2 x 2-1/2 x 1/4	3.19
Structural Shapes	---	---	---	4.1 min.	---	1.33 min.	---	3.1 min.

### Woven Wire Gate Post Requirements

Post Type	Single gate up to 4 ft. Double gate up to 8 ft.		Single gate over 4 ft. to 8 ft. Double gate over 8 ft. to 16 ft.		Single gate over 8 ft. to 12 ft. Double gate over 16 ft. to 24 ft.	
	Diameter (inches)	Weight (lb/ft.)	Diameter (inches)	Weight (lb/ft.)	Diameter (inches)	Weight (lb/ft.)
Type A	2.375"	3.65	2.875"	5.79	3.5"	7.58
Type B	2.375"	3.11	2.875"	4.64	---	1.34
Type C	2.375"	3.09	2.875"	3.78	---	1.33
Tubing	2-1/2 sq.	4.32	3 sq.	5.78	3 sq.	8.8
Angle	2-1/2 x 2-1/2 x 1/4	4.1	3 x 3 x 5/16	6.1	3-1/2 x 3-1/2 x 3/8	8.5
Structural Shapes	---	4.1 min.	---	6.1 min.	---	8.5 min.

**(2) Chain-link fence.** Metal posts, rail, braces, and gate frames shall be the shape and dimension as shown on the plans and shall meet the bending strength and dimension tolerance of AASHTO M 181.

Pipe and rolled shapes shall be according to ASTM F1043. Square hollow structural steel tubing shall be according to ASTM A500 Grade B or ASTM A501, with ASTM F1043, Type A internal and external coating.

### Chain-link Fence Post Requirements

Post Type	Gate Frames		Corner, End or Pull Posts		Line Posts		Braces	
	Diameter (inches)	Weight (lb/ft.)	Diameter (inches)	Weight (lb/ft.)	Diameter (inches)	Weight (lb/ft.)	Diameter (inches)	Weight (lb/ft.)
Type A	1.66 O.D.	2.27	2.375 O.D.	3.65	1.90 O.D.	2.72	1.66 O.D.	2.27
Type B	1.66 O.D.	1.83	2.375 O.D.	3.11	1.90 O.D.	2.28	1.66 O.D.	1.83
Type C	1.66 O.D.	1.82	2.375 O.D.	3.09	1.90 O.D.	2.26	1.66 O.D.	1.82
Tubing	---	---	---	---	2-1/2 sq.	4.32	---	---
Angle	---	---	2-1/2 x 2-1/2 x 1/4	4.1	---	---	2-1/2 x 2-1/2 x 1/4	3.19
Roll Formed	---	---	3-1/2 x 3-1/2	As Specified	---	---	1-5/8 x 1-1/4	As Specified
H	---	---	---	---	1.875 x 1.625	2.72	1.31 x 1.5	2.25

### Chain-link Gate Post Requirements

Post Type	Single gate up to 4 ft. Double gate up to 8 ft.		Single gate over 4 ft. to 8 ft. Double gate over 8 ft. to 16 ft.		Single gate over 8 ft. to 12 ft. Double gate over 16 ft. to 24 ft.	
	Diameter (inches)	Weight (lb/ft.)	Diameter (inches)	Weight (lb/ft.)	Diameter (inches)	Weight (lb/ft.)
Type A	2.375 O.D.	3.65	2.875 O.D.	5.79	3.5 O.D.	7.58
Type B	2.375 O.D.	3.11	2.875 O.D.	4.64	3.5 O.D.	5.707
Tubing	2-1/2 sq.	4.32	3 sq.	5.78	3 sq.	8.8

- 164-2.4 Gates.** Gates frames shall consist of galvanized steel pipe and shall conform to the specifications for the same material under paragraph 164-2.3 b. titled STEEL POSTS, RAILS, AND BRACES.
- 164-2.5 Wire ties and tension wires.** Wire ties and tension wire for use in conjunction with a given type of fabric shall be the same material as the fabric type. The tension wire shall be No. 7 AWG coiled spring wire coated similarly to the respective wire fabric being used and shall conform to AASHTO M 181, Type I, Class 2, or Type II. The fabric shall be attached to the tension wire as specified in the contract documents, but not greater than every four (4) feet.
- 164-2.6 Fabric ties.** The fabric ties to be used with other than vinyl-coated fabric shall be stainless steel hog rings minimum diameter of 0.120 inches, No. 9 AWG aluminum wire or No. 9 AWG galvanized steel wire with 1.2 ounces per square foot zinc coating. The fabric ties to be used with vinyl fabric shall be of the same material as the fabric.
- 164-2.7 Miscellaneous fittings and hardware.** Miscellaneous steel fittings and hardware for use with zinc-coated, aluminum-coated, or mischmetal-coated steel fabric shall be of commercial grade steel or better quality, wrought or cast as appropriate to the fitting or hardware, and sufficient in strength to provide a balanced design when used in conjunction with fabric, posts, and wires of the specified quality. All miscellaneous fittings shall be made of malleable cast iron or pressed steel and shall be galvanized according to AASHTO M 232. Barbed wire support arms shall withstand a load of 250 pounds applied vertically to the outermost end of the arm.
- 162-2.8 Bolts and nuts.** All bolts and nuts shall be according to ASTM A307 and shall be zinc-coated according to AASHTO M 232 or ASTM B695, Class 50 with galvanizing not to exceed 6 mils.

- 164-2.9 Wood braces.** Cleats, gate stops, and braces shall be of the size specified in the contract documents. They shall be of the same species and quality specified for the posts or approved by the Engineer, and they shall be free from knots larger than one-third (1/3) the width of the piece. Gate stops shall be made of posts of suitable length. Braces may be made of posts of suitable length or of sawed lumber. All cleats, gate stops, and any braces in contact with the ground and for a distance of at least six (6) inches above the ground shall be treated by the hot and cold bath process, specified herein for posts. The wire used for cable for bracing shall be No. 9 AWG smooth galvanized soft wire.
- 164-2.10 Staples.** The staples shall be No. 9 galvanized steel wire, one (1) inch long for hardwood posts and 1-1/2-inch long for use in softwood posts.
- 164-2.11 Concrete.** The concrete for fence post footings and pads at gates shall conform to the requirements of Item 610 titled CONCRETE FOR MISCELLANEOUS STRUCTURES.
- 164-2.12 Ground rods.** Ground rods shall be copper-clad steel. The ground rods shall be of the length and diameter specified on the plans, but in no case be less than eight (8) feet long and five-eighths (5/8) inch in diameter.
- 163-2.13 Marking.** Each roll of fabric shall carry a tag showing the kind of base metal, kind of coating, the gauge of the wire, the length of fencing in the roll, and the name of the manufacturer. Posts, wire, and other fittings shall be identified as to manufacturer, kind of base metal, and kind of coating.
- 164-2.14 Weed control material.** A commercially available weed control material shall be applied at the manufacturer's recommended rate.

### CONSTRUCTION METHODS

- 164-3.1 General.** The fence shall be constructed in accordance with the contract documents using new materials. All work shall be performed in a workmanlike manner, satisfactory to the Resident Engineer. The Contractor shall layout the fence line as specified in the contract documents. The Contractor shall span the opening below the fence with barbed wire at all locations where it is not practical to conform the fence to the general contour of the ground surface because of natural or manmade features such as drainage ditches. The finished fence shall be plumb, taut, true to line and ground contour, and complete in every detail. The new fence shall be permanently tied to the terminals of existing fences as shown in the contract documents or as directed by the Resident Engineer. The Contractor shall stake down the fence at several points between posts as specified in the contract documents or as directed by the Resident Engineer.
- The Contractor shall arrange the work so construction of the new fence immediately follows the removal of existing fences. The length of unfenced section at any time shall not exceed 300 feet. The work shall progress in this manner, and at the close of the working day, the newly constructed fence shall be tied to the unremoved existing fence.
- 164-3.2 Clearing fence line.** The site of the fence shall be sufficiently cleared of obstructions, and surface irregularities. The fence line shall be graded so that the fence will conform to the general contour of the ground. The fence line shall be cleared on each side of the centerline of the fence. This clearing shall consist of the removal of all stumps, brush, rocks, trees, or other obstructions that will interfere with proper construction of the fence. Stumps within the cleared area of the fence line shall be grubbed or excavated. The bottom of the fence shall be placed a uniform distance above ground, as specified in the contract documents. When specified in the contract documents or as directed by the Resident Engineer, the existing fences which interfere with the new fence location shall be removed by the Contractor as part of the construction work, unless such removal is listed as a separate item in the bid schedule. All holes remaining after post and stump removal shall be refilled with suitable soil, gravel, or other suitable material and shall be compacted with tampers.

The work shall include the handling and disposal of all material cleared, of excess excavation and the removal of spoiled material regardless of the type, character, composition, or condition of such material encountered.

### 164-3.3 Installing posts.

- a. **Woven wire fence.** Wood posts shall be set with large ends down, plumb, and in a straight line on the side on which the wire is to be fastened. Posts shall be set full depth and shall not be cut off to eliminate rock or other excavation. Where rock is encountered, it shall be removed, to provide full-depth and full-size holes. The bottom of all posts shall be cut off square. The diameter of the holes shall be at least six (6) inches larger than the diameter of the posts. When cleats are used on posts, the holes shall be dug large enough to accommodate the cleat.

Steel posts shall be spaced as specified in the contract documents. Corner, brace, anchor, end, and gate posts shall be set in concrete bases as specified in the contract documents. The top of the base concrete shall be slightly above the ground surface, trowel finished, and sloped to drain. Post holes of full depth and size for the concrete bases for posts shall be provided. All line posts may be either driven or set in dug holes to a penetration depth of three (3) feet. All post setting shall be done carefully and to true alignment. Dirt removed for placing posts, anchor bars, flanges, etc., shall be replaced, tamped, and leveled. When posts are driven, care shall be exercised to prevent marring or buckling of the posts. Damaged posts shall be replaced at the Contractor's expense. After posts are placed and lined, the holes shall be backfilled with suitable material that shall be properly compacted by the use of tampers. The posts adjacent to end, corner, anchor, and gate posts shall be set and braced with braces and wire, as specified in the contract documents. No extra compensation shall be made for rock excavation.

- b. **Chain-link fence.** All posts shall be set in concrete at the required dimension and depth and at the spacing specified in the contract documents. Posts should be spaced not more than ten (10) feet apart and should be set a minimum of 36 inches in concrete footings. If the frost depth is greater than 36 inches, the posts should be set accordingly. The posts holes shall be in proper alignment so that there is a minimum of three (3) inches of concrete on all sides of the posts. The concrete shall be thoroughly compacted around the posts by tamping or vibrating and shall have a smooth finish slightly higher than the ground and sloped to drain away from the posts. All posts shall be set plumb and to the required grade and alignment. No materials shall be installed on the posts, nor shall the posts be disturbed in any manner within seven (7) days after the individual post footing is completed.

Should rock be encountered at a depth less than the planned footing depth, a hole two (2) inches larger than the greatest dimension of the posts shall be drilled to a depth of 12 inches. After the posts are set, the remainder of the drilled hole shall be filled with grout, composed of one (1) part Portland cement and two (2) parts mortar sand. Any remaining space above the rock shall be filled with concrete in the manner described above.

In lieu of drilling, the rock may be excavated to the required footing depth. No extra compensation shall be made for rock excavation.

- 164-3.4 **Installing top rails.** The top rail shall be continuous and shall pass through the post tops. The coupling used to join the top rail lengths shall allow for expansion.

### 164-3.5 Installing braces.

- a. **Woven wire fence.** Corner, end, gate, and adjacent intermediate posts shall be anchored and braced as specified in the contract documents. Anchor posts shall be set at approximately 500 foot intervals and braced to the adjacent posts. Posts shall be braced before the wire fencing is placed.
- b. **Chain-link fence.** Horizontal brace rails, with diagonal truss rods and turnbuckles, shall be installed at all terminal posts.

**164-3.6 Installing fabric.**

- a. **Woven wire fence.** All barbed wire and woven wire shall be placed on the side of the posts away from the airport or as directed by the Resident Engineer at the height specified in the contract documents.

(1) **Wood posts.** Longitudinal wires shall be installed parallel and drawn uniformly taut. The vertical stay wires of the woven wire fencing shall be straight and vertical. At end and gate posts the woven wire and barbed wire shall be wrapped once around the post; each longitudinal wire shall be stapled at least three (3) times and the ends of these wires shall be tied with a snug, tight twist. Each longitudinal wire shall be stapled to each intermediate post with one (1) steel wire staple; at the corner and anchor posts, two (2) or more staples shall be used. The top strands of barbed wire of all fences shall be stapled with two (2) staples in each post. All staples shall be set diagonally with the grain of the wood and driven up tight. After the fence has been erected, the tops of the wood posts shall be sawed off with a 1-to-3 pitch. The bottom wire of the wire fencing shall clear the ground by not more than two (2) inches or less than one (1) inch at any place.

(2) **Steel posts.** The woven wire shall be carefully stretched and hung without sag and with true alignment. Care shall be taken not to stretch the wire so tightly that it will break in cold weather or pull up corner and brace posts. All horizontal wires shall be fastened securely to each post by fasteners or clips designed for use with the posts furnished. The woven wire shall be wrapped around end, corner, and gate posts, and the ends of all horizontal wires shall be tied with snug, tight twists. The wire shall be secured to prevent slipping up and down the post. Barbed wire strands shall be stretched, and each strand secured to each post to prevent slipping out of line or becoming loose. At end, corner, and gate posts the barbed wire shall be securely wrapped and anchored once about the post from outside and secured against slipping by tying the ends with snug, tight twists. However, on spans of less than 100 feet both ends of the span need not be wrapped around the posts. The bottom wire of the woven wire fencing shall clear the ground by not more than four (4) inches or less than one (1) inch at any place.

- b. **Chain-link fence.** The wire fabric shall be firmly attached to the posts and braced as shown on the plans specified in the contract documents. All wire shall be stretched taut and shall be installed to the required elevations. The fence shall generally follow the contour of the ground, with the bottom of the fence fabric no less than one (1) inch or more than four (4) inches from the ground surface. Grading shall be performed where necessary to provide a neat appearance.

At locations of small natural swales or drainage ditches and where it is not practical to have the fence conform to the general contour of the ground surface, longer posts may be used, and multiple strands of barbed wire stretched to span the opening below the fence. The vertical clearance between strands of barbed wire shall be six (6) inches or less.

- c. **Chain-link skirt.** Excavate trench to the depth required for proper installation of the chain-link fabric. Obtain Resident Engineer's approval of depth of excavation before placing the fabric. Place the fabric and lap splice it to existing fence fabric and tie with wire ties at two (2) foot spacing. Cut fabric around fence post footing to allow proper placement. Backfill with native soil to original grade and compact. Gate concrete pads shall be installed at each gate or as shown on the plans specified in the contract documents or as directed by the Resident Engineer.

- 164-3.7 Splicing wire.** Splices in barbed and woven wire will be permitted if made with an approved galvanized bolt-clamp splice or a wire splice made as follows: the end of the wires shall be carried three (3) inches past the splice tool and wrapped around the other wire away from the tool for at least six (6) turns in opposite directions. After the tool is removed, the space occupied by it shall be closed by pulling the ends together. The unused ends of the wires shall be cut close to make a neat, workmanlike job. Woven wire shall be spliced only at posts.

**164-3.8 Installing gates.** Gates shall be hung on gate fittings, as specified in the contract documents.

- a. **Woven wire fence.** Fittings on the gate posts shall be clamped, screwed, or bolted to prevent slipping. Gates shall be erected to swing in the direction indicated and shall be provided with gate stops, as specified. Gates shall be erected at locations specified in the contract documents. Gate concrete pads shall be installed at each gate or as specified in the contract documents.
- b. **Chain-link fence.** The lower hinge (ball and socket type) shall be placed on top of the concrete in which the gate post is set. The sockets for the cane or foot bolts shall be set in concrete so that the plunger pin will fit perfectly in the socket when the gate is in a closed position. Gates shall be so erected as to swing in the direction indicated and shall be provided with gate stops as specified in the contract documents. Gate keepers shall be provided to hold gates when in open position and shall be located and installed as directed by the Resident Engineer. All hardware shall be thoroughly secured, properly adjusted and left in perfect working order. Hinges and diagonal bracing in gates shall be adjusted so that gates will hang level.

**164-3.9 Existing fence connections.** Wherever the new fence joins an existing fence, either at a corner or at the intersection of straight fence lines, a corner or anchor post shall be set at the junction and braced and anchored the same as described for corner posts.

If the connection is made at other than the corner of the new fence, the last span of the old fence shall contain a brace span.

**164-3.10 Electrical grounds.**

- a. **Woven wire fence.** Continuous fence shall be grounded at intervals not exceeding 200 feet. There shall be a ground not exceeding 35 feet from a gate in each section of the fence adjacent to a gate. There shall be a minimum of one (1) ground in any partial section of fence, constructed separately but in conjunction with main fence.

Fence under a power line shall be grounded by three (3) grounds, one (1) directly under the crossing and one (1) on each side 25 to 35 feet away. A single ground shall be placed directly under each telephone wire or cable crossing. Each barbed wire and the top and bottom wires of the woven fence shall be fastened to the metal post by a mechanical means to assure a tight connection for positive grounding. When metal line posts are used in lieu of wood line posts, this grounding is not required.

- b. **Chain-link fence.** Continuous fence shall be grounded at intervals not exceeding 500 feet. There shall be a ground within 100 feet of gates in each section of the fence adjacent to the gate.

Fence under a power line shall be grounded by three (3) grounds, one (1) directly under the crossing and one (1) on each side 25 to 50 feet away. A single ground shall be located directly under each telephone wire or cable crossing.

The ground shall be accomplished with a copper clad rod eight (8) feet long and a minimum of five-eighths (5/8) inches in diameter driven vertically until the top is six (6) inches below the ground surface. A No. 6 AWG solid copper conductor shall be clamped to the rod and to the fence in such a manner that each element of the fence is grounded. Installation of ground rods shall not constitute a pay item and shall be considered incidental to fence construction. The Contractor shall comply with FAA-STD-019, *Lightning and Surge Protection, Grounding, Bonding and Shielding Requirements for Facilities and Electronic Equipment, paragraph 4.2.3.8, Lightning Protection for Fences and Gates*, when fencing is adjacent to FAA facilities.

**164-3.11 Weed control application.** Weed control material shall be applied over an area five (5) feet wide, measured from the fence centerline, and over the chain link wildlife fence. Apply weed control material as recommended by the manufacturer's instructions and in compliance with state and local regulations.

**164-3.12 Restoration.** All areas disturbed by work shall be restored to its original condition. The restoration shall include any necessary sodding, top soiling, fertilizing, liming, seeding, sprigging, mulching, or other landscaping as specified in the contract documents. All such work shall be performed in accordance with Part 12 titled TURFING. The Contractor shall be held responsible for maintaining all disturbed surfaces and replacements until final acceptance. The cost of restoration shall be considered incidental to the contract and as a subsidiary obligation of the Contractor.

#### METHOD OF MEASUREMENT

- 164-4.1** The quantity of wildlife exclusion fence shall be measured for payment by the number of linear feet of fence in place as specified, completed, and accepted by the Resident Engineer. It shall be measured along the top of the fence from center to center of end posts or corner posts, excluding the length occupied by the gates. Separate measurement shall be made for the various sizes.
- 164-4.2** The quantity of gates shall be measured for payment by the number of each unit installed as specified, completed, and accepted by the Resident Engineer. Separate measurement shall be made for the various types and sizes.
- 164-4.3** The quantity of concrete gate pads shall be measured for payment by the number of completed units for each concrete gate pad installed and accepted by the Resident Engineer.

#### BASIS OF PAYMENT

- 164-5.1** Payment for accepted quantities of work performed by the Contractor and measured by the Resident Engineer shall be made at the contract unit price as specified in paragraphs 164-4.1 through 164-4.3 of this section. Payment shall be full compensation for furnishing all materials and for preparation, erection, and installation of these materials, and for all labor, equipment, tools and incidentals necessary to complete the work as specified.

#### REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

##### ASTM International (ASTM)

ASTM A 307	Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength
ASTM A 500	Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A 501	Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
ASTM B 6	Standard Specification for Zinc
ASTM B 695	Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel
ASTM F 1043	Standard Specification for Strength and Protective Coatings on Steel Industrial Fence Framework
ASTM F 1345	Standard Specification for Zinc 5% Aluminum-Mischmetal Alloy Coated Steel Chain-Link Fence Fabric



**American Association of State Highway and Transportation Officials (AASHTO)**

AASHTO M 111	Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
AASHTO M 133	Standard Specification for Preservatives and Pressure Treatment Processes for Timber
AASHTO M 181	Standard Specification for Chain-Link Fence
AASHTO M 232	Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
AASHTO M 279	Standard Specification for Metallic-Coated, Steel Woven Wire Fence Fabric
AASHTO M 280	Standard Specification for Metallic-Coated (Carbon) Steel Barbed Wire
AASHTO M 281	Standard Specification for Steel Fence Posts and Assemblies, Hot-Wrought

**Federal Aviation Administration Standard (FAA STD)**

FAA-STD-019	Lightning and Surge Protection, Grounding, Bonding and Shielding Requirements for Facilities and Electronic Equipment
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**END OF ITEM 164**

## Part 11 – Drainage

### Item 701 Pipe for Storm Drains and Culverts

#### DESCRIPTION

- 701-1.1** This item shall consist of the construction of pipe culverts and storm drains in accordance with these specifications, at the specified locations and in reasonably close conformity with the lines and grades specified in the contract documents or required by the Resident Engineer.

#### MATERIALS

- 701-2.1** Materials shall be of the type specified in the contract documents. Underground piping and components used in drainage systems for terminal and aircraft fueling ramp drainage shall be noncombustible and inert to fuel in accordance with National Fire Protection Association (NFPA) 415.
- 701-2.2** **Pipe.** The pipe shall be of the type called for in the contract documents.
- 701-2.3** **Concrete.** The concrete for pipe cradles and all connections to existing and proposed drainage structures shall conform to the requirements of Item 610 titled CONCRETE FOR MISCELLANEOUS STRUCTURES.
- 701-2.4** **Rubber gaskets.** Rubber gaskets for rigid pipe shall conform to the requirements of ASTM C443. Rubber gaskets for PVC pipe, polyethylene, and polypropylene pipe shall conform to the requirements of ASTM F477. Rubber gaskets for zinc-coated steel pipe and precast galvanized pipe shall conform to the requirements of ASTM D1056, for the "RE" closed cell grades. Rubber gaskets are required on all reinforced concrete pipes.
- 701-2.5** **Mortar.** Pipe joint mortar shall consist of one (1) part Portland cement and two (2) parts sand. The Portland cement shall conform to the requirements of AASHTO M 85, Type I. The sand shall conform to the requirements of per the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 11-08, *Aggregate Gradation Control System (AGCS)*. Water used in mixing or curing shall be from potable water sources. Other sources shall be tested in accordance with AASHTO T 26 and must be approved by the Engineer prior to use.
- 701-2.6** **Joint fillers.** Poured filler for joints shall conform to the requirements of ASTM D6690.
- 701-2.7** **Plastic gaskets.** Plastic gaskets shall conform to the requirements of ASTM C990.
- 701-2.8.** **Controlled low-strength material (CLSM).** Controlled low-strength material shall conform to the requirements of Item 153 titled CONTROLLED LOW-STRENGTH MATERIAL (CLSM). When CLSM is used, all joints shall have gaskets.
- 701-2.9** **Precast structures.** Precast concrete products shall be per the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 19-08, *Quality Control/Quality Assurance Program for Precast Concrete Products* and/or be on the current Illinois Department of Transportation's published Qualified Producer List of *Certified Precast Concrete Producers*.
- 701-2.10** **Handling holes.** Handling holes in precast concrete pipe shall be filled with a precast concrete plug or sealed and covered with mastic or mortar.
- 701-2.11** **Bedding.** The gradation of the bedding material shall meet the requirements of the gradation given in the following table when tested per the current Illinois Department of Transportation,

Bureau of Materials Policy Memorandum (PM) 11-08, *Aggregate Gradation Control System (AGCS)*.

### Gradation of Bedding

Sieve Size	Gradation Percent Passing				
	Dry Trench Conditions				Wet Trench Conditions
	CA 6	CA 9	CA 10	CA 12	CA 7
1-1/2 inch	100	100			100
1 inch	95±5	97±3	100		95±5
3/4 inch			95±5	100	
1/2 inch	75±5	60±15	80±15	95±5	45±15
3/8 inch				85±10	
No. 4	43±13	30±15	50±10	60±10	5±5
No. 16	25±15	10±10	30±15	35±10	
No. 200	8±4	6±6	9±4	9±4	

**701-2.12 Backfill.** On all areas outside of the pavement areas, material for backfill shall be fine, readily compactible soil or granular material. Backfill material shall be free of brick, rock, or any other objectionable material. Backfill material shall meet the approval of the Engineer. If the pipe is to be installed in locations or areas under pavements, the gradation of the backfill material shall meet the requirements of the gradation given in the following table when tested per the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 11-08, *Aggregate Gradation Control System (AGCS)*.

### Gradation of Backfill

Sieve Size	Gradation Percent Passing		
	FA 1	FA 2	FA 6
3/8	100	100	
No. 4	97±3	97±3	92±8
No. 16	65±20	65±20	
No. 50	16±13	20±10	
No. 100	5±5	5±5	20±20
No. 200			6±6

Alternatively, at no additional cost to the contract, backfill using controlled low strength material (CLSM) in accordance with Item 153 titled CONTROLLED LOW STRENGTH MATERIAL may also be used.

### CONSTRUCTION METHODS

**701-3.1 Excavation.** The width of the pipe trench shall be sufficient to permit satisfactory jointing of the pipe and thorough tamping of the bedding material under and around the pipe, but it shall not be less than the external diameter of the pipe plus 12 inches on each side. The trench walls

shall be approximately vertical. The width of the trench shall be sufficient to permit satisfactorily jointing of the pipe and thorough compaction of the bedding material under the pipe and backfill material around the pipe, but it shall not be greater than the widths specified in the contract documents.

Where rock, hardpan, or other unyielding material is encountered, the Contractor shall remove it from below the foundation grade for a depth of at least eight (8) inch or one-half (1/2) inch for each foot of fill over the top of the pipe (whichever is greater) but for no more than three-quarters of the nominal diameter of the pipe. The excavation below grade should be filled with granular material to form a uniform foundation. The cost of furnishing and placing this material shall be included in the contract unit price for storm sewer. Before any rock is removed, the Resident Engineer shall have the opportunity to obtain the necessary data to determine the quantity for payment. The bottom of the trench shall be excavated to a horizontal section as far as practicable.

Where a firm foundation is not encountered at the grade established, due to soft, spongy, or other unstable soil, the unstable soil shall be removed and replaced with approved granular material for the full trench width. The Resident Engineer shall determine the depth of removal and amount of backfill necessary. The bedding material shall be compacted to provide adequate support for the pipe. When not specified in the contract documents, the cost of removing unstable soil and replacing it with approved material shall be covered by a change order for the excavation and then placement of approved material.

The Contractor shall do all bracing, sheathing, or shoring necessary to perform and protect the excavation as required for safety and conformance to governing laws. Specifically, the Contractor shall observe that all requirements of the Occupational Safety and Health Administration (OSHA) relating to excavations, trenching and shoring are strictly adhered to. Unless otherwise provided, the bracing, sheathing, or shoring shall be removed by the Contractor after the backfill has reached at least 12 inches over the top of the pipe. The sheathing or shoring shall be pulled as the granular backfill is placed and compacted to avoid any unfilled spaces between the trench wall and the backfill material. The cost of bracing, sheathing, or shoring, and the removal of same, shall be included in the contract unit price for the storm sewer.

The excavation for pipes placed in embankment fill shall not be made until the embankment has been completed to a height above the top of the pipe as specified in the contract documents.

**701-3.2 Bedding.** The bedding surface for the pipe shall provide a foundation of uniform density to support the pipe throughout its entire length. Well compacted aggregate, at least four (4) inches in depth below the pipe, shall be placed for the entire width of the trench and length of the pipe; except when the storm sewer outlets from an embankment or natural ground, the last three (3) feet of the pipe shall be bedded in impervious material. The aggregate and impervious material shall be compacted by mechanical means to the satisfaction of the Resident Engineer.

If the excavation has been made deeper than necessary, the foundation shall be brought to the proper grade by the addition of well compacted bedding material.

**701-3.3 Laying pipe.** The pipe laying shall begin at the lowest point of the trench and proceed upgrade. The lower segment of the pipe shall be in contact with the bedding throughout its full length. Bell or groove ends of rigid pipes and outside circumferential laps of flexible pipes shall be placed facing upgrade.

Paved or partially lined pipe shall be placed so that the longitudinal center line of the paved segment coincides with the flow line.

Elliptical and elliptically reinforced concrete pipes shall be placed with the manufacturer's reference lines designating the top of the pipe within five (5) degrees of a vertical plane through the longitudinal axis of the pipe.

**701-3.4 Joining pipe.** Joints shall be as specified in the contract documents.

Mortar joints shall be made with an excess of mortar to form a continuous bead around the outside of the pipe and shall be finished smooth on the inside. Molds or runners shall be used for grouted joints to retain the poured grout. Rubber ring gaskets shall be installed to form a flexible watertight seal.

- a. **Concrete pipe.** Concrete pipe may be either bell and spigot or tongue and groove. Pipe sections at joints shall be fully seated and the inner surfaces flush and even. Concrete pipe joints shall be sealed with rubber gaskets meeting ASTM C443 when leak resistant joints are required. Concrete pipe joints shall be sealed with butyl mastic meeting ASTM C990 or mortar when soil tight joints are required. Joints shall be thoroughly wetted before applying mortar or grout. Joint-sealing compound, hot-pour, mineral-filled, may be used in filling joints of bell and spigot sewer pipe. The bell and spigot pipe shall be installed and centered so that the annular space is uniform. This annular space shall be calked and then shall be sealed with a joint compound conforming to the requirements of ASTM D6690. When jointing pipe in its final position, a suitable joint runner previously coated to facilitate removal shall be placed around the pipe, leaving an opening at the top of the runner. The joint shall be poured until completely filled with the compound; the pouring shall be made as rapidly as possible without entrapping air. After the compound has cooled and set, the runner may be removed. The joint shall be inspected for unfilled spaces or unsatisfactory jointing. Alternate joints may be poured before the pipe is lowered into the trench. In this case, the joint shall be poured with the pipe in a vertical position without the use of the runner. The compound shall be thoroughly set before the pipe is moved. When previously jointed, the pipe shall be handled carefully so as not to move or deform the jointing.
- b. **Metal pipe.** Metal pipe shall be firmly joined by form-fitting bands conforming to the requirements of AASHTO M 36 for steel pipe and AASHTO M 196 for aluminum pipe.
- c. **PVC, polyethylene, or polypropylene pipe.** Joints for PVC, Polyethylene, or Polypropylene pipe shall conform to the requirements of ASTM D3212 when leak resistant joints are required. Joints for PVC and Polyethylene pipe shall conform to the requirements of AASHTO M 330 when soil tight joints are required. Fittings for polyethylene pipe shall conform to the requirements of AASHTO M 252 or ASTM M 294. Fittings for polypropylene pipe shall conform to AASHTO M 330.
- d. **Fiberglass pipe.** Joints and fittings shall be as specified in the contract documents and in accordance with the manufacturer's recommendations. Joints shall meet the requirements of ASTM D4161 for flexible elastomeric seals.

**701-3.5 Backfill.** Pipes shall be inspected before any fill material is placed; any pipes found to be out of alignment, unduly settled, or damaged shall be removed and re-laid or replaced at the Contractor's expense. On all areas outside of the pavement areas, the backfill material shall be placed in lifts no greater than eight (8) inches, loose measurement, and compacted by mechanical means to the satisfaction of the Engineer. The trench shall be backfilled to the natural line or finished surface as rapidly as the condition of the sewer will permit. All backfill material shall be deposited in such a manner as not to damage the sewer. The filling of the trench shall be carried on simultaneously on both sides of the pipe.

If the pipe is to be installed in locations or areas under pavements, material for backfill shall be select granular backfill material meeting the requirements set forth in paragraph 701-2.12 titled BACKFILL. Selected granular backfill materials shall be compacted in lifts no greater than six (6) inches and compacted to at least 95% of the maximum density of laboratory specimens compacted and tested per AASHTO T 99 for areas designated for aircraft with gross weights of 60,000 pounds or less and AASHTO T 180 for areas designated for aircraft with gross weights greater than 60,000 pounds. The in-place field density shall be determined per AASHTO T 310 (Direct Transmission Density/Backscatter Moisture). The machine shall be calibrated in accordance with AASHTO T 310 within 12 months prior to its use on this contract. The Contractor shall not proceed to construct another lift of backfill until the previous lift has been

accepted by the Resident Engineer. If the specified density is not attained, the area represented by the failed test must be reworked and/or recompacted and two (2) additional random tests made. This procedure shall be followed until the specified density is reached. Maximum density refers to maximum dry density at optimum moisture content unless otherwise specified.

The Contractor shall provide a qualified nuclear gauge and operator for Quality Control (QC) testing for density.

Alternatively, controlled low-strength material (CLSM) may be used for backfill provided adequate flotation resistance can be achieved by restraints, weighing, or placement technique.

It shall be the Contractor's responsibility to protect installed pipes and culverts from damage due to construction equipment operations. The Contractor shall be responsible for installation of any extra strutting or backfill required to protect pipes from the construction equipment.

**701-3.6 Connections.** Where the contract documents specify connections to existing or proposed structures, these connections shall be watertight and made so that a smooth uniform flow line will be obtained throughout the drainage system.

**701-3.7 Pipe removal.** This work shall consist of removal of existing pipes of various types and sizes. Trenches resulting from pipe removal shall be backfilled and compacted in accordance with Item 152 titled EXCAVATION, SUBGRADE, AND EMBANKMENT. Pipe shall be disposed of by the Contractor off airport property.

**701-3.8 Sequencing operations and maintaining drainage.** The Contractor shall sequence and conduct operations in such a manner as to maintain positive drainage at all times. It shall be the Contractor's responsibility to provide temporary ditches, pumps, inlets, culvert pipes and other items and appurtenances which might be required to achieve maintenance of drainage during construction. All such work will be incidental to the project. This work shall include maintenance of field tile flows.

**701-3.9 Restoration.** After the backfill is completed, the Contractor shall dispose of all surplus material, dirt and rubbish from the site. Following restoration of all disturbed areas near airport movement surfaces, the Contractor shall visually inspect the area for foreign object debris (FOD) and remove any that is found. Where soil and/or sod has been removed, it shall be replaced as soon as possible after the backfilling is completed. All areas disturbed by work shall be restored to its original condition. The restoration shall include any necessary sodding, topsoiling, fertilizing, liming, seeding, sprigging, mulching, or other landscaping as specified in the contract documents. All such work shall be performed in accordance with Part 12 titled TURFING. The Contractor shall be held responsible for maintaining all disturbed surfaces and replacements until final acceptance. When the disturbance is through paved areas, restoration shall be equal to existing conditions. The cost of restoration shall be considered incidental to the contract and as a subsidiary obligation of the Contractor.

**701-3.10 Inspection requirements.** An initial post installation inspection shall be performed by the Resident Engineer no sooner than 30 days after completion of installation and final backfill. Clean or flush all lines prior to inspection.

Use a camera with lighting suitable to allow a clear picture of the entire periphery of the pipe interior. Center the camera in the pipe both vertically and horizontally and be able to pan and tilt to a 90-degree angle with the axis of the pipe rotating 360 degrees. Use equipment to move the camera through the pipe that will not obstruct the camera's view or interfere with proper documentation of the pipe's condition. The video image shall be clear, focused, and relatively free from roll, static, or other image distortion qualities that would prevent the reviewer from evaluating the condition of the pipe.

For pipe sizes larger than 48 inches, a walk-through visual inspection shall be performed.

Reinforced concrete pipe shall be inspected, evaluated, and reported on in accordance with ASTM C1840, *Standard Practice for Inspection and Acceptance of Installed Reinforced Concrete Culvert, Storm Drain, and Storm Sewer Pipe*. Any issues reported shall include still

photo and video documentation. The zoom ratio shall be provided for all still or video images that document any issues of concern by the inspection firm.

Flexible pipes shall be inspected for rips, tears, joint separations, soil migration, cracks, localized buckling, settlement, alignment, and deflection. Determine whether the allowable deflection has been exceeded by use of a laser profiler for internal pipe diameters of 48 inches or less, or direct measurement for internal pipe diameters greater than 48 inches. Laser profile equipment shall utilize low barrel distortion video equipment. Deflection of installed pipe shall not exceed the limits provided in the table below, as a percentage of the average inside diameter of the pipe.

### Maximum Allowable Pipe Deflection

Type of Pipe	Maximum Allowable Deflection (%)
Corrugated Metal Pipe	5
Concrete Lined CMP	3
Thermoplastic Pipe	5
Fiberglass	5

If deflection readings in excess of the allowable deflection are obtained, remove the pipe with excessive deflection and replace with new pipe. Isolated areas may exceed allowable by 2.5% with concurrence of the Engineer. Repair or replace any pipe with cracks exhibiting displacement across the crack, bulges, creases, tears, spalls, or delamination. The report for flexible pipe shall include as a minimum, the deflection results and final post installation inspection report. The inspection report shall include: a copy of all video taken, pipe location identification, equipment used for inspection, inspector name, deviation from design line and grade, and inspector's notes.

### METHOD OF MEASUREMENT

- 701-4.1** The quantity of pipe shall be measured for payment by the number of linear feet as specified, completed, and accepted by the Resident Engineer. It shall be measured along the centerline of the pipe from end or inside face of structure to the end or inside face of structure, whichever is applicable. The several classes, types and size of pipe shall be measured separately. All fittings shall be included in the footage as typical pipe sections in the pipe being measured. Bedding and backfill are considered incidental to this item and included in the Contractor's unit price. No separate measurement or payment will be made for bedding or backfill.
- 701-4.2** When encountered, the quantity of rock, hardpan, or other unyielding material shall be measured for payment by the number of cubic yards excavated by the Contractor and approved by the Resident Engineer. No payment shall be made for the backfill material placed for the bed of the pipe.

### BASIS OF PAYMENT

- 701-5.1** Payment for accepted quantities of work performed by the Contractor and measured by the Resident Engineer shall be made at the contract unit price as specified in paragraphs 701-4.1 and 701-4.2 of this section. Payment shall be full compensation for furnishing all materials and for all preparation, excavation, and installation of these materials; and for all labor, equipment, tools, and incidentals necessary to complete the work as specified.

## REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

### ASTM International (ASTM)

ASTM C 443	Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
ASTM C 990	Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants
ASTM D 1056	Standard Specification for Flexible Cellular Materials Sponge or Expanded Rubber
ASTM D 3212	Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM D 4161	Standard Specification for "Fiberglass" (Glass-Fiber Reinforced Thermosetting Resin) Pipe Joints Using Flexible Elastomeric Seals
ASTM D 6690	Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements
ASTM F 477	Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM F 679	Standard Specification for Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings

### American Association of State Highway and Transportation Officials (AASHTO)

AASHTO M 36	Standard Specification for Corrugated Steel Pipe, Metallic Coated for Sewers and Drains
AASHTO M 85	Standard Specification for Portland Cement
AASHTO M 86	Standard Specification for Nonreinforced Concrete Sewer, Storm Drain, and Culvert Pipe
AASHTO M 170	Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
AASHTO M 196	Standard Specification for Corrugated Aluminum Pipe for Sewers and Drains
AASHTO M 206	Standard Specification for Reinforced Concrete Arch Culvert, Storm Drain, and Sewer Pipe
AASHTO M 207	Standard Specification for Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe
AASHTO M 219	Standard Specification for Corrugated Aluminum Alloy Structural Plate for Field-Bolted Pipe, Pipe-Arches, and Arches
AASHTO M 243	Standard Specification for Field Applied Coating of Corrugated Metal Structural Plate for Pipe, Pipe-Arches, and Arches
AASHTO M 252	Standard Specification for Corrugated Polyethylene Drainage Pipe
AASHTO M 294	Standard Specification for Corrugated Polyethylene Pipe, 300- to 1500-mm (12- to 60-in.) Diameter
AASHTO M 298	Standard Specification for Class PS46 Poly(Vinyl Chloride) (PVC) Pipe



AASHTO M 330	Standard Specification for Polypropylene Pipe, 300- to 1500-mm (12- to 60-in.) Diameter
AASHTO T 26	Standard Method of Test for Quality of Water to Be Used in Concrete
AASHTO T 99	Standard Method of Test for Moisture–Density Relations of Soils Using a 2.5-kg (5.5-lb) Rammer and a 305-mm (12-in.) Drop
AASHTO T 180	Standard Method of Test for Moisture–Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop
AASHTO T 310	Standard Method of Test for In-Place Density and Moisture Content of Soil and Soil–Aggregate by Nuclear Methods (Shallow Depth)

**Illinois Department of Transportation, Bureau of Materials Qualified Product List**

Certified Precast Concrete Producers

**Illinois Department of Transportation, Bureau of Materials Policy Memoranda (PM)**

PM 11-08	Aggregate Gradation Control System (AGCS)
PM 19-08	Quality Control/Quality Assurance Program for Precast Concrete Products

**National Fire Protection Association (NFPA)**

NFPA 415	Standard on Airport Terminal Buildings, Fueling Ramp Drainage, and Loading Walkways
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**END ITEM 701**

## Item 702 Slotted Drains

### DESCRIPTION

- 702-1.1** This item shall consist of the construction of steel slotted drains or cast-iron slotted vane drains in accordance with these specifications, at the specified locations and in reasonably close conformity with the lines and grades specified in the contract documents or required by the Resident Engineer.

### MATERIALS

- 702-2.1 General.** All slotted drains shall meet the requirements specified in the contract documents. All slotted drains shall meet specified hydraulic design requirements and shall support the loadings specified.

**702-2.2 Pipe.**

- a. **Steel slotted drain.** Pipe shall be metallic coated (galvanized or aluminized type 2) corrugated steel type I meeting the requirements of AASHTO M 36. Pipe diameter and gauge shall be as specified in the contract documents. The corrugated steel pipe shall have a minimum of two (2) rerolled annular ends.
- b. **Cast iron slotted vane drain.** Polyvinyl Chloride (PVC) pipe shall meet the requirements of ASTM D3034. Pipe diameter shall be as specified in the contract documents. The pipe shall have an open slot to accept the cast iron slotted vane drain castings.

**702-2.3 Grates and castings.**

- a. **Steel slotted drain.** Grates shall be manufactured from ASTM A36 Grade 36 steel. Spacers and bearing bars (sides) shall be 3/16-inch material. The spacers shall be welded to each bearing bar with four (4) 1-1/4-inch long by 3/16-inch wide fillet welds on each side of the bearing bar at spacings not exceeding six (6) inches. The grates shall be six (6) inches high or specified in the contract documents and shall have a maximum 1-3/4-inch opening in the top.

Grates shall be galvanized in accordance with AASHTO M 111 except with a two (2) ounces per square feet galvanized coating.

The grates shall be fillet welded to the corrugated steel pipe with a minimum weld one (1) inch long on each side of the grate at every other corrugation. Weld areas and the heat affected zones where the slot is welded to the corrugated pipe shall be thoroughly cleaned and painted with a zinc-rich paint in accordance with repair of damaged coatings in AASHTO M 36.

Each 20-foot length of drain delivered to the job site shall be within the following tolerances: vertical bow  $\pm 3/8$ -inch, horizontal bow  $\pm 5/8$ -inch, twist  $\pm 1/2$  inch.

- b. **Cast iron slotted vane drain.** Castings shall meet the requirements of AASHTO M 105 and AASHTO M 306, Class 35 gray iron. Castings shall be furnished with no coatings.

Castings shall be designed to fit on open slots in 15-inch PVC pipe. Casting sections shall not exceed three (3) feet in length. Casting sections shall have a built-in vane configuration with bar spacings not exceeding six (6)-inches. The opening at the surface shall not exceed 3-3/4-inch, and the vane shall be constructed on a radius so that the opening shall be less than 1-1/2-inch at a depth of 1-1/2-inch as measured vertically from the surface. Casting

sections shall integrally lock into the concrete by use of top and bottoms flanges and shear tabs. Castings shall accept bolts for bolting sections together and shall accept wire for fitting to pipe.

Standard details can be found in the current American Association of State Highway and Transportation Officials (AASHTO) AGC-ARTBA publication *A Guide to Standardized Highway Drainage Products*. All products used shall meet the most demanding aircraft loading and tire pressure requirements, as well as maintenance equipment loadings.

- 702-2.4 Concrete.** The concrete used shall conform to the requirements of Item 610 titled CONCRETE FOR MISCELLANEOUS STRUCTURES.

### CONSTRUCTION METHODS

- 702-3.1 Excavation.** The width of the trench shall be sufficient to permit satisfactory installation and jointing of the slotted drain and placing of a concrete backfill material under and around the drain but shall not be less than the external pipe diameter plus six (6) inches on each side. The depth of the trench shall be a minimum of 2 inches below the invert for steel slotted drain and six (6) inches below the invert for a cast iron slotted vane drain.
- 702-3.2 Installation.** Slotted drains shall be laid in sections joined firmly together as specified in the contract documents. The top of all drains shall be held firmly in place to the proper grade, to preclude movement during the backfilling operation.
- 702-3.3 Joining.** Slotted steel drain joints shall be firmly joined by modified hugger type bands, or as indicated, to secure the pipe and prevent infiltration of the backfill. When the slotted steel drain is banded together, the adjacent grates shall have a maximum three (3) inch gap. Cast iron drain castings shall be bolted together.
- 702-3.4 Backfilling.** Slotted drains shall be inspected before any backfill is placed. Damaged drains shall be aligned or replaced at the expense of the Contractor.

The trench holding the slotted drain assembly shall be backfilled with concrete that will easily flow under and around the drain and the trench wall. The opening in the top of grates and castings shall be covered to prevent unwanted material from entering the drain during the backfilling and subsequent surfacing operations.

### METHOD OF MEASUREMENT

- 702-4.1** The quantity of each type of slotted drain shall be measured for payment by the number of linear feet as specified, completed, and accepted by the Resident Engineer. It shall be measured along the centerline of the drain from end or inside face of structure to the end or inside face of structure, whichever is applicable. The several classes, types, and sizes of drain shall be measured separately. All fittings shall be included in the footage as typical pipe sections being measured.

### BASIS OF PAYMENT

- 702-5.1** Payment for accepted quantities of work performed by the Contractor and measured by the Resident Engineer shall be made at the contract unit price as specified in paragraph 702-4.1 of this section. Payment shall be full compensation for all materials, all preparation, excavation, backfill, and installation of the slotted drain; and all labor, equipment, tools, and incidentals necessary to complete the work as specified.

**REFERENCES**

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

**ASTM International (ASTM)**

ASTM A 36	Standard Specification for Carbon Structural Steel
ASTM D 3034	Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings

**American Association of State Highway and Transportation Officials (AASHTO)**

AASHTO M 36	Standard Specification for Corrugated Steel Pipe, Metallic Coated for Sewers and Drains
AASHTO M 105	Standard Specification for Gray Iron Castings
AASHTO M 111	Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
AASHTO M 306	Standard Specification for Drainage, Sewer, Utility, and Related Castings
AASHTO-AGC-ARTBA	Task Force 13 Report A Guide to Standardized Highway Drainage Products

**END OF ITEM 702**

## Item 705 Pipe Underdrains for Airports

### DESCRIPTION

- 705-1.1** This item shall consist of the construction of pipe drains in accordance with these specifications, at the specified locations and in reasonably close conformity with the lines and grades specified in the contract documents or required by the Resident Engineer.

### MATERIALS

- 705-2.1 General.** Materials shall be of the type specified in the contract documents.
- a. **Type 1.** A perforated pipe, encased in fabric, installed in a trench backfilled with fine aggregate.
  - b. **Type 2.** A perforated pipe, without fabric, installed in a fabric lined trench backfilled with a coarse aggregate.
  - c. **Type 3.** A four (4) inch pipe, without fabric but with narrower perforations, installed in a trench backfilled with a coarser fine aggregate.
  - d. **Type 4.** A non-perforated pipe installed in a trench to outlet pipe underdrains.
- 705-2.2 Pipe.** The pipe shall be of the type specified in the contract documents.
- a. **Type 1.** Pipe underdrains, Type 1 shall meet the following requirements.
    - (1) **Perforated corrugated polyethylene (PE) pipe or perforated corrugated polyethylene (PE) pipe with a smooth interior.** The manufacturer shall be listed as compliant through the NTPEP program and the pipe shall be according to AASHTO M 252. The pipe shall have a minimum pipe stiffness of 46 pounds per square inch at 5% deflection and shall be capable of 60% vertical deflection in parallel plate loading without splitting or cracking. This material is limited to a four (4) inch diameter.
  - b. **Type 2.** Pipe underdrains, Type 2 shall meet the following requirements.
    - (1) **Perforated corrugated polyethylene (PE) pipe or perforated corrugated polyethylene (PE) pipe with a smooth interior.** The manufacturer shall be listed as compliant through the NTPEP program and the pipe shall be according to AASHTO M 252. The pipe shall have a minimum pipe stiffness of 46 pounds per square inch at 5% deflection and shall be capable of 60% vertical deflection in parallel plate loading without splitting or cracking.
  - c. **Type 3.** Pipe underdrains, Type 3 shall meet the following requirements.
    - (1) **Perforated corrugated polyethylene (PE) pipe.** The manufacturer shall be listed as compliant through the NTPEP program and the pipe shall be according to AASHTO M 252. The pipe shall have a minimum pipe stiffness of 46 pounds per square inch at 5% deflection and shall be capable of 60% vertical deflection in parallel plate loading without splitting or cracking. The pipe shall be four (4) inches diameter and the slot size shall be 0.07 inch  $\pm$  0.01 inch. The number of slots and the slot length may be modified provided the inlet flow specified in AASHTO M 252 is maintained.

d. **Type 4.** Pipe underdrains, Type 4 shall meet the following requirements.

- (1) **Corrugated polyethylene (PE) pipe with a smooth interior.** The manufacturer shall be listed as compliant through the NTPEP program and the pipe shall be according to AASHTO M 294. The pipe shall be Type S or D.

**705-2.3 Mortar.** Pipe joint mortar shall consist of one (1) part by volume of Portland cement and two (2) parts sand. The Portland cement shall conform to the requirements of AASHTO M 85, Type I. The sand shall conform to the requirements of per the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 11-08, *Aggregate Gradation Control System (AGCS)*. Water used in mixing or curing shall be from potable water sources. Other sources shall be tested in accordance with AASHTO T 26 and must be approved by the Engineer prior to use.

**705-2.4 Elastomeric seals.** Elastomeric seals shall conform to the requirements of ASTM F477.

**705-2.5 Backfill.**

- a. **Type 1.** Pipe underdrains, Type 1 granular material used for backfilling shall conform to the to the gradation given in the following table when tested in accordance with the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 11-08, *Aggregate Gradation Control System (AGCS)*.

**Gradation of Backfill**

Sieve Size	Gradation Percent Passing		
	FA 1	FA 2	FM 20
3/8	100	100	100
No. 4	97±3	97±3	97±3
No. 8			80±20
No. 16	65±20	65±20	50±15
No. 50	16±13	20±10	19±11
No. 100	5±5	5±5	10±7
No. 200			*2±2

- b. **Type 2.** Pipe underdrains, Type 2 porous backfill shall be free of clay, humus, or other objectionable matter, and shall conform to the gradation given in the following table when tested in accordance with the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 11-08, *Aggregate Gradation Control System (AGCS)*.

**Gradation of Backfill**

Sieve Size	Gradation Percent Passing
	CM 16
1/2 inch	100
3/8 inch	97±3
No. 4	30±15
No. 16	*4±4

- c. **Type 3.** Pipe underdrains, Type 3 granular material used for backfilling shall conform to the to the gradation given in the following table when tested in accordance with the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 11-08, *Aggregate Gradation Control System (AGCS)*.

#### Gradation of Backfill

Sieve Size	Gradation Percent Passing
	FA 4
3/8	100
No. 16	5±5

#### 705-2.6 Filter fabric.

- a. **Type 1.** The fabric envelope for encasing pipe underdrains, Type 1, may be either a knitted, woven, or nonwoven fabric. Fabric materials shall be as follows.
- (1) **Knitted fabric.** Knitted fabric envelope shall be Type A according to ASTM D 6707 and be a continuous one (1) piece knitted polymeric material that fits over the pipe underdrain like a sleeve. It shall be free from any chemical treatment or coating that might significantly reduce porosity and permittivity.
  - (2) **Woven or nonwoven fabric.** The fabric shall be Class 3 according to AASHTO M 288 and consist of woven yarns or nonwoven filaments of polyolefins or polyesters. Woven slit film geotextiles (i.e. geotextiles made from yarns of a flat, tape-like character) shall not be permitted. The yarns or filaments shall be dimensionally stable (i.e., maintain their relative position with respect to each other) and resistant to delamination. The yarns or filaments shall be free from any chemical treatment or coating that might significantly reduce porosity and permittivity. Nonwoven fabric shall be needle punched.
  - (3) **Physical properties.** The physical properties for knitted, woven, or nonwoven fabric shall be according to the following.

PHYSICAL PROPERTIES			
	Knitted <sup>1</sup>	Woven <sup>2</sup>	Nonwoven <sup>2</sup>
Grab Strength, lb ASTM D 4632 <sup>3</sup>	--	180 min.	112 min.
Elongation/Grab Strain, % ASTM D 4632 <sup>3</sup>	--	49 max.	50 min.
Trapezoidal Tear Strength, lb ASTM D 4533 <sup>3</sup>	--	67 min.	40 min.
Puncture Strength, lb ASTM D 6241 <sup>3</sup>	180 min.	370 min.	222 min.
Apparent Opening Size, Sieve No. ASTM D 4751 <sup>4</sup>	30 max.	40 max.	40 max.
Permittivity, sec <sup>-1</sup> ASTM D 4491	1.0 min.		
Ultraviolet Stability, % retained strength after 500 hours of exposure ASTM D 4355	--	50 min.	50 min.

1. Manufacturer's certification to meet test requirements.
2. NTPEP results (manufacturer's QC test values) or manufacturer's certification to meet test requirements.
3. Values represent the minimum average roll value (MARV) in the weaker principle direction [machine direction (MD) or cross-machine direction (XD)].
4. Values represent the maximum average roll value.

**Handling and Storage.** The fabric envelope shall be delivered to the job site in such a manner as to facilitate handling and incorporation into the work without damage. Fabric envelope materials shall be stored out of direct sunlight.

- b. Type 2.** Geotechnical fabric for pipe underdrains, Type 2, shall be Class 3 according to AASHTO M 288 and consist of woven yarns or nonwoven filaments of polyolefins or polyesters. Woven slit film geotextiles (i.e. geotextiles made from yarns of a flat, tape-like character) shall not be permitted. The yarns or filaments shall be dimensionally stable (i.e., maintain their relative position with respect to each other) and resistant to delamination. The yarns or filaments shall be free from any chemical treatment or coating that might significantly reduce porosity and permittivity. The fabric shall conform to the following requirements.

<b>PHYSICAL PROPERTIES<sup>1</sup></b>		
	Woven	Nonwoven
Grab Strength, lb ASTM D 4632 <sup>2</sup>	180 min.	112 min.
Elongation/Grab Strain, % ASTM D 4632 <sup>2</sup>	49 max.	50 min.
Trapezoidal Tear Strength, lb ASTM D 4533 <sup>2</sup>	67 min.	40 min.
Puncture Strength, lb ASTM D 6241 <sup>2</sup>	370 min.	222 min.
Apparent Opening Size, Sieve No. ASTM D 4751 <sup>3</sup>	60 max.	
Permittivity, sec <sup>-1</sup> ASTM D 4491	0.2 min.	
Ultraviolet Stability, % retained strength after 500 hours of exposure ASTM D 4355	50 min.	

1. NTPEP results (manufacturer's QC test values) to meet test requirements. Manufacturer shall have public release status and current reports on laboratory results in Test Data of NTPEP's DataMine.
2. Values represent the minimum average roll value (MARV) in the weaker principle direction [machine direction (MD) or cross-machine direction (XD)].
3. Values represent the maximum average roll value.

## CONSTRUCTION METHODS

- 705-3.1 Equipment.** All equipment required for the construction of pipe underdrains shall be on the project, in good working condition, and approved by the Engineer before construction is permitted to start.



**705-3.2 Excavation.** The width of the pipe trench shall be sufficient to permit satisfactory jointing of the pipe and thorough tamping of the bedding material under and around the pipe but shall not be less than the external diameter of the pipe plus six (6) inches on each side of the pipe. The trench walls shall be approximately vertical.

Where rock, hardpan, or other unyielding material is encountered, it shall be removed below the foundation grade for a depth of at least four (4) inches. The excavation below grade shall be backfilled with selected fine compressible material, such as silty clay or loam, and lightly compacted in layers not over six (6) inches in uncompacted depth to form a uniform but yielding foundation. The cost of furnishing and placing this material shall be included in the contract unit price for pipe underdrain. Before any rock is removed, the Resident Engineer shall have the opportunity to obtain the necessary data to determine the quantity for payment. The bottom of the trench shall be excavated to a horizontal section as far as practicable.

Where a firm foundation is not encountered at the grade established, due to soft, spongy, or other unstable soil, the unstable soil shall be removed and replaced with approved granular material for the full trench width. The Resident Engineer shall determine the depth of removal and amount of backfill necessary. The granular material shall be compacted to provide adequate support for the pipe. When not specified in the contract documents, the cost of removing unstable soil and replacing it with approved material shall be covered by a change order for the excavation and then placement of approved material.

Excavated material not required or acceptable for backfill shall be disposed of by the Contractor as directed by the Resident Engineer. The excavation shall not be carried below the required depth; if this occurs, the trench shall be backfilled at the Contractor's expense with material approved by the Engineer and compacted to the density of the surrounding material.

The Contractor shall do all bracing, sheathing, or shoring necessary to perform and protect the excavation as required for safety and conformance to governing laws. Specifically, the Contractor shall observe that all requirements of the Occupational Safety and Health Administration (OSHA) relating to excavations, trenching and shoring are strictly adhered to. Unless otherwise provided, the bracing, sheathing, or shoring shall be removed by the Contractor after the backfill has reached at least 12 inches over the top of the pipe. The sheathing or shoring shall be pulled as the granular backfill is placed and compacted to avoid any unfilled spaces between the trench wall and the backfill material. The cost of bracing, sheathing, or shoring, and the removal of same, shall be included in the contract unit price for the pipe underdrain.

**705-3.3 Bedding.** The pipe bedding shall be constructed uniformly over the full length of the pipe barrel, as specified in the contract documents. The pipe shall be bedded in the underlying material to a depth not less than 10% of the external diameter of the pipe and, where trenching is required, the trench shall have a width of not less than the external diameter of the pipe plus 18 inches. The bottom of the trench shall be compacted in a manner meeting the approval of the Resident Engineer.

**705-3.4 Laying and installing pipe.** Polyethylene pipe shall be installed in accordance with the requirements of ASTM D2321. Perforations shall meet the requirements of AASHTO M 252 or AASHTO M 294 Class 2, unless otherwise specified in the contract documents. The pipe shall be laid accurately to line and grade.

The upgrade end of pipelines, not terminating in a structure, shall be plugged or capped as approved by the Resident Engineer.

Unless otherwise shown on the plans, a four (4) inch bed of granular backfill material shall be spread in the bottom of the trench throughout the entire length under all perforated pipe underdrains.

Pipe outlets for the underdrains shall be constructed when required or specified in the contract documents. The pipe shall be laid with tight-fitting joints. Porous backfill is not required around or over pipe outlets for underdrains. All connections to other drainage pipes or structures shall

be made as required and in a satisfactory manner. If connections are not made to other pipes or structures, the outlets shall be protected and constructed as specified in the contract documents.

**705-3.5 Filter fabric.** When the use of geotechnical fabric is specified for lining the trench, the fabric shall be delivered to the jobsite in such a manner to facilitate handling and incorporation into the work without damage. In no case shall the fabric be stored and exposed to direct sunlight that might significantly diminish its strength or toughness. Torn or punctured fabric shall not be used.

After the trench has been approved by the Resident Engineer, the fabric shall be loosely rolled out so the center of the fabric is at the centerline of the excavated trench, and it will not tear when the aggregate is placed. When more than one (1) section of fabric is used, the fabric shall overlap a minimum of two (2) feet. Enough fabric shall remain uncovered after the trench is filled to provide for fabric overlap at the top.

During backfilling with angular aggregates, a minimum six (6) inches cushion of the aggregate shall be carefully placed over the lined trench before end dumping larger aggregates out of trucks or other equipment. Following the backfilling operation, the fabric shall be lapped over the top and covered with the next specified material.

**705-3.6 Mortar.** The mortar shall be of the desired consistency for caulking and filling the joints of the pipe and for making connections to other pipes or to structures. Mortar that is not used within 45 minutes after water has been added shall be discarded. Retempering of mortar shall not be permitted.

**705-3.7 Backfill.**

a. **Type 1 and Type 3.** When granular backfill is required, placement in the trench and about the pipe shall be as specified in the contract documents. The granular backfill shall not contain an excessive amount of foreign matter, nor shall soil from the sides of the trench or from the soil excavated from the trench be allowed to filter into the granular backfill. When required by the Resident Engineer, a template shall be used to properly place and separate the two (2) sizes of backfill. The backfill shall be placed in loose layers not exceeding six (6) inches in depth. The granular backfill shall be compacted by hand and pneumatic tampers to the requirements as given for embankment. Backfilling shall be done to avoid damaging top or side pressure on the pipe. The granular backfill shall extend to the elevation of the trench or specified in the contract documents.

b. **Type 2.** If porous backfill is placed in paved or adjacent to paved areas before grading or subgrade operations is completed, the backfill material shall be placed immediately after laying the pipe. The depth of the granular backfill shall be not less than 12 inches, measured from the top of the underdrain. During subsequent construction operations, a minimum depth of 12 inches of backfill shall be maintained over the underdrains. When the underdrains are to be completed, any unsuitable material shall be removed exposing the porous backfill. Porous backfill containing objectionable material shall be removed and replaced with suitable material. The cost of removing and replacing any unsuitable material shall be at the Contractor's expense.

If a granular subbase blanket course is used which extends several feet beyond the edge of paving to the outside edge of the underdrain trench, the granular backfill material over the underdrains shall be placed in the trench up to an elevation of two (2) inches above the bottom surface of the granular subbase blanket course. Immediately prior to the placing of the granular subbase blanket course, the Contractor shall blade this excess trench backfill from the top of the trench onto the adjacent subgrade where it can be incorporated into the granular subbase blanket course. Any unsuitable material that remains over the underdrain trench shall be removed and replaced. The subbase material shall be placed to provide clean contact between the subbase material and the underdrain granular backfill material for the full width of the underdrain trench.

- c. **Type 4.** All trenches and excavations shall be backfilled soon after the pipes are installed, unless additional protection of the pipe is directed. The embedment material shall be select material from excavation or borrow and shall be approved by the Resident Engineer. The select material shall be placed on each side of the pipe out to a distance of the nominal pipe diameter and one (1) foot over the top of the pipe and shall be readily compacted. It shall not contain stones three (3) inches or larger in size, frozen lumps, chunks of highly plastic clay, or any other material that is objectionable to the Resident Engineer. The material shall be moistened or dried, as required to aid compaction. Placement of the embedment material shall not cause displacement of the pipe. Thorough compaction under the haunches and along the sides to the top of the pipe shall be obtained.

The embedment material shall be placed in loose layers not exceeding six (6) inches in depth under and around the pipe. Backfill material over the pipe shall be placed in lifts not exceeding eight (8) inches. Successive layers shall be added and thoroughly compacted by hand and pneumatic tampers, approved by the Resident Engineer, until the trench is completely filled and brought to the planned elevation. Embedment and backfilling shall be done to avoid damaging top or side of the pipe.

The backfill shall be compacted per Item 152 titled EXCAVATION, SUBGRADE, AND EMBANKMENT to the density required.

- 705-3.8 Flexible Pipe Ring Deflection.** The flexible pipe shall be inspected by the Contractor during and after installation to ensure that the internal diameter of the pipe barrel has not been reduced by more than 5%. For guidance on properly sizing mandrels, refer to ASTM D3034 and ASTM F679 appendices.
- 705-3.9 Connections.** When the contract documents call for connections to existing or proposed pipe or structures, these connections shall be watertight and made to obtain a smooth uniform flow line throughout the drainage system.
- 705-3.10 Restoration.** After the backfill is completed, the Contractor shall dispose of all surplus material, soil, and rubbish from the site. Surplus soil may be deposited in embankments, shoulders, or as directed by the Resident Engineer. Following restoration of all disturbed areas near airport movement surfaces, the Contractor shall visually inspect the area for foreign object debris (FOD) and remove any that is found. Where soil and/or sod has been removed, it shall be replaced as soon as possible after the backfilling is completed. All areas disturbed by work shall be restored to its original condition. The restoration shall include any necessary sodding, topsoiling, fertilizing, liming, seeding, sprigging, mulching, or other landscaping as specified in the contract documents. All such work shall be performed in accordance with Part 12 titled TURFING. The Contractor shall be held responsible for maintaining all disturbed surfaces and replacements until final acceptance. When the disturbance is through paved areas, restoration shall be equal to existing conditions. The cost of restoration shall be considered incidental to the contract and as a subsidiary obligation of the Contractor.

#### METHOD OF MEASUREMENT

- 705-4.1** The quantity of pipe underdrain shall be measured for payment by the number of linear feet as specified, completed, and accepted by the Resident Engineer. It shall be measured along the centerline of the pipe from end or inside face of structure to the end or inside face of structure, whichever is applicable. The several classes, types, and sizes of pipe shall be measured separately. All fittings shall be included in the footage as typical pipe sections in the pipeline being measured.

#### BASIS OF PAYMENT

- 705-5.1** Payment for accepted quantities of work performed by the Contractor and measured by the Resident Engineer shall be made at the contract unit price as specified in paragraph 705-4.1 of

this section. Payment shall be full compensation for furnishing all materials and for all preparation, excavation, and installation of these materials; and for all labor, equipment, tools, and incidentals necessary to complete the work as specified.

### REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

#### ASTM International (ASTM)

ASTM D 2321	Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
ASTM D 4355	Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture, and heat in a Xenon Arc-Type Apparatus
ASTM D 4491	Test Methods for Water Permeability of Geotextiles by Permittivity
ASTM D 4533	Standard Test Method for Trapezoid Tearing Strength of Geotextiles
ASTM D 4632	Standard Test Method for Grab Breaking Load and Elongation of Geotextiles
ASTM D 4751	Standard Test Methods for Determining Apparent Opening Size of a Geotextile
ASTM D 6241	Standard Test Method for Static Puncture Strength of Geotextiles and Geotextile-Related Products Using a 50-mm Probe
ASTM D 6707	Standard Specification for Circular-Knit Geotextile for Use in Subsurface Drainage Applications
ASTM F 477	Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe

#### American Association of State Highway and Transportation Officials (AASHTO)

AASHTO M 85	Standard Specification for Portland Cement
AASHTO M 252	Standard Specification for Corrugated Polyethylene Drainage Pipe
AASHTO M 288	Standard Specification for Geosynthetic Specification for Highway Applications
AASHTO M 294	Standard Specification for Corrugated Polyethylene Pipe, 300- to 1500-mm (12- to 60-in.) Diameter
AASHTO T 26	Standard Method of Test for Quality of Water to Be Used in Concrete

#### Illinois Department of Transportation, Bureau of Materials Policy Memoranda (PM)

PM 11-08	Aggregate Gradation Control System (AGCS)
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**END OF ITEM 705**

## Item 751 Manholes, Catch Basins, Inlets and Inspection Holes

### DESCRIPTION

- 751-1.1** This item shall consist of construction and adjustment of manholes, catch basins, inlets, and inspection holes, in accordance with these specifications, at the specified locations and conforming to the lines, grades, and dimensions specified in the contract documents or required by the Resident Engineer.

### MATERIALS

- 751-2.1** **Brick.** The brick shall conform to the requirements of ASTM C62, Grade SW.
- 751-2.2** **Mortar.** Mortar shall consist of one (1) part Portland cement and two (2) parts sand. The cement shall conform to the requirements of AASHTO M 85, Type I. The sand shall conform to the requirements of per the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 11-08, *Aggregate Gradation Control System (AGCS)*. Water used in mixing or curing shall be from potable water sources. Other sources shall be tested in accordance with AASHTO T 26 and must be approved by the Engineer prior to use.
- 751-2.3** **Concrete.** The plain and reinforced concrete used in structures, connections of pipes with structures, and the support of structures or frames shall conform to the requirements of Item 610 titled CONCRETE FOR MISCELLANEOUS STRUCTURES.
- 751-2.4** **Precast concrete pipe manhole rings.** Precast concrete pipe manhole rings shall conform to the requirements of AASHTO M 199. Unless otherwise specified, the risers and offset cone sections shall have an inside diameter of not less than 36 inches nor more than 48 inches. There shall be a gasket between individual sections and sections cemented together with mortar on the inside of the manhole. Gaskets shall conform to the requirements of ASTM C443.
- 751-2.5** **Corrugated metal.** Corrugated metal shall conform to the requirements of American Association of State Highway and Transportation Officials (AASHTO) M 36.
- 751-2.6** **Frames, covers, and grates.** The castings shall conform to one (1) of the following requirements:
- a. AASHTO M 105 and AASHTO M 306, Class 35: Gray iron castings
  - b. ASTM A47, Grade No. 32510: Malleable iron castings
  - c. ASTM A27: Steel castings
  - d. ASTM A148: Structural steel for grates and frames
  - e. ASTM A536, Grade 65-45-12: Ductile iron castings
  - f. ASTM A897: Austempered ductile iron castings

All castings or structural steel units shall conform to the dimensions specified in the contract documents and shall be designed to support the loadings, aircraft gear configuration and/or direct loading, specified.

Each frame and cover or grate unit shall be provided with fastening members to prevent it from being dislodged by traffic, but which will allow easy removal for access to the structure.

All castings shall be thoroughly cleaned. After fabrication, structural steel units shall be galvanized to meet the requirements of AASHTO M 111.

- 751-2.7 Steps.** The steps or ladder bars shall be gray or malleable cast iron or galvanized steel. The steps shall be the size, length, and shape specified in the contract documents and those steps that are not galvanized shall be given a coat of asphalt paint, when directed.
- 751-2.8 Precast structures.** Precast concrete products shall be per the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 19-08, *Quality Control/Quality Assurance Program for Precast Concrete Products* and/or be on the current Illinois Department of Transportation's published Qualified Producer List of *Certified Precast Concrete Producers*.
- 751-2.9 Steel reinforcement.** Concrete reinforcing shall consist of deformed bars of either structural, intermediate, or hard grade billet steel meeting ASTM A706, Grade 60 or welded wire fabric meeting AASHTO M 55.
- 751-2.10 Handling holes.** Handling holes in precast concrete pipe shall be filled with a precast concrete plug or sealed and covered with mastic or mortar.
- 751-2.11 Bedding.** The gradation of the bedding material shall meet the requirements of the gradation given in paragraph 701-2.12 titled BACKFILL when tested per the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 11-08, *Aggregate Gradation Control System (AGCS)*.
- 751-2.12 Backfill.** On all areas outside of the pavement areas, material for backfill shall be fine, readily compactible soil or granular material. Backfill material shall be free of brick, rock, or any other objectionable material. Backfill material shall meet the approval of the Engineer. If the structure is in the subgrade or if the nearest point of the excavation for these structures falls within two (2) feet of the pavement edge, the gradation of the backfill material shall meet the requirements of the gradation given in the following table when tested per the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 11-08, *Aggregate Gradation Control System (AGCS)*.

#### Gradation of Backfill

Sieve Size	Gradation Percent Passing		
	FA 1	FA 2	FA 6
3/8	100	100	
No. 4	97±3	97±3	92±8
No. 16	65±20	65±20	
No. 50	16±13	20±10	
No. 100	5±5	5±5	20±20
No. 200			6±6

#### CONSTRUCTION METHODS

- 751-3.1 Unclassified excavation.** The Contractor shall excavate for structures and footings to the lines and grades or elevations specified in the contract documents or as directed by the Resident Engineer. The excavation shall be of sufficient size to permit the placing of the full width and length of the structure or structure footings shown. The elevations of the bottoms of footings, as specified in the contract documents, shall be considered as approximately only; and the Resident Engineer may direct, in writing, changes in dimensions or elevations of footings necessary for a satisfactory foundation.

Boulders, logs, or any other objectionable material encountered in excavation shall be removed. All rock or other hard foundation material shall be cleaned of all loose material and cut to a firm surface either level, stepped, or serrated, as directed by the Resident Engineer. All seams or

crevices shall be cleaned out and grouted. All loose and disintegrated rock and thin strata shall be removed. Where concrete will rest on a surface other than rock, the bottom of the excavation shall not be disturbed and excavation to final grade shall not be made until immediately before the concrete or reinforcing steel is placed.

The Contractor shall do all bracing, sheathing, or shoring necessary to implement and protect the excavation and the structure as required for safety or conformance to governing laws. Specifically, the Contractor shall observe that all requirements of the Occupational Safety and Health Administration (OSHA) relating to excavations, trenching and shoring are strictly adhered to. All bracing, sheathing, or shoring involved in the construction of this item shall be removed by the Contractor after the completion of the structure. Removal shall not disturb or damage finished masonry. The cost of bracing, sheathing, or shoring, and the removal of the same, shall be included in the contract unit price for the structure.

After excavation is completed for each structure, the Contractor shall notify the Resident Engineer. No concrete or reinforcing steel shall be placed until the Resident Engineer has approved the depth of the excavation and the character of the foundation material.

**751-3.2 Bedding.** All precast structures shall be installed on a three (3) inch sand cushion meeting the requirements of paragraph 751-2.11 titled BEDDING.

**751-3.3 Brick structures.**

- a. **Foundations.** A prepared foundation shall be placed for all brick structures after the foundation excavation is completed and accepted. Unless otherwise specified, the base shall consist of reinforced concrete mixed, prepared, and placed in accordance with the requirements of Item 610 titled CONCRETE FOR MISCELLANEOUS STRUCTURES.
- b. **Laying brick.** All brick shall be clean and thoroughly wet before laying so that they will not absorb any appreciable amount of additional water at the time they are laid. All brick shall be laid in freshly made mortar. Mortar not used within 45 minutes after water has been added shall be discarded. Retempering of mortar shall not be permitted. An ample layer of mortar shall be spread on the beds and a shallow furrow shall be made in it that can be readily closed by the laying of the brick. All bed and head joints shall be filled solid with mortar. End joints of stretchers and side or cross joints of headers shall be fully buttered with mortar and a shoved joint made to squeeze out mortar at the top of the joint. Any bricks that may be loosened after the mortar has taken its set, shall be removed, cleaned, and re-laid with fresh mortar. No broken or chipped brick shall be used in the face, and no spalls or bats shall be used except where necessary to shape around irregular openings or edges; in which case, full bricks shall be placed at ends or corners where possible, and the bats shall be used in the interior of the course. In making closures, no piece of brick shorter than the width of a whole brick shall be used; and wherever practicable, whole brick shall be used and laid as headers.
- c. **Joints.** All joints shall be filled with mortar at every course. Exterior faces shall be laid up in advance of backing. Exterior faces shall be plastered or parged with a coat of mortar not less than three-eighths (3/8) inch thick before the backing is laid up. Prior to parging, all joints on the back of face courses shall be cut flush. Unless otherwise noted, joints shall be not less than one-quarter (1/4) inch nor more than one-half (1/2) inch wide and the selected joint width shall be maintained uniform throughout the work.
- d. **Pointing.** Face joints shall be neatly struck, using the weather-struck joint. All joints shall be finished properly as the laying of the brick progresses. When nails or line pins are used, the holes shall be immediately plugged with mortar and pointed when the nail or pin is removed.
- e. **Cleaning.** Upon completion of the work all exterior surfaces shall be thoroughly cleaned by scrubbing and washing with water. If necessary to produce satisfactory results, cleaning shall be done with a 5% solution of muriatic acid which shall then be rinsed off with liberal quantities of water.

- f. **Curing and cold weather protection.** The brick masonry shall be protected and kept moist for at least 48 hours after laying the brick. Brick masonry work or pointing shall not be done when there is frost on the brick or when the air temperature is below 50°F unless the Contractor has, on the project ready to use, suitable covering and artificial heating devices necessary to keep the atmosphere surrounding the masonry at a temperature of not less than 60°F for the duration of the curing period.

- 751-3.4 Concrete structures.** Concrete structures which are to be cast-in-place within the project boundaries shall be built on prepared foundations, conforming to the dimensions and specified in the contract documents. The construction shall conform to the requirements specified in Item 610 titled CONCRETE FOR MISCELLANEOUS STRUCTURES. Any reinforcement required shall be placed as specified in the contract documents and shall be approved by the Resident Engineer before the concrete is placed.

All invert channels shall be constructed and shaped accurately to be smooth, uniform, and cause minimum resistance to flowing water. The interior bottom shall be sloped to the outlet.

- 751-3.5 Precast concrete structures.** Precast concrete structures shall be constructed on prepared or previously placed slab foundations conforming to the dimensions and locations specified in the contract documents. All precast concrete sections necessary to build a completed structure shall be furnished. The different sections shall fit together readily. Joints between precast concrete risers and tops shall be full-bedded in cement mortar and shall: (1) be smoothed to a uniform surface on both interior and exterior of the structure or (2) utilize a rubber gasket per ASTM C443. The top of the upper precast concrete section shall be suitably formed and dimensioned to receive the metal frame and cover or grate, or other cap, as required. Provision shall be made for any connections for lateral pipe, including drops and leads that may be installed in the structure. The flow lines shall be smooth, uniform, and cause minimum resistance to flow. The metal or metal encapsulated steps that are embedded or built into the side walls shall be aligned and placed in accordance to AASHTO M 199. When a metal ladder replaces the steps, it shall be securely fastened into position.

- 751-3.6 Corrugated metal structures.** Corrugated metal structures shall be prefabricated. All standard or special fittings shall be furnished to provide pipe connections or branches with the correct dimensions and of sufficient length to accommodate connecting bands. The fittings shall be welded in place to the metal structures. The top of the metal structure shall be designed so that either a concrete slab or metal collar may be attached to allow the fastening of a standard metal frame and grate or cover. Steps or ladders shall be furnished as specified in the contract documents. Corrugated metal structures shall be constructed on prepared foundations, conforming to the dimensions and locations as specified in the contract documents. When indicated, the structures shall be placed on a reinforced concrete base.

- 751-3.7 Inlet and outlet pipes.** Inlet and outlet pipes shall extend through the walls of the structures a sufficient distance beyond the outside surface to allow for connections. They shall be cut off flush with the wall on the inside surface of the structure, unless otherwise directed. For concrete or brick structures, mortar shall be placed around these pipes to form a tight, neat connection.

- 751-3.8 Placement and treatment of castings, frames, and fittings.** All castings, frames, and fittings shall be placed in the positions specified in the contract documents or as directed by the Resident Engineer and shall be set true to line and elevation. If frames or fittings are to be set in concrete or cement mortar, all anchors or bolts shall be in place before the concrete or mortar is placed. The unit shall not be disturbed until the mortar or concrete has set.

When frames or fittings are placed on previously constructed masonry, the bearing surface of the masonry shall be brought true to line and grade and shall present an even bearing surface so the entire face or back of the unit will come in contact with the masonry. The unit shall be set in mortar beds and anchored to the masonry as indicated on the plans or as directed by the Resident Engineer. All units shall set firm and secure.



After the frames or fittings have been set in final position, the concrete or mortar shall be allowed to harden for seven (7) days before the grates or covers are placed and fastened down.

**751-3.9 Installation of steps.** The steps shall be installed as specified in the contract documents or as directed by the Resident Engineer. When the steps are to be set in concrete, they shall be placed and secured in position before the concrete is placed. When the steps are installed in brick masonry, they shall be placed as the masonry is being built. The steps shall not be disturbed or used until the concrete or mortar has hardened for at least seven (7) days. After seven (7) days, the steps shall be cleaned and painted, unless they have been galvanized.

When steps are required with precast concrete structures, they shall meet the requirements of AASHTO M 199. The steps shall be cast into the side of the sections at the time the sections are manufactured or set in place after the structure is erected by drilling holes in the concrete and cementing the steps in place.

When steps are required with corrugated metal structures, they shall be welded into aligned position at a vertical spacing of 12 inches.

Instead of steps, prefabricated ladders may be installed. For brick or concrete structures, the ladder shall be held in place by grouting the supports in drilled holes. For metal structures, the ladder shall be secured by welding the top support to the structure and grouting the bottom support into drilled holes in the foundation or as directed by the Resident Engineer.

**751-3.10 Backfill.** On all areas outside of the pavement areas, the backfill material shall be placed in lifts no greater than eight (8) inches, loose measurement, and compacted by mechanical means to the satisfaction of the Engineer. Each layer shall be deposited evenly around the structure to approximately the same elevation. The top of the fill shall meet the elevation shown on the plans or as directed by the Resident Engineer.

If the structure is in the subgrade or if the nearest point of the excavation for these structures falls within two (2) feet of the pavement edge, the material for backfill shall meet the requirements set forth in paragraph 751-2.12 titled BACKFILL. Backfill material shall be compacted in lifts no greater than six (6) inches and compacted to at least 95% of the maximum density of laboratory specimens compacted and tested per AASHTO T 99 for areas designated for aircraft with gross weights of 60,000 pounds or less and AASHTO T 180 for areas designated for aircraft with gross weights greater than 60,000 pounds. The in-place field density shall be determined per AASHTO T 310 (Direct Transmission Density/Backscatter Moisture). The machine shall be calibrated in accordance with AASHTO T 310 within 12 months prior to its use on this contract. The Contractor shall not proceed to construct another lift of backfill until the previous lift has been accepted by the Resident Engineer. If the specified density is not attained, the area represented by the failed test must be reworked and/or recompacted and two (2) additional random tests made. This procedure shall be followed until the specified density is reached. Maximum density refers to maximum dry density at optimum moisture content unless otherwise specified.

The Contractor shall provide a qualified nuclear gauge and operator for Quality Control (QC) testing for density.

Backfill shall not be placed against any structure until approved by the Resident Engineer. For concrete structures, approval shall not be given until the concrete has been in place seven (7) days, or until tests establish that the concrete has attained sufficient strength to withstand any pressure created by the backfill and placing methods.

Backfill shall not be measured for direct payment. The cost of backfill shall be considered incidental to the pay item and as a subsidiary obligation of the Contractor.

**751-3.11 Restoration.** After the backfill is completed, the Contractor shall dispose of all surplus material, dirt, and rubbish from the site. Surplus dirt may be deposited in embankments, shoulders, or as approved by the Resident Engineer. Following restoration of all disturbed areas near airport movement surfaces, the Contractor shall visually inspect the area for foreign object debris (FOD)

and remove any that is found. Where soil and/or sod has been removed, it shall be replaced as soon as possible after the backfilling is completed. All areas disturbed by work shall be restored to its original condition. The restoration shall include any necessary sodding, topsoiling, fertilizing, liming, seeding, sprigging, mulching, or other landscaping as specified in the contract documents. All such work shall be performed in accordance with Part 12 titled TURFING. The Contractor shall be held responsible for maintaining all disturbed surfaces and replacements until final acceptance. When the disturbance is through paved areas, restoration shall be equal to existing conditions. The cost of restoration shall be considered incidental to the contract and as a subsidiary obligation of the Contractor.

#### METHOD OF MEASUREMENT

- 751-4.1** The quantity of manholes, catch basins, inlets, and inspection holes shall be measured for payment by the number of each unit installed as specified, completed, and accepted by the Resident Engineer.

#### BASIS OF PAYMENT

- 751-5.1** Payment for accepted quantities of work performed by the Contractor and measured by the Resident Engineer shall be at the contract unit price as specified in paragraph 751-4.1 of this section. Payment shall be full compensation for furnishing all materials and for all preparation, excavation, backfilling and placing of the materials; furnishing and installation of such specials and connections to pipes and other structures; and for all labor equipment, tools and incidentals necessary to complete the work as specified.

#### REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

##### **ASTM International (ASTM)**

ASTM A27	Standard Specification for Steel Castings, Carbon, for General Application
ASTM A47	Standard Specification for Ferritic Malleable Iron Castings
ASTM A148	Standard Specification for Steel Castings, High Strength, for Structural Purposes
ASTM A536	Standard Specification for Ductile Iron Castings
ASTM A706	Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement
ASTM A897	Standard Specification for Austempered Ductile Iron Castings
ASTM C62	Standard Specification for Building Brick (Solid Masonry Units Made from Clay or Shale)
ASTM C443	Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets

##### **American Association of State Highway and Transportation Officials (AASHTO)**

AASHTO M 36	Standard Specification for Corrugated Steel Pipe, Metallic-Coated, for Sewers and Drains
AASHTO M 55	Standard Method of Test for Steel Welded Wire Reinforcement, Plain, for Concrete

AASHTO M 85	Standard Specification for Portland Cement
AASHTO M 105	Standard Specification for Gray Iron Castings
AASHTO M 111	Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
AASHTO M 199	Standard Specification for Precast Reinforced Concrete Manhole Sections
AASHTO M 306	Standard Specification for Drainage, Sewer, Utility, and Related Castings
AASHTO T 26	Standard Method of Test for Quality of Water to Be Used in Concrete

**Illinois Department of Transportation, Bureau of Materials Policy Memoranda (PM)**

PM 11-08	Aggregate Gradation Control System (AGCS)
PM 19-08	Quality Control/Quality Assurance Program for Precast Concrete Products

**Illinois Department of Transportation, Bureau of Materials Qualified Product List**

Certified Precast Concrete Producers

**END OF ITEM 751**

**Item 752 Concrete Culverts, Headwalls, and Miscellaneous Drainage Structures****DESCRIPTION**

- 752-1.1** This item shall consist of plain and reinforced concrete culverts, headwalls, and miscellaneous drainage structures constructed in accordance with these specifications, at the specified locations and conforming to the lines, grades, and dimensions specified in the contract documents or required by the Resident Engineer.

**MATERIALS**

- 752-2.1 Concrete.** The plain and reinforced concrete used in structures shall meet the requirements of Item 610 titled CONCRETE FOR MISCELLANEOUS STRUCTURES.
- 752-2.2 Precast structures.** Precast concrete products shall be per the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 19-08, Quality Control/Quality Assurance Program for Precast Concrete Products and/or be on the current Illinois Department of Transportation's published Qualified Producer List of *Certified Precast Concrete Producers*.
- 752-2.3 Steel reinforcement.** Concrete reinforcing shall consist of deformed bars of either structural, intermediate, or hard grade billet steel meeting ASTM A706, Grade 60 or welded wire fabric meeting AASHTO M 55.
- 752-2.4 Handling holes.** Handling holes in precast concrete pipe shall be filled with a precast concrete plug or sealed and covered with mastic or mortar.
- 752-2.5 Bedding.** The gradation of the bedding material shall meet the requirements of the gradation given in paragraph 752-2.6 titled BACKFILL when tested per the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 11-08, *Aggregate Gradation Control System (AGCS)*.
- 752-2.6 Backfill.** On all areas outside the pavement areas, material for backfill shall be fine, readily compactible soil or granular material. Backfill materials shall be free of brick, rock, or any other objectionable material. Backfill material shall meet the approval of the Engineer. If the structure is in the subgrade or if the nearest point of the excavation for these structures falls within two (2) feet of the pavement edge, the gradation of the backfill material shall meet the requirements of the gradation given in the following table when tested per the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 11-08, *Aggregate Gradation Control System (AGCS)*.

### Gradation of Backfill

Sieve Size	Gradation Percent Passing		
	FA 1	FA 2	FA 6
3/8	100	100	
No. 4	97±3	97±3	92±8
No. 16	65±20	65±20	
No. 50	16±13	20±10	
No. 100	5±5	5±5	20±20
No. 200			6±6

### CONSTRUCTION METHODS

- 752-3.1 Unclassified excavation.** The Contractor shall excavate for structures and footings to the lines and grades and elevations specified in the contract documents or as directed by the Resident Engineer. The excavation shall be of sufficient size to permit the placing of the full width and length of the structure or structure footings shown. The elevations of the bottoms of footings, as specified in the contract documents, shall be considered as approximate only; and the Resident Engineer may direct, in writing, changes in dimensions or elevations of footings necessary to secure a satisfactory foundation.

Boulders, logs, or any other objectionable material encountered in excavation shall be removed. All rock or other hard foundation material shall be cleaned of all loose material and cut to a firm surface either level, stepped, or serrated, as directed by the Resident Engineer. All seams or crevices shall be cleaned out and grouted. All loose and disintegrated rock and thin strata shall be removed. Where concrete will rest on a surface other than rock, the bottom of the excavation shall not be disturbed and excavation to final grade shall not be made until immediately before the concrete or reinforcing steel is placed.

The Contractor shall do all bracing, sheathing, or shoring necessary to perform and protect the excavation and the structure as required for safety or conformance to governing laws. Specifically, the Contractor shall observe that all requirements of the Occupational Safety and Health Administration (OSHA) relating to excavations, trenching and shoring are strictly adhered to. All bracing, sheathing, or shoring shall be removed by the Contractor after the completion of the structure. Removal shall not disturb or damage the finished concrete. The cost of bracing, sheathing, or shoring, and the removal of the same, removal shall be included in the contract unit price for the structure.

After excavation is completed for each structure, the Contractor shall notify the Resident Engineer. No concrete or reinforcing steel shall be placed until the Resident Engineer has approved the depth of the excavation and the character of the foundation material.

- 752-3.2 Bedding.** All precast structures shall be installed on a three (3) inch sand cushion meeting the requirements of paragraph 752-2.5 titled BEDDING.

- 752-3.3 Backfill.** On all areas outside of the pavement areas, the backfill material shall be placed in lifts no greater than eight (8) inches, loose measurement, and compacted by mechanical means to the satisfaction of the Engineer.

If the structure is in the subgrade or if the nearest point of the excavation for these structures falls within two (2) feet of the pavement edge, the material for backfill shall meet the requirements set forth in paragraph 752-2.6 titled BACKFILL. Backfill material shall be compacted in lifts no greater than six (6) inches and compacted to at least 95% of the maximum density of laboratory specimens compacted and tested per AASHTO T 99 for areas designated

for aircraft with gross weights of 60,000 pounds or less and AASHTO T 180 for areas designated for aircraft with gross weights greater than 60,000 pounds. The in-place field density shall be determined per AASHTO T 310 (Direct Transmission Density/Backscatter Moisture). The machine shall be calibrated in accordance with AASHTO T 310 within 12 months prior to its use on this contract. The Contractor shall not proceed to construct another lift of backfill until the previous lift has been accepted by the Resident Engineer. If the specified density is not attained, the area represented by the failed test must be reworked and/or recompacted and two (2) additional random tests made. This procedure shall be followed until the specified density is reached. Maximum density refers to maximum dry density at optimum moisture content unless otherwise specified.

The Contractor shall provide a qualified nuclear gauge and operator for Quality Control (QC) testing for density.

No backfilling shall be placed against any structure until approved by the Resident Engineer. For concrete, approval shall not be given until the concrete has been in place seven (7) days, or until tests establish that the concrete has attained sufficient strength to withstand any pressure created by the backfill or the placement methods.

Fill placed around concrete culverts shall be deposited on each side at the same time and to approximately the same elevation. All slopes bounding or within the areas to be backfilled shall be stepped or serrated to prevent wedge action against the structure.

Backfill will not be measured for direct payment. The cost of backfill shall be considered incidental to the pay item and as a subsidiary obligation of the Contractor.

**752-3.4 Weep holes.** Weep holes shall be constructed as specified in the contract documents.

**752-3.5 Restoration.** After the backfill is completed, the Contractor shall dispose of all surplus material, dirt, and rubbish from the site. Surplus dirt may be deposited in embankment, shoulders, or as approved by the Resident Engineer. Following restoration of all disturbed areas near airport movement surfaces, the Contractor shall visually inspect the area for foreign object debris (FOD) and remove any that is found. Where soil and/or sod has been removed, it shall be replaced as soon as possible after the backfilling is completed. All areas disturbed by work shall be restored to its original condition. The restoration shall include any necessary sodding, topsoiling, fertilizing, liming, seeding, sprigging, mulching, or other landscaping as specified in the contract documents. All such work shall be performed in accordance with Part 12 titled TURFING. The Contractor shall be held responsible for maintaining all disturbed surfaces and replacements until final acceptance. When disturbance is through paved areas, restoration shall be equal to existing conditions. The cost of restoration shall be considered incidental to the contract and as a subsidiary obligation of the Contractor.

#### METHOD OF MEASUREMENT

**752-4.1** The quantity of concrete culverts, headwalls, and miscellaneous drainage structures shall be measured for payment by the number of each unit installed as specified, completed, and accepted by the Resident Engineer.

#### BASIS OF PAYMENT

**752-5.1** Payment for accepted quantities of work performed by the Contractor and measured by the Resident Engineer shall be at the contract unit price as specified in paragraph 752-4.1 of this section. Payment shall be full compensation for furnishing all materials and for all preparation, excavation, backfilling and placing of the materials; furnishing and installation of such specials and connections to pipes and other structures; and for all labor equipment, tools and incidentals necessary to complete the work as specified.

## REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

### **ASTM International (ASTM)**

AASHTO A706	Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement
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### **American Association of State Highway and Transportation Officials (AASHTO)**

AASHTO M 55	Standard Method of Test for Steel Welded Wire Reinforcement, Plain, for Concrete
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AASHTO T 99	Standard Method of Test for Moisture–Density Relations of Soils Using a 2.5-kg (5.5-lb) Rammer and a 305-mm (12-in.) Drop
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AASHTO T 191	Standard Method of Test for Density of Soil In-Place by the Sand-Cone Method
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AASHTO T 180	Standard Method of Test for Moisture–Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop
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AASHTO T 310	Standard Method of Test for In-Place Density and Moisture Content of Soil and Soil–Aggregate by Nuclear Methods (Shallow Depth)
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### **Illinois Department of Transportation, Bureau of Materials Policy Memoranda (PM)**

PM 11-08	Aggregate Gradation Control System (AGCS)
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PM 19-08	Quality Control/Quality Assurance Program for Precast Concrete Products
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### **Illinois Department of Transportation, Bureau of Materials Qualified Product List**

Certified Precast Concrete Producers

**END OF ITEM 752**

## Item 754 Concrete Gutters, Ditches, and Flumes

### DESCRIPTION

- 754-1.1** This item shall consist of concrete gutters, ditches, and flumes constructed in accordance with these specifications at the specified locations in accordance with the dimensions, lines, and grades as specified in the contract documents or required by the Resident Engineer.

### MATERIALS

- 754-2.1 Concrete.** The plain and reinforced concrete shall meet the requirements of Item 610 titled CONCRETE FOR MISCELLANEOUS STRUCTURES.
- 754-2.2 Steel reinforcement.** Concrete reinforcing shall consist of deformed bars of either structural, intermediate, or hard grade billet steel meeting ASTM A706, Grade 60 or welded wire fabric meeting AASHTO M 55.
- 754-2.3 Joints.** Joint filler materials and premolded joint material shall conform to Item 605 titled JOINT SEALANTS FOR PAVEMENTS.
- 754-2.4 Protective coat.** Protective coat shall meet the requirements of AASHTO M 233 (boiled linseed oil), except the protective coat shall have a nonvolatile range of 53% to 57% and the petroleum spirits used in the production of the protective coat shall be Type I meeting the requirements of ASTM D235 with a maximum copper corrosion rating of two (2).

### CONSTRUCTION METHODS

- 754-3.1 Preparing subgrade.** Excavation shall be made to the required width and depth, and the subgrade upon which the item is to be built shall be compacted to a firm uniform grade. All soft and unsuitable material shall be removed and replaced with suitable approved material. When required, a layer of approved granular material, compacted to the thickness specified in the contract documents, shall be placed to form a subbase. The underlying course shall be checked and accepted by the Resident Engineer before placing and spreading operations are started.
- 754-3.2 Placing concrete.** The forms and the mixing, placing, finishing, and curing of concrete shall conform to the requirements of Item 610 titled CONCRETE FOR MISCELLANEOUS STRUCTURES and the following requirements.

The concrete shall be tamped until it is consolidated, and mortar covers the top surface. The surface of the concrete shall be floated smooth and the edges rounded to the radii specified in the contract documents. Before the concrete is given the final finishing, the surface shall be tested with a ten (10) foot straightedge, and any irregularities of more than one-quarter (1/4) inch in ten (10) foot shall be eliminated.

The concrete shall be placed with dummy-grooved joints not to exceed 25 feet apart and no section shall be less than four (4) feet long.

Expansion joints of the type specified in the contract documents shall be constructed to replace dummy groove joints at a spacing of approximately 100 feet. When the gutter is placed next to concrete pavement, expansion joints in the gutter shall be located opposite expansion joints in the pavement. When a gutter abuts a pavement or other structure, an expansion joint shall be placed between the gutter and the other structure.



**754-3.3 Concrete gutter, curb, and curb and gutter.** Joints in concrete gutter, curb, and combination curb and gutter shall be a continuation of the joints in the adjacent cement concrete pavement, base course, base course widening, or shoulder. Expansion joints adjacent to drainage castings may be placed in prolongation with other joint types.

When concrete gutter, curb, and combination curb and gutter are constructed adjacent to flexible pavement or shoulders, joints shall be constructed as specified in the contract documents.

At points where the proposed or existing sidewalk or driveway pavement occupies the entire space between the proposed curb and an adjacent building or permanent structure, one (1) inch preformed expansion joint shall be placed between the sidewalk, building, or driveway pavement and the proposed curb. The expansion joint material shall extend the entire depth of the sidewalk, or driveway pavement, or to such depth as will allow 1-inch expansion between the proposed curb and adjacent sidewalk, building or driveway pavement.

Longitudinal construction, transverse contraction, and transverse expansion joints shall be constructed according to the applicable portions of Item 501 titled CEMENT CONCRETE PAVEMENT. Contraction joints shall be sawed to a depth equal to one-third (1/3) the thickness of the gutter flag and to a width of not less than one-eighth (1/8) inch. The expansion joint filler material shall be cut to the exact cross section of the gutter, curb, or combination curb and gutter. Dowel bars for expansion and contraction joints in combination concrete curb and gutter shall be spaced as specified in the contract documents, except only one (1) dowel bar will be required at a joint if the width of the gutter is less than 18 inches.

Transverse contraction and longitudinal construction joints shall be sealed according to Item 605 titled JOINT SEALANTS FOR PAVEMENTS, except transverse joints in concrete curb and gutter shall be sealed with polysulfide or polyurethane joint sealant.

When combination concrete curb and gutter is constructed across alleys or private drives, the top of curbs shall be depressed according to the details shown on the plans. The transition from full height curb to depressed curb shall be made in a distance equal to at least four (4) times the difference in height from the full height to the depressed curb.

Where asphalt base course or base course widening is specified to extend under the curb and gutter, the curb and gutter may be poured full depth of the pavement in lieu of the base course.

Areas of adjacent cement concrete pavement, base course, or base course widening less than 12 inches in width shall be constructed monolithically with the curb or combination curb and gutter. Areas of adjacent cement concrete pavement, base course, or base course widening greater than 12 inches in width may be constructed monolithically with the curb or combination curb and gutter. When monolithic construction is performed, the following shall apply.

- a. Tie bars between the cement concrete pavement and the curb or combination curb and gutter will not be required.
- b. Tie bars between the cement concrete base course or base course widening and the curb or combination curb and gutter will be required. The tie bars shall be held in the proper position by support pins or placed by approved mechanical means.
- c. Pavement reinforcement, when required in the pavement, shall be extended laterally to within three (3) to five (5) inches from the back of the curb.
- d. The longitudinal joint between the cement concrete pavement, base course, or base course widening and the curb or combination curb and gutter shall not be constructed.

Transition from one (1) type of gutter, curb, or curb and gutter to another type shall be constructed according to the details shown on the plans.

**754-3.4 Paved ditch.** Anchor walls shall be spaced at not more than 50-foot intervals along the paved ditch. Anchor walls and the cut-off wall shall be constructed monolithically with the paved ditch.

At the option of the Contractor, No. 3 reinforcing bars placed at 12-inch centers longitudinally in the paved ditch and vertically in the anchor and cut-off walls may be used in lieu of the welded wire reinforcement.

A one-half (1/2) inch thick preformed joint filler shall be placed at the junction of paved ditch with any other structure.

**754-3.5 Finishing.** All exposed surfaces shall be finished smooth and even and given a light brush finish while the concrete is still workable. The edges shall be rounded with approved finishing tools having the radii specified in the contract documents.

Forms shall be removed within 24 hours after the concrete has been placed. Minor defects shall be repaired with mortar containing one (1) part cement and two (2) parts fine aggregate mixed with water.

Depositing, compacting, and finishing the item shall be conducted to build a satisfactory structure. If any section of concrete is found to be porous, or is otherwise defective, it shall be removed and replaced by the Contractor without additional compensation.

**754-3.6 Protective coat.** When pavement is constructed after November 1 and it will be opened to traffic prior to the following April 15, or when directed by the Resident Engineer, a protective coat shall be applied to the surface of the pavement and appurtenances, when the concrete is at least 14 days old and before the pavement is marked and opened to traffic.

Before the protective coat is applied, the concrete surface shall have at least a 48-hour drying period since the last rain and shall be cleaned to remove all oil, grime, and loose particles which would prevent the mixture from penetrating the concrete.

The protective coat shall consist of two (2) applications of the mixture and each application shall be at a rate of 50 square yards per gallon or less. The protective coat shall be sprayed on the surface with a mechanical spraying machine which will perform the work in a satisfactory manner. The spray nozzles shall be within 18 inches of the concrete or as directed by the Resident Engineer. The interior of the distributor tank shall be thoroughly cleaned prior to placing the protective coat therein. Unless otherwise directed by the Engineer, the temperature of the concrete and air shall be 40°F or higher at the time of application.

The second application of the protective coat shall be made when, in the opinion of the Engineer, the concrete has regained its dry appearance.

Traffic shall be prohibited from the area until the concrete has regained its dry appearance.

**754-3.7 Backfill.** After the concrete has obtained the specified strength, the spaces adjacent to the structure shall be backfilled to the required elevation with suitable material, compacted and neatly graded.

**754-3.8 Removals.** The existing curb, gutter, combination curb and gutter, paved ditches, and flumes shall be sawcut at the limits of removal. If adjacent pavement or structures are to remain in place the Contractor shall provide saw cuts along the pavement or structures to remain. The curb, gutter, combination curb and gutter, paved ditches, and flumes shall be completely removed and disposed of by the Contractor off of airport property.

**754-3.9 Restoration.** After the backfill is completed, the Contractor shall dispose of all surplus material, dirt, and rubbish from the site. Surplus dirt may be deposited in embankments, shoulders, or as approved by the Resident Engineer. Following restoration of all disturbed areas near airport movement surfaces, the Contractor shall visually inspect the area for foreign object debris (FOD) and remove any that is found. Where soil and/or sod has been removed, it shall be replaced as soon as possible after the backfilling is completed. All areas disturbed by work shall be restored to its original condition. The restoration shall include any necessary sodding, topsoiling, fertilizing, liming, seeding, sprigging, mulching, or other landscaping as specified in the contract

documents. All such work shall be performed in accordance with Part 12 titled TURFING. The Contractor shall be held responsible for maintaining all disturbed surfaces and replacements until final acceptance. When disturbance is through paved areas, restoration shall be equal to existing conditions. The cost of restoration shall be considered incidental to the contract and as a subsidiary obligation of the Contractor.

#### **METHOD OF MEASUREMENT**

- 754-4.1** The quantity of concrete curb, gutter, combination concrete curb and gutter, and paved ditch shall be measured for payment by the number of linear feet as specified, completed, and accepted by the Resident Engineer. It shall be measured in the flow line of the gutter or paved ditch and along the face of concrete curb, which measurement will include drainage castings incorporated in various curbs and curbs and gutters but will exclude entrances, inlets, and outlets for gutters and outlets for combination curb and gutters..

#### **BASIS OF PAYMENT**

- 754-5.1** Payment for accepted quantities of work performed by the Contractor and measured by the Resident Engineer shall be paid for at the contract unit price as specified in paragraph 754-4.1 of this section. Payment shall be full compensation for furnishing all materials and for all preparation, excavation, backfilling and placing of the materials; furnishing and installation of such specials and connections to pipes and other structures; and for all labor equipment, tools and incidentals necessary to complete the work as specified.

#### **REFERENCES**

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

##### **ASTM International (ASTM)**

ASTM A706	Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement
ASTM D235	Standard Specification for Mineral Spirits (Petroleum Spirits) (Hydrocarbon Dry Cleaning Solvent)

##### **American Association of State Highway and Transportation Officials (AASHTO)**

AASHTO M 233	Standard Specification for Boiled Linseed Oil Mixture for Treatment of Portland Cement Concrete
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**END OF ITEM 754**

## Part 12 – Turfing

### Item 901 Seeding

#### DESCRIPTION

- 901-1.1** This item shall consist of soil preparation, seeding, fertilizing and/or liming for all areas within the limits specified in the contract documents or as required by the Resident Engineer.

#### MATERIALS

- 901-2.1** **Seed.** The species and application rates of grass, legume, and cover-crop seed furnished shall be those stipulated herein. Seed shall conform to the requirements of Federal Specification JJJ-S-181, Federal Specification, Seeds, Agricultural.

Seed shall be furnished separately or in mixtures in standard containers labeled in conformance with the Agricultural Marketing Service (AMS) Seed Act and applicable state seed laws with the seed name, lot number, net weight, percentages of purity and of germination and hard seed, and percentage of maximum weed seed content clearly marked for each kind of seed. The Contractor shall furnish the Resident Engineer duplicate signed copies of a statement by the vendor certifying that each lot of seed has been tested by a recognized laboratory for seed testing within six (6) months of date of delivery. This statement shall include: name and address of laboratory, date of test, lot number for each kind of seed, and the results of tests as to name, percentages of purity and of germination, and percentage of weed content for each kind of seed furnished, and, in case of a mixture, the proportions of each kind of seed. Wet, moldy, or otherwise damaged seed will be rejected.

Seeds shall be applied as follows:

#### Seed Properties and Rate of Application

Seed	Minimum Seed Purity	Minimum Germination	Application Rate (lb/acre)
*Tall Fescue	98%	90%	60
Annual Rye	98%	90%	20
*Red Fescue	98%	85%	30
*Hard Fescue	96%	85%	30

\*Seed shall be of a variety bred to contain high levels of endophyte.

In locations where poor soil conditions exist, the Resident Engineer may require that Perennial Ryegrass be substituted for the Annual Ryegrass.

Seeding shall be performed during the period between April 1 and June 1 or September 1 and November 1 provided that the ground is not frozen or in any way detrimental to the seed.

If the Contractor elects to use their own seed mixture, the Contractor shall ensure seed recommended is not a hazardous wildlife attractant (high endophyte variety).

- 901-2.2** **Lime.** Lime shall be ground limestone containing not less than 85% of total carbonates and shall be ground to such fineness that 90% will pass through a No. 20 mesh sieve and 50% will pass through a No. 100 mesh sieve. Coarser material will be acceptable, providing the rates of

application are increased to provide not less than the minimum quantities and depth specified in the special provisions on the basis of the two (2) sieve requirements above. Dolomitic lime or a high magnesium lime shall contain at least 10% of magnesium oxide. Lime shall be applied at the rate of 2 ton per acre. All liming materials shall conform to the requirements of ASTM C602.

All agricultural lime sources must be listed on the Illinois Department of Agriculture's *Limestone Program Producer Information* booklet listed on the Department website.

The Contractor has the option to perform a soil test, at their expense, to determine if lime is not necessary, based upon the existing pH level of the soil. The pH level of the soil must be between 5.5 and 7.6 for the application of lime to be eliminated. The soil test results must be reviewed and approved by the Engineer before the application of lime can be waived.

- 901-2.3 Fertilizer.** Fertilizer shall be standard commercial fertilizers supplied separately or in mixtures containing the percentages of total nitrogen, available phosphoric acid, and water-soluble potash. They shall be applied at the rate and to the depth specified and shall meet the requirements of applicable state laws. They shall be furnished in standard containers with name, weight, and guaranteed analysis of contents clearly marked thereon. No cyanamide compounds or hydrated lime shall be permitted in mixed fertilizers.

The fertilizers may be supplied in one (1) of the following forms:

- a. A dry, free-flowing fertilizer suitable for application by a common fertilizer spreader;
- b. A finely-ground fertilizer soluble in water, suitable for application by power sprayers; or
- c. A granular or pellet form suitable for application by blower equipment.

Fertilizers shall be spread at the rate of 270 pounds per acre.

Fertilizer Nutrients	Rate (lb/acre)
Nitrogen	135
Phosphorus	45
Potassium	90

- 901-2.4 Soil for repairs.** The soil for fill and top soiling of areas to be repaired shall be at least of equal quality to that which exists in areas adjacent to the area to be repaired. The soil shall be relatively free from large stones, roots, stumps, or other materials that will interfere with subsequent sowing of seed, compacting, and establishing turf, and shall be approved by the Resident Engineer before being placed.

## CONSTRUCTION METHODS

- 901-3.1 Advance preparation and cleanup.** After grading of areas has been completed and before applying fertilizer and ground limestone, areas to be seeded shall be raked or otherwise cleared of stones larger than two (2) inches in any diameter, sticks, stumps, and other debris that might interfere with sowing of seed, growth of grasses, or subsequent maintenance of grass-covered areas. If any damage by erosion or other causes has occurred after the completion of grading and before beginning the application of fertilizer and ground limestone, the Contractor shall repair such damage include filling gullies, smoothing irregularities, and repairing other incidental damage.

An area to be seeded shall be considered a satisfactory seedbed without additional treatment if it has recently been thoroughly loosened and worked to a depth of not less than five (5) inches as a result of grading operations and, if immediately prior to seeding, the top three (3) inches of soil is loose, friable, reasonably free from large clods, rocks, large roots, or other undesirable matter, and if shaped to the required grade.

When the area to be seeded is sparsely sodded, weedy, barren and unworked, or packed and hard, any grass and weeds shall first be cut or otherwise satisfactorily disposed of, and the soil then scarified or otherwise loosened to a depth not less than five (5) inches. Clods shall be broken and the top three (3) inches of soil shall be worked into a satisfactory seedbed by discing, or by use of cultipackers, rollers, drags, harrows, or other appropriate means.

### 901-3.2 Dry application method.

- a. **Liming.** If required, lime shall be applied separately and prior to the application of any fertilizer or seed and only on seedbeds that have previously been prepared as described above. The lime shall then be worked into the top three (3) inches of soil after which the seedbed shall again be properly graded and dressed to a smooth finish.
- b. **Fertilizing.** Following advance preparations and cleanup, and liming if required, fertilizer shall be uniformly spread at the rate that will provide not less than the minimum quantity stated in paragraph 901-2.3 titled FERTILIZER.
- c. **Seeding.** Grass seed shall be sown at the rate specified in paragraph 901-2.1 titled SEED immediately after fertilizing. The fertilizer and seed shall be raked within the depth range stated in the special provisions. Seeds of legumes, either alone or in mixtures, shall be inoculated before mixing or sowing, in accordance with the instructions of the manufacturer of the inoculant. When seeding is required at other than the seasons specified in the contract documents, a cover crop shall be sown by the same methods required for grass and legume seeding.
- d. **Rolling.** After the seed has been properly covered, the seedbed shall be immediately compacted by means of an approved lawn roller, weighing 40 to 65 pounds per foot of width for clay soil (or any soil having a tendency to pack), and weighing 150 to 200 pounds per foot of width for sandy or light soils.

### 901-3.3 Wet application method.

- a. **General.** The Contractor may elect to apply seed and fertilizer (and lime, if required) by spraying them on the previously prepared seedbed in the form of an aqueous mixture and by using the methods and equipment described herein. The rates of application shall be as specified in the special provisions.
- b. **Spraying equipment.** The spraying equipment shall have a container or water tank equipped with a liquid level gauge calibrated to read in increments not larger than 50 gallons over the entire range of the tank capacity, mounted so as to be visible to the nozzle operator. The container or tank shall also be equipped with a mechanical power-driven agitator capable of keeping all the solids in the mixture in complete suspension at all times until used.

The unit shall also be equipped with a pressure pump capable of delivering 100 gallons per minute at a pressure of 100 pounds per square inches. The pump shall be mounted in a line that will recirculate the mixture through the tank whenever it is not being sprayed from the nozzle. All pump passages and pipe-lines shall be capable of providing clearance for five-eighths (5/8) inch solids. The power unit for the pump and agitator shall have controls mounted so as to be accessible to the nozzle operator. There shall be an indicating pressure gauge connected and mounted immediately at the back of the nozzle.

The nozzle pipe shall be mounted on an elevated supporting stand in such a manner that it can be rotated through 360 degrees horizontally and inclined vertically from at least 20 degrees below to at least 60 degrees above the horizontal. There shall be a quick-acting, three-way control valve connecting the recirculating line to the nozzle pipe and mounted so that the nozzle operator can control and regulate the amount of flow of mixture delivered to the nozzle. At least three (3) different types of nozzles shall be supplied so that mixtures may be properly sprayed over distance varying from 20 to 100 feet. One (1) shall be a close-range ribbon nozzle, one (1) a medium-range ribbon nozzle, and one (1) a long-range jet

nozzle. For ease of removal and cleaning, all nozzles shall be connected to the nozzle pipe by means of quick-release couplings.

In order to reach areas inaccessible to the regular equipment, an extension hose at least 50 feet in length shall be provided to which the nozzles may be connected.

- c. **Mixtures.** If required, lime shall be applied separately, in the quantity specified, prior to the fertilizing and seeding operations. Not more than 220 pounds of lime shall be added to and mixed with each 100 gallons of water. Seed and fertilizer shall be mixed together in the relative proportions specified, but not more than a total of 220 pounds of these combined solids shall be added to and mixed with each 100 gallons of water.

All water used shall be obtained from fresh water sources and shall be free from injurious chemicals and other toxic substances harmful to plant life. The Contractor shall identify to the Resident Engineer all sources of water at least two (2) weeks prior to use. The Resident Engineer may take samples of the water at the source or from the tank at any time and have a laboratory test the samples for chemical and saline content. The Contractor shall not use any water from any source that is disapproved by the Resident Engineer following such tests.

All mixtures shall be constantly agitated from the time they are mixed until they are finally applied to the seedbed. All such mixtures shall be used within two (2) hours from the time they were mixed, or they shall be wasted and disposed of at approved locations.

- d. **Spraying.** If required, lime shall be sprayed only upon previously prepared seedbeds. After the applied lime mixture has dried, the lime shall be worked into the top three (3) inches, after which the seedbed shall again be properly graded and dressed to a smooth finish.

Mixtures of seed and fertilizer shall only be sprayed upon previously prepared seedbeds on which the lime, if required, shall already have been worked in. The mixtures shall be applied by means of a high-pressure spray that shall always be directed upward into the air so that the mixtures will fall to the ground like rain in a uniform spray. Nozzles or sprays shall never be directed toward the ground in such a manner as might produce erosion or runoff.

Particular care shall be exercised to ensure that the application is made uniformly and at the prescribed rate and to guard against misses and overlapped areas. Proper predetermined quantities of the mixture in accordance with specifications shall be used to cover specified sections of known area.

Checks on the rate and uniformity of application may be made by observing the degree of wetting of the ground or by distributing test sheets of paper or pans over the area at intervals and observing the quantity of material deposited thereon.

On surfaces that are to be mulched as specified in the contract documents or designated by the Resident Engineer, seed and fertilizer applied by the spray method need not be raked into the soil or rolled. However, on surfaces on which mulch is not to be used, the raking and rolling operations will be required after the soil has dried.

- 901-3.4 Maintenance of seeded areas.** The Contractor shall protect seeded areas against traffic or other use by warning signs or barricades, as approved by the Resident Engineer. Surfaces gullied or otherwise damaged following seeding shall be repaired by regrading and reseeding as directed. The Contractor shall mow, water as directed, and otherwise maintain seeded areas in a satisfactory condition until final inspection and acceptance of the work.

When either the dry or wet application method outlined above is used for work done out of season, it will be required that the Contractor establish a good stand of grass of uniform color and density to the satisfaction of the Resident Engineer. A grass stand shall be considered adequate when bare spots are one (1) square foot or less, randomly dispersed, and do not exceed 3% of the area seeded. The turf shall not contain ruts, gullies or undulations. If, at the time of final inspection, it is not possible to determine if a good stand of grass has been

established, payment for the unaccepted portions of the areas seeded out of season will be withheld until such time as these requirements have been met.

#### METHOD OF MEASUREMENT

**901-4.1** The quantity of seeding shall be measured for payment by the number of acres measured on the ground surface, as specified, completed and accepted by the Resident Engineer.

Areas of seeding not showing a uniform stand of grass in density and color shall not be approved for payment. Such areas shall be re-seeded to the Department's satisfaction at the Contractor's cost.

The quantity of water utilized for seed bed preparation and maintenance of the seeded areas shall be considered incidental to the contract and as a subsidiary obligation of the Contractor.

When the project is constructed essentially to the lines, grades, or dimensions shown on the Plans, and the Contractor and the Resident Engineer have agreed in writing on form AER 981, *Agreement on Accuracy of Plan Quantities*, that the plan quantities are accurate, no further measurement will be required and payment will be made for the quantities shown in the contract for the various items involved. If an error in plan quantity is discovered after the work has been started, an appropriate adjustment will be made.

When the contract documents have been altered or when disagreement exists between the Contractor and the Engineer as to the accuracy of the plan quantities, either party shall, before any work is started which would affect the measurement, have the right to request in writing and thereby cause the quantities involved to be measured as herein specified.

#### BASIS OF PAYMENT

**901-5.1** Payment for accepted quantities of work performed by the Contractor and measured by the Resident Engineer shall be made at the contract unit price as specified in paragraph 901-4.1 of this section. Payment shall be full compensation for furnishing and placing all material and for all labor, equipment, tools, and incidentals necessary to complete the work as specified.

#### REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

##### **ASTM International (ASTM)**

ASTM C602	Standard Specification for Agricultural Liming Materials
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##### **Federal Specifications (FED SPEC)**

FED SPEC	JJJ-S-181, Federal Specification, Seeds, Agricultural
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#### END OF ITEM 901



## Item 903 Sprigging

### DESCRIPTION

- 903-1.1** This item shall consist of planting sprigs of living grass plants at the locations specified in the contract documents or as directed by the Resident Engineer.

### MATERIALS

- 903-2.1 Sprigs.** Sprigs shall be healthy living stems (stolons or rhizomes), of the grass species stated in the special provisions, harvested without adhering soil and obtained from sources where the sod is heavy and thickly matted. The presence of weeds or other material that might be detrimental to the proposed planting will be cause for rejection of sprigs.

- 903-2.2 Lime.** Lime shall be ground limestone containing not less than 85% of total carbonates and shall be ground to such fineness that 90% will pass through a No. 20 mesh sieve and 50% will pass through a No. 100 mesh sieve. Coarser material will be acceptable, providing the rates of application are increased to provide not less than the minimum quantities and depth specified in the special provisions on the basis of the two (2) sieve requirements above. Dolomitic lime or a high magnesium lime shall contain at least 10% of magnesium oxide. Lime shall be applied at the rate of two (2) ton per acre. All liming materials shall conform to the requirements of ASTM C602.

All agricultural lime sources must be listed on the Illinois Department of Agriculture's *Limestone Program Producer Information* booklet listed on the Department website.

The Contractor has the option to perform a soil test, at their expense, to determine if lime is not necessary, based upon the existing pH level of the soil. The pH level of the soil must be between 5.5 and 7.6 for the application of lime to be eliminated. The soil test results must be reviewed and approved by the Engineer before the application of lime can be waived.

- 903-2.3 Fertilizer.** Fertilizer shall be standard commercial fertilizers supplied separately or in mixtures containing the percentages of total nitrogen, available phosphoric acid, and water-soluble potash. They shall be applied at the rate and to the depth specified and shall meet the requirements of applicable state laws. They shall be furnished in standard containers with name, weight, and guaranteed analysis of contents clearly marked thereon. No cyanamide compounds or hydrated lime shall be permitted in mixed fertilizers.

The fertilizers may be supplied in one (1) of the following forms:

- a. **Dry, free-flowing fertilizer.** Suitable for application by a common fertilizer spreader.
- b. **Finely-ground fertilizer soluble in water.** Suitable for application by power sprayers.
- c. **Granular or pellet form fertilizer.** Suitable for application by blower equipment.

Fertilizers shall be spread at the rate of 270 pounds per acre.

Fertilizer Nutrients	Rate (lb/acre)
Nitrogen	135
Phosphorus	45
Potassium	90

- 903-2.4 Water.** All water used shall be sufficiently free from oil, acid, alkali, salt, or other harmful materials that would inhibit the growth of grass.
- 903-2.5 Soil for repairs.** The soil for fill and top soiling of areas to be repaired shall be at least of equal quality to that which exists in areas adjacent to the area to be repaired. The soil shall be relatively free from large stones, roots, stumps, or other materials that will interfere with subsequent sowing of seed, compacting, and establishing turf, and shall be approved by the Resident Engineer before being placed.

### CONSTRUCTION METHODS

- 903-3.1 General.** Areas to be sprigged and the location of sprigging material, if available on the site, shall be specified in the contract documents. Areas requiring special ground surface preparation such as tilling, and those in a satisfactory condition to remain undisturbed, shall also be specified in the contract documents.

Suitable equipment necessary for proper preparation of the ground surface and for the handling and placing of all required materials shall be on hand, in good condition, and shall be approved by the Resident Engineer before the various operations are started. The Contractor shall demonstrate to the Resident Engineer, before starting the various operations, that the planting and application of required materials will be made at the specified rates.

When weather conditions are such that unsatisfactory results may occur, the work shall be stopped until the desired results can be obtained.

- 903-3.2 Advance preparation and cleanup.** After grading of areas has been completed and before applying fertilizer and limestone, areas to be sprigged shall be raked or otherwise cleared of stones larger than two (2) inches in any diameter, sticks, stumps, and other debris which might interfere with sprigging, growth of grasses, or subsequent maintenance of grass-covered areas. If any damage by erosion or other causes has occurred after grading of areas and before beginning the application of fertilizer and ground limestone, the Contractor shall repair such damage including filling gullies, smoothing irregularities, and repairing other incidental damage.

- 903-3.3 Applying fertilizer and ground limestone.** Following advance preparation and cleanup, fertilizer shall be uniformly spread at a rate that will provide not less than the minimum quantity of each fertilizer ingredient as stated in the special provisions. If use of ground limestone is required, it shall then be spread at a rate that will provide not less than the minimum quantity stated in the special provisions. These materials shall be incorporated into the soil to a depth of not less than two (2) inches by discing, raking, or other suitable methods. Any stones larger than two (2) inches in any diameter, large clods, roots, and other litter brought to the surface by this operation shall be removed.

In steep slopes where fertilizer and ground limestone cannot be incorporated effectively by mechanical equipment, they may be applied with power sprayers, blower equipment, or other approved method, and need not be incorporated into the soil.

- 903-3.4 Harvesting sprigs.** The sprigs obtained from sources off the site shall be from suitable areas as close as practical to the planting site. Regardless of the source, sprigging material that contains grass and weeds taller than six (6) inches shall be mowed to a height of three (3) inches, and the clippings raked and removed before harvesting begins. Harvesting may be performed by any suitable method, including crisscross cultivation, shallow plowing, or other acceptable methods to thoroughly loosen the sprigs from the soil and to bring them to the surface. After loosening the sprigs from the soil, they shall be gathered in small piles or windrows, watered, and kept moist until planted.

Not more than 24 hours shall elapse between harvesting and planting sprigs, except that, when weather or other uncontrollable conditions interrupt the work, a time extension may be granted, provided the sprigs are still moist and viable. Sprigs that have heated in stockpiles, have become

frozen, permitted to dry out, or otherwise seriously damaged during harvesting or delivery shall be rejected and shall be disposed of as directed by the Resident Engineer.

- 903-3.5 Planting sprigs.** Sprigging shall be done only within the periods stipulated in the special provisions. Sprigging shall not be done during windy weather, or when the ground is dry, excessively wet, frozen, or otherwise untillable. If the soil is not moist when the sprigs are being set, water shall be applied until the soil is moist and in a workable condition. One (1) or more of the following methods shall be used, whichever is specified in the contract documents:
- a. Broadcast sprigging.** Sprigs shall be broadcast by hand or by suitable equipment in a uniform layer over the prepared surface with spacing between sprigs not to exceed six (6) inches. The sprigs shall then be forced into the soil to a depth of two (2) to four (4) inches with a straight spade or similar tool, or with a disc harrow or other equipment set to cover the sprigs to the required depth.
  - b. Row sprigging.** Furrows shall be opened along the approximate contour of slopes at the spacing and depth stated in the special provisions. Sprigs shall be placed without delay in a continuous row in the open furrow with successive sprigs touching, and they shall be covered immediately.
  - c. Spot sprigging.** Spot sprigging shall be performed as specified under row sprigging, except that groups of four (4) sprigs or more shall be spaced 18 inches apart in the rows.

- 903-3.6 Mulching and compacting.** After planting of sprigs has been completed and prior to compacting, the surface shall be cleared of stones larger than two (2) inches in any diameter, large clods, roots, and other litter brought to the surface during sprigging.

If mulching of sprigged areas is specified in the contract documents, the sprigged areas shall be covered with mulch in accordance with the requirements of Item 908 titled MULCHING within 24 hours from the time sprigging has been completed, weather and soil conditions permitting.

If mulching is not specified in the contract documents, the sprigged area shall be compacted within 24 hours from the time sprigging has been completed, weather and soil conditions permitting, by cultipackers, rollers, or other satisfactory equipment operated at right angles to the slope. Compaction shall not be done when the soil is in such condition that it is picked up by the equipment.

- 903-3.7 Establishing turf.** A stand of turf shall be when there is 95% ground cover of the established species. The Contractor shall be responsible for the proper care of the sprigged areas during the period when the plants are becoming established and he shall protect the sprigged areas against traffic by warning signs or barricades approved by the Resident Engineer. Surfaces gullied or otherwise damaged following sprigging shall be repaired by regrading and re-sprigging as directed by the Resident Engineer. The Contractor shall mow, water as directed, and otherwise maintain sprigged areas in a satisfactory condition until final inspection and acceptance of the work.

#### METHOD OF MEASUREMENT

- 903-4.1** The quantity of sprigging shall be measured for payment by the number of units of 1,000 square feet, measured on the ground surface, as specified, completed and accepted by the Resident Engineer.

**BASIS OF PAYMENT**

**903-5.1** Payment for accepted quantities of work performed by the Contractor and measured by the Resident Engineer shall be made at the contract unit price as specified in paragraph 903-4.1 of this section. Payment shall be full compensation for furnishing and placing all material including any required mulching of sprigged areas, and for all labor, equipment, tools, and incidentals necessary to complete the work as specified.

**REFERENCES**

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

**ASTM International (ASTM)**

ASTM C602                      Standard Specification for Agricultural Liming Materials

**END OF ITEM 903**

## Item 904 Sodding

### DESCRIPTION

- 904-1.1** This item shall consist of furnishing, hauling, and placing approved live sod on prepared areas at the locations specified in the contract documents or as directed by the Resident Engineer.

### MATERIALS

- 904-2.1 Sod.** Sod furnished by the Contractor shall have a good cover of living or growing grass. This shall be interpreted to include grass that is seasonally dormant during the cold or dry seasons and capable of renewing growth after the dormant period. All sod shall be obtained from areas where the soil is reasonably fertile and contains a high percentage of loamy topsoil. Sod shall be cut or stripped from living, thickly matted turf relatively free of weeds or other undesirable foreign plants, large stones, roots, or other materials that might be detrimental to the development of the sod or to future maintenance. At least 70% of the plants in the cut sod shall be composed of the species stated in the special provisions, and any vegetation more than six (6) inches in height shall be mowed to a height of not more than four (4) inches and no less than 1.5 inches before sod is lifted. Sod, including the soil containing the roots and the plant growth showing above, shall be cut uniformly to a thickness not less than one (1) inch.

- 904-2.2 Lime.** Lime shall be ground limestone containing not less than 85% of total carbonates and shall be ground to such fineness that 90% will pass through a No. 20 mesh sieve and 50% will pass through a No. 100 mesh sieve. Coarser material will be acceptable, providing the rates of application are increased to provide not less than the minimum quantities and depth specified in the special provisions on the basis of the two (2) sieve requirements above. Dolomitic lime or a high magnesium lime shall contain at least 10% of magnesium oxide. Lime shall be applied at the rate of two (2) tons per acre. All liming materials shall conform to the requirements of ASTM C602.

All agricultural lime sources must be listed on the Illinois Department of Agriculture's *Limestone Program Producer Information* booklet listed on the Department website.

The Contractor has the option to perform a soil test, at their expense, to determine if lime is not necessary, based upon the existing pH level of the soil. The pH level of the soil must be between 5.5 and 7.6 for the application of lime to be eliminated. The soil test results must be reviewed and approved by the Engineer before the application of lime can be waived.

- 904-2.3 Fertilizer.** Fertilizer shall be standard commercial fertilizers supplied separately or in mixtures containing the percentages of total nitrogen, available phosphoric acid, and water-soluble potash. They shall be applied at the rate and to the depth specified and shall meet the requirements of applicable state laws. They shall be furnished in standard containers with name, weight, and guaranteed analysis of contents clearly marked thereon. No cyanamide compounds or hydrated lime shall be permitted in mixed fertilizers.

The fertilizers may be supplied in one (1) of the following forms:

- a. **Dry, free-flowing fertilizer.** Suitable for application by a common fertilizer spreader.
- b. **Finely-ground fertilizer soluble in water.** Suitable for application by power sprayers.
- c. **Granular or pellet form fertilizer.** Suitable for application by blower equipment.

Fertilizers shall be spread at the rate of 270 pounds per acre.

Fertilizer Nutrients	Rate (lb/acre)
Nitrogen	135
Phosphorus	45
Potassium	90

- 904-2.4 Water.** The water shall be sufficiently free from oil, acid, alkali, salt, or other harmful materials that would inhibit the growth of grass.
- 904-2.5 Soil for repairs.** The soil for fill and top soiling of areas to be repaired shall be at least of equal quality to that which exists in areas adjacent to the area to be repaired. The soil shall be relatively free from large stones, roots, stumps, or other materials that will interfere with subsequent sowing of seed, compacting, and establishing turf, and shall be approved by the Resident Engineer before being placed.

### CONSTRUCTION METHODS

- 904-3.1 General.** Areas to be solid, strip, or spot sodded shall be specified in the contract documents. Areas requiring special ground surface preparation such as tilling and those areas in a satisfactory condition that are to remain undisturbed shall also be specified in the contract documents.

Suitable equipment necessary for proper preparation of the ground surface and for the handling and placing of all required materials shall be on hand, in good condition, and shall be approved by the Resident Engineer before the various operations are started. The Contractor shall demonstrate to the Resident Engineer before starting the various operations that the application of required materials will be made at the specified rates.

- 904-3.2 Preparing the ground surface.** After grading of areas has been completed and before applying fertilizer and limestone, areas to be sodded shall be raked or otherwise cleared of stones larger than two (2) inches in any diameter, sticks, stumps, and other debris which might interfere with sodding, growth of grasses, or subsequent maintenance of grass-covered areas. If any damage by erosion or other causes occurs after grading of areas and before beginning the application of fertilizer and ground limestone, the Contractor shall repair such damage. This may include filling gullies, smoothing irregularities, and repairing other incidental damage.
- 904-3.3 Applying fertilizer and ground limestone.** Following ground surface preparation, fertilizer shall be uniformly spread at a rate which will provide not less than the minimum quantity of each fertilizer ingredient, as stated in the special provisions. If use of ground limestone is required, it shall then be spread at a rate that will provide not less than the minimum quantity stated in the special provisions. These materials shall be incorporated into the soil to a depth of not less than two (2) inches by discing, raking, or other suitable methods acceptable to the Resident Engineer. Any stones larger than two (2) inches in any diameter, large clods, roots, and other litter brought to the surface by this operation shall be removed.
- 904-3.4 Obtaining and delivering sod.** After inspection and approval of the source of sod by the Resident Engineer, the sod shall be cut with approved sod cutters to such a thickness that after it has been transported and placed on the prepared bed, but before it has been compacted, it shall have a uniform thickness of not less than 2-1/2 inches. Sod sections or strips shall be cut in uniform widths, not less than ten (10) inches, and in lengths of not less than 18 inches, but of such length as may be readily lifted without breaking, tearing, or loss of soil. Where strips are required, the sod must be rolled without damage with the grass folded inside. The Contractor may be required to mow high grass before cutting sod.

The sod shall be transplanted within 24 hours from the time it is stripped, unless circumstances beyond the Contractor's control make storing necessary. In such cases, sod shall be stacked,

kept moist, and protected from exposure to the air and sun and shall be kept from freezing. Sod shall be cut and moved only when the soil moisture conditions are such that favorable results can be expected. Where the soil is too dry, approval to cut sod may be granted only after it has been watered sufficiently to moisten the soil to the depth the sod is to be cut.

- 904-3.5 Laying sod.** Sodding shall be performed only during the seasons when satisfactory results can be expected. Frozen sod shall not be used, and sod shall not be placed upon frozen soil. Sod shall be placed when temperatures are less than 80°F. Sod shall not be placed during the months of July and August without the approval of the Resident Engineer. Sod may be transplanted during periods of drought with the approval of the Engineer, provided the sod bed is watered to moisten the soil to a depth of at least four (4) inches immediately prior to laying the sod.

The sod shall be moist and shall be placed on a moist earth bed. Pitch forks shall not be used to handle sod and dumping from vehicles shall not be permitted. The sod shall be carefully placed by hand, edge to edge and with staggered joints, in rows at right angles to the slopes, commencing at the base of the area to be sodded and working upward. The sod shall immediately be pressed firmly into contact with the sod bed by tamping or rolling with approved equipment to provide a true and even surface and ensure knitting without displacement of the sod or deformation of the surfaces of sodded areas. Where the sod may be displaced during sodding operations, the workmen, when replacing it, shall work from ladders or treaded planks to prevent further displacement. Screened soil of good quality shall be used to fill all cracks between sods. The quantity of the fill soil shall not cause smothering of the grass. Where the grades are such that the flow of water will be from paved surfaces across sodded areas, the surface of the soil in the sod after compaction shall be set approximately one (1) inch below the pavement edge. Where the flow will be over the sodded areas and onto the paved surfaces around manholes and inlets, the surface of the soil in the sod after compaction shall be placed flush with pavement edges.

On slopes steeper than one (1) vertical to 2-1/2 horizontal and in v-shaped or flat-bottom ditches or gutters, the sod shall be pegged with wooden pegs not less than 12 inches in length and have a cross-sectional area of not less than three-quarters (3/4) square inch. The pegs shall be driven flush with the surface of the sod.

- 904-3.6 Watering.** Adequate water and watering equipment must be on hand before sodding begins, and sod shall be kept moist until it has become established and its continued growth assured. In all cases, watering shall be done in a manner that will avoid erosion from the application of excessive quantities and will avoid damage to the finished surface.
- 904-3.7 Establishing turf.** The Contractor shall provide general care for the sodded areas as soon as the sod has been laid and shall continue until final inspection and acceptance of the work. All sodded areas shall be protected against traffic or other use by warning signs or barricades approved by the Resident Engineer. The Contractor shall mow the sodded areas with approved mowing equipment, depending upon climatic and growth conditions and the needs for mowing specific areas. Weeds or other undesirable vegetation shall be mowed, and the clippings raked and removed from the area.
- 904-3.8 Repairing.** When the surface has become gullied or otherwise damaged during the period covered by this contract, the affected areas shall be repaired to re-establish the grade and the condition of the soil, as directed by the Resident Engineer, and shall then be sodded as specified in paragraph 904-3.5 titled LAYING SOD.

## METHOD OF MEASUREMENT

- 904-4.1** The quantity of sod shall be measured for payment by the number of square yards of the surface covered with sod, as specified, completed, and accepted by the Resident Engineer.

Areas of sodding not showing a uniform stand of grass in density and color shall not be approved for payment. Such areas shall be re-sodded to the Department's satisfaction at the Contractor's cost.

The quantity of water utilized for sod bed preparation and maintenance of the sodded areas shall be considered incidental to the contract and as a subsidiary obligation of the Contractor.

#### **BASIS OF PAYMENT**

**904-5.1** Payment for accepted quantities of work performed by the Contractor and measured by the Resident Engineer shall be made at the contract unit price as specified in paragraph 904-4.1 of this section. Payment shall be full compensation for all labor, equipment, material, staking, and incidentals necessary to satisfactorily complete the work as specified.

**a. Initial Payment.** Upon placement of the sod, 25% of the pay item will be paid.

**b. Final Payment.** Upon acceptance of the sod, the remaining 75% will be paid,

To be acceptable for final payment, the sod shall be growing in place for a minimum of 30 days in a live, healthy condition. When directed by the Resident Engineer, any defective or unacceptable sod shall be removed, replanted, and watered.

#### **REFERENCES**

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

##### **ASTM International (ASTM)**

ASTM C602                      Standard Specification for Agricultural Liming Materials

#### **END OF ITEM 904**



## Item 905 Topsoil

### DESCRIPTION

- 905-1.1** This item shall consist of preparing the ground surface for topsoil application, removing topsoil from designated stockpiles or areas to be stripped on the site or from approved sources off the site, and placing and spreading the topsoil on prepared areas at the locations specified in the contract documents or as directed by the Resident Engineer.

Topsoil shall be stripped from cut areas and below proposed pavements and stockpiled outside of the grading limits. Topsoil shall be utilized in shoulders adjacent to the proposed pavements. Additionally, the surface of all disturbed areas shall be covered with a layer of topsoil, as needed, to facilitate drainage and the growth of turf.

### MATERIALS

- 905-2.1 Topsoil.** Topsoil shall be the surface layer of soil with no admixture of refuse or any material toxic to plant growth, and it shall be reasonably free from subsoil and stumps, roots, brush, stones (two (2) inches or more in diameter), and clay lumps or similar objects. Brush and other vegetation that will not be incorporated with the soil during handling operations shall be cut and removed. Ordinary sod and herbaceous growth such as grass and weeds are not to be removed but shall be thoroughly broken up and intermixed with the soil during handling operations. Heavy sod or other cover, which cannot be incorporated into the topsoil by discing or other means, shall be removed. The topsoil or soil mixture, unless otherwise specified or approved, shall have a pH range of approximately 5.5 pH to 7.6 pH, when tested in accordance with the methods of testing of the Association of Official Agricultural Chemists in effect on the date of invitation of bids. The organic content shall be not less than 3% nor more than 20% as determined by the wet-combustion method (chromic acid reduction). There shall be not less than 20% nor more than 80% of the material passing the 200-mesh sieve as determined by the wash test in accordance with the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 11-08, Aggregate Gradation Control System (AGCS).

Natural topsoil may be amended by the Contractor with approved materials and methods to meet the above specifications. For contractor sourced off-site topsoil, any amendments needed are at the Contractor's expense. For on-site topsoil or plan specified offsite sources, it is assumed the needed amendments were determined in the design phase and included in the quantities specified in the contract documents.

- 905-2.2 Inspection and tests.** For Contractor sourced topsoil, the Resident Engineer shall be notified of the source of topsoil to be furnished 21 days prior to use. The topsoil shall be inspected by the Contractor and the Resident Engineer to determine if the selected soil meets the requirements specified and to determine the depth to which stripping will be permitted. At this time, the Contractor may be required to take representative soil samples from several locations within the area under consideration and to the proposed stripping depths, for testing purposes as specified in paragraph 905-2.1 titled TOPSOIL.

### CONSTRUCTION METHODS

- 905-3.1 General.** Areas to be top soiled shall be specified in the contract documents. If topsoil is available on the site, the location of the stockpiles or areas to be stripped of topsoil and the stripping depths shall be shown on the plans.

Suitable equipment necessary for proper preparation and treatment of the ground surface, stripping of topsoil, and for the handling and placing of all required materials shall be on hand, in good condition, and approved by the Engineer before the various operations are started.

- 905-3.2 Preparing the ground surface.** Immediately prior to dumping and spreading the topsoil on any area, the surface shall be loosened by discs or spike-tooth harrows, or by other means approved by the Engineer, to a minimum depth of two (2) inches to facilitate bonding of the topsoil to the covered subgrade soil. The surface of the area to be top soiled shall be cleared of all stones larger than two (2) inches in any diameter and all litter or other material which may be detrimental to proper bonding, the rise of capillary moisture, or the proper growth of the desired planting. Limited areas, as specified in the contract documents, which are too compact to respond to these operations shall receive special scarification.

Grades on the area to be top soiled, which have been established by others as specified in the contract documents, shall be maintained in a true and even condition. Where grades have not been established, the areas shall be smooth-graded and the surface left at the prescribed grades in an even and compacted condition to prevent the formation of low places or pockets where water will stand.

- 905-3.3 Obtaining topsoil.** Prior to the stripping of topsoil from designated areas, any vegetation, briars, stumps and large roots, rubbish or stones found on such areas, which may interfere with subsequent operations, shall be removed using methods approved by the Resident Engineer. Heavy sod or other cover, which cannot be incorporated into the topsoil by discing or other means shall be removed.

When suitable topsoil is available on the site, the Contractor shall remove this material from the designated areas and to the depth as directed by the Resident Engineer. The topsoil shall be spread on areas already tilled and smooth-graded or stockpiled in areas approved by the Resident Engineer. Any topsoil stockpiled by the Contractor shall be re-handled and placed without additional compensation. Any topsoil that has been stockpiled on the site by others, and is required for topsoil purposes, shall be removed and placed by the Contractor. The sites of all stockpiles and areas adjacent thereto which have been disturbed by the Contractor shall be graded if required and put into a condition acceptable for seeding.

When suitable topsoil is secured off the airport site, the Contractor shall locate and obtain the supply, subject to the approval of the Engineer. The Contractor shall notify the Resident Engineer sufficiently in advance of operations in order that necessary measurements and tests can be made. The Contractor shall remove the topsoil from approved areas and to the depth as directed. The topsoil shall be hauled to the site of the work and placed for spreading or spread as required. Any topsoil hauled to the site of the work and stockpiled shall be re-handled and placed without additional compensation.

- 905-3.4 Placing topsoil.** The topsoil shall be evenly spread on the prepared areas to a uniform depth of two (2) inches after compaction, unless otherwise specified in the contract documents. Spreading shall not be done when the ground or topsoil is frozen, excessively wet, or otherwise in a condition detrimental to the work. Spreading shall be carried on so that turving operations can proceed with a minimum of soil preparation or tilling.

After spreading, any large, stiff clods and hard lumps shall be broken with a pulverizer or by other effective means, and all stones or rocks (two (2) inches or more in diameter), roots, litter, or any foreign matter shall be raked up and disposed of by the Contractor. After spreading is completed, the topsoil shall be satisfactorily compacted by rolling with a cultipacker or by other means approved by the Resident Engineer. The compacted topsoil surface shall conform to the required lines, grades, and cross-sections. Any topsoil or other dirt falling upon pavements as a result of hauling or handling of topsoil shall be promptly removed.

Rutted or damaged areas due to construction and other areas graded as a part of this contract shall have topsoil spread as required to facilitate drainage and turving.

**METHOD OF MEASUREMENT**

- 905-4.1** The quantity of topsoil obtained on the site shall be measured for payment by the number of cubic yards of topsoil measured in its original position and stripped or excavated. The quantity of topsoil stockpiled by others and removed for topsoil by the Contractor shall be measured by the number of cubic yards of topsoil measured in the stockpile. The quantity of topsoil shall be measured by volume in cubic yards computed by the method of end areas.
- 905-4.2** The quantity of topsoil obtained off the site shall be measured for payment by the number of cubic yards of topsoil measured in its original position and stripped or excavated. Topsoil shall be measured by volume in cubic yards computed by the method of end areas.

**BASIS OF PAYMENT**

- 905-5.1** Payment for accepted quantities of work performed by the Contractor and measured by the Resident Engineer shall be made at the contract unit price as specified in paragraphs 905-4.1 and 905-4.2 of this section. Payment shall be full compensation for furnishing all materials and for all preparation, placing, and spreading of the materials, and for all labor, equipment, tools, and incidentals necessary to complete the work as specified.

**REFERENCES**

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

**Illinois Department of Transportation, Bureau of Materials Policy Memoranda (PM)**

PM 11-08

Aggregate Gradation Control System (AGCS)

**END OF ITEM 905**

## Item 908 Mulching

### DESCRIPTION

- 908-1.1** This item shall consist of furnishing, hauling, placing, and securing mulch on all seeded areas and surfaces specified in the contract documents or designated by the Resident Engineer.

### MATERIALS

- 908-2.1** **Mulch material.** Mulch material shall be hay or straw, except hydraulic mulch shall be used on slopes exceeding 3-to-1 unless otherwise specified in the contract documents. Mulch shall be free from noxious weeds, mold, and other deleterious materials. Mulch materials, which contain matured seed of species that would volunteer and be detrimental to the proposed overseeding, or to surrounding farmland, will not be acceptable. Straw or other mulch material which is fresh and/or excessively brittle, or which is in such an advanced stage of decomposition as to smother or retard the planted grass, will not be acceptable.
- a. **Hay.** Hay shall be native hay in an air-dry condition and of proper consistency for placing with commercial mulch blowing equipment. Hay shall be sterile, containing no fertile seed.
  - b. **Straw.** Straw shall be the stalks from threshed plant residue of oats, wheat, barley, rye, or rice from which grain has been removed. Furnish in air-dry condition and of proper consistency for placing with commercial mulch blowing equipment. Straw shall contain no fertile seed.
  - c. **Hay mulch containing seed.** Hay mulch shall be mature hay containing viable seed of native grasses or other desirable species stated in the special provisions or as approved by the Engineer. The hay shall be cut and handled so as to preserve the maximum quantity of viable seed. Hay mulch that cannot be hauled and spread immediately after cutting shall be placed in weather-resistant stacks or baled and stored in a dry location until used.
  - d. **Hydraulic mulch.** The mulch component shall be comprised of a minimum of 70% biodegradable material such as wood cellulose, paper fibers, straw or cotton and shall contain no growth or germination inhibiting factors. The remainder of the components shall consist of the manufacturer's choice of tackifiers and/or strengthening fibers needed to meet the performance specifications. Tackifiers shall be non-toxic and LC 50 test results shall be provided along with the certificate of analysis (COA). Hydraulic mulch shall disperse evenly and rapidly and remain in slurry when agitated with water. When uniformly applied, the slurry shall form an absorbent cover allowing percolation of water to the underlying surface. Hydraulic mulch shall be packaged in UV and moisture resistant factory labeled packages or bags with the net quantity of the packaged material plainly shown on each package. The biodegradable material shall be relatively free of glossy papers and shall not be water soluble. The hydraulic mulches shall be according to the following.

### Light-Duty Hydraulic Mulch

Property <sup>1</sup>	Value
Functional Longevity <sup>2</sup>	3 months
Minimum Application Rates	2,000 lb/acre
Typical Maximum Slope Gradient (V:H)	≤ 1:3
Maximum Uninterrupted Slope Length	50 feet
Maximum C Factor	0.15
Minimum Vegetation Establishment <sup>5</sup>	200%

### Heavy-Duty Hydraulic Mulch

Property <sup>1</sup>	Value
Functional Longevity <sup>2</sup>	12 months
Minimum Application Rates	3,000 lb/acre
Typical Maximum Slope Gradient (V:H)	≤ 1:2
Maximum Uninterrupted Slope Length	100 feet
Maximum C Factor <sup>3,4</sup>	0.02
Minimum Vegetation Establishment <sup>5</sup>	400%

1. This table sets minimum requirements only. Refer to manufacturer recommendations for application rates, instructions, gradients, maximum continuous slope lengths and other site specific recommendations.
2. Manufacturer's estimated time period, based upon field observations, that a material can be anticipated to provide erosion control as influenced by its composition and site-specific conditions.
3. "C" Factor calculated as ratio of soil loss from Hydraulic Erosion Control Product (HECP) protected slope (tested at specified or greater gradient, h:v) to soil loss from unprotected (control) plot based on large-scale testing.
4. Large-scale test methods shall be according to ASTM D6459.
5. Minimum vegetation establishment shall be calculated according to ASTM D7322.

The certificate of analysis (COA) shall be provided with each shipment of hydraulic mulch stating the number of packages or bags furnished and that the material complies with these requirements.

- e. **Asphalt binder.** Asphalt binder material shall conform to the requirements of AASHTO M 140, Type SS-1 or RS-1.

**908-2.2 Inspection.** The Resident Engineer shall be notified of sources and quantities of mulch materials available and the Contractor shall furnish the Resident Engineer with representative samples of the materials to be used 30 days before delivery to the project. These samples may be used as standards with the approval of the Engineer and any materials brought on the site that do not meet these standards shall be rejected.

## CONSTRUCTION METHODS

**908-3.1 Mulching.** Before spreading mulch, all large clods, stumps, stones, brush, roots, and other foreign material shall be removed from the area to be mulched. Mulch shall be applied immediately after seeding. The spreading of the mulch may be by hand methods, blower, or other mechanical methods, provided a uniform covering is obtained.

Mulch material shall be furnished, hauled, and evenly applied on the areas specified in the contract documents or designated by the Resident Engineer. Straw or hay mulch and hydraulic mulch on slopes flatter than 3-to-1 shall be applied within 24 hours of the time seeding has been performed. Straw or hay shall be spread over the surface to a uniform thickness at the rate of two (2) to three (3) tons per acre to provide a loose depth of not less than 1-1/2 inches nor more than three (3) inches. The application method shall consist of hand or machine application of hay or straw mulch. The mulch shall be loose enough to permit air to circulate but compact enough to reduce erosion. If baled mulch material is used, care shall be taken that the material is in a loosened condition and contains no lumps or knots of compacted material. Other organic material shall be spread at the rate directed by the Resident Engineer. Mulch may be blown on the slopes and the use of cutters in the equipment for this purpose will be permitted to the extent that at least 95% of the mulch in place on the slope shall be six (6) inches or more in length. When mulches applied by the blowing method are cut, the loose depth in place shall be not less than one (1) inch nor more than two (2) inches.

On slopes equal to or steeper than 3-to-1 or when specified in the contract documents, hydraulic mulch of the type specified shall be applied uniformly at the rate specified. On slopes equal to or steeper than 3-to-1, hydraulic mulch shall be applied the same day as seeded or planted.

When light-duty hydraulic mulch is specified, the method shall consist of the machine application of a light-duty hydraulic mulch. When heavy-duty hydraulic mulch is specified, the method shall consist of the machine application of a heavy-duty hydraulic mulch and the mulch shall be applied using a mechanically agitated hydraulic mulching machine. Seeding shall be conducted as a separate operation and shall not be added to the hydraulic mulch slurry. Hydraulic mulch shall not be applied when the ambient temperature is at or below freezing. To achieve full and even coverage, the hydraulic mulch shall be applied from two (2) opposing directions. Mixing and application rates shall be according to the manufacturer's recommendations and meet the minimum application rates specified.

Following all mulching operation, every precaution shall be taken to prohibit foot or vehicular traffic, or the movement of equipment over the mulched area. At any location where mulching has been displaced by any Contractor's equipment or personnel, the seeding or other work damaged as a result of that displacement shall immediately be replaced to the satisfaction of the Resident Engineer at the Contractor's expense.

It shall be the Contractor's responsibility to make certain that the rate of mulch application is maintained constant throughout the seeding operations.

**908-3.2 Securing mulch.** The mulch shall be held in place by light discing, a very thin covering of topsoil, pins, stakes, wire mesh, asphalt binder, or other adhesive material approved by the Engineer.

The hay or straw shall be stabilized by anchoring mulch into the soil by means of full blades or disks. These blades or disks shall be without camber, be approximately 20 inches in diameter. The disks shall be notched and shall be spaced at approximately three (3) inch intervals and shall be equipped with scrapers. The stabilizer shall weigh approximately 1,000 pounds and shall have a working width not to exceed 72 inches and shall be equipped with a ballast compartment, so that when directed, weight can be increased. The Contractor shall notify the RE of their proposed method of securement for his or her approval prior to performing the work.

Where mulches have been secured by either of the asphalt binder methods, it will not be permissible to walk on the slopes after the binder has been applied. When an application of asphalt binder material is used to secure the mulch, the Contractor must take every precaution

to guard against damaging or disfiguring structures or property on or adjacent to the areas worked and will be held responsible for any such damage resulting from the operation.

If the "peg and string" method is used, the mulch shall be secured by the use of stakes or wire pins driven into the ground on five (5) foot centers or less. Binder twine shall be strung between adjacent stakes in straight lines and crisscrossed diagonally over the mulch, after which the stakes shall be firmly driven nearly flush to the ground to draw the twine down tight onto the mulch.

### **908-3.3 Care and repair.**

- a. The Contractor shall care for the mulched areas until final acceptance of the project. Care shall consist of providing protection against traffic or other use by placing warning signs, as approved by the Resident Engineer, and erecting any barricades that may be specified in the contract documents before or immediately after mulching has been completed on the designated areas.
- b. The Contractor shall be required to repair or replace any mulch that is defective or becomes damaged until the project is finally accepted. When, in the judgment of the Resident Engineer, such defects or damages are the result of poor workmanship or failure to meet the requirements of the specifications, the cost of the necessary repairs or replacement shall be borne by the Contractor.
- c. If the "asphalt spray" method is used, all mulched surfaces shall be sprayed with asphalt binder material so that the surface has a uniform appearance. The binder shall be uniformly applied to the mulch at the rate of approximately eight (8) gallons per 1,000 square feet, or as directed by the Resident Engineer, with a minimum of six (6) gallons and a maximum of ten (10) gallons per 1,000 square feet depending on the type of mulch and the effectiveness of the binder securing it. Asphalt binder material may be sprayed on the mulched slope areas from either the top or the bottom of the slope. An approved spray nozzle shall be used. The nozzle shall be operated at a distance of not less than four (4) feet from the surface of the mulch and uniform distribution of the asphalt material shall be required. A pump or an air compressor of adequate capacity shall be used to ensure uniform distribution of the asphalt material.
- d. If the "asphalt mix" method is used, the mulch shall be applied by blowing, and the asphalt binder material shall be sprayed into the mulch as it leaves the blower. The binder shall be uniformly applied to the mulch at the rate of approximately eight (8) gallons per 1,000 square feet or as directed by the Resident Engineer, with a minimum of six (6) gallons and a maximum of ten (10) gallons per 1,000 square feet depending on the type of mulch and the effectiveness of the binder securing it.

## **METHOD OF MEASUREMENT**

### **908-4.1** The quantity of mulching shall be measured for payment by the number of square yards of the surface covered with mulch, as specified, completed, and accepted by the Resident Engineer.

When the project is constructed essentially to the lines, grades, or dimensions shown on the Plans, and the Contractor and the Resident Engineer have agreed in writing on form AER 981, *Agreement on Accuracy of Plan Quantities*, that the plan quantities are accurate, no further measurement will be required and payment will be made for the quantities shown in the contract for the various items involved. If an error in plan quantity is discovered after the work has been started, an appropriate adjustment will be made.

When the contract documents have been altered or when disagreement exists between the Contractor and the Engineer as to the accuracy of the plan quantities, either party shall, before any work is started which would affect the measurement, have the right to request in writing and thereby cause the quantities involved to be measured as herein specified.

**BASIS OF PAYMENT**

**908-5.1** Payment for accepted quantities of work performed by the Contractor and measured by the Resident Engineer shall be made at the contract unit price as specified in paragraph 908-4.1 of this section. Payment shall be full compensation for furnishing all materials and for placing and anchoring the materials, and for all labor, equipment, tools, and incidentals necessary to complete the work as specified.

**REFERENCES**

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

**American Association of State Highway and Transportation Officials (AASHTO)**

AASHTO M 140      Standard Specification for Emulsified Asphalt

**END OF ITEM 908**



## Part 13 – Lighting Installation

### Item 101 Airport Rotating Beacons

#### DESCRIPTION

- 101-1.1** This item shall consist of removal of existing beacons, refurbishing of existing beacons, and furnishing and installing new airport rotating beacons. The work shall include mounting, leveling, wiring, painting, maintaining, and testing of the beacon. In addition, this item also includes all materials and incidentals necessary to place the beacons in operating condition as completed units to the satisfaction of the Resident Engineer. This item shall include a mounting platform if specified in the contract documents.

#### EQUIPMENT AND MATERIALS

**101-2.1 General.**

- a. Airport lighting equipment and materials covered by advisory circulars shall be certified in the current Federal Aviation Administration Advisory Circular (AC) 150/5345-53, *Airport Lighting Equipment Certification Program (ALECP)* and listed in the ALECP Addendum. FAA certified airfield lighting shall be compatible with each other to perform in compliance with FAA criteria and the intended operation.
- b. All other equipment and materials covered by other referenced specifications shall be subject to acceptance through manufacturer's certification of compliance (COC) with the applicable specification when requested by the Engineer.
- c. Manufacturer's certifications shall not relieve the Contractor of the responsibility to provide materials that are per these specifications. Materials supplied and/or installed that do not comply with these specifications shall be removed, when directed by the Resident Engineer, and replaced with materials, that are per these specifications, at the Contractor's cost.
- d. All materials and equipment used to construct this item shall be submitted to the Resident Engineer for approval prior to ordering the equipment. Submittals consisting of marked catalog sheets or shop drawings shall be provided. Submittal data shall be presented in a clear, precise and thorough manner. Original catalog sheets are preferred. Photocopies are acceptable provided they are as good a quality as the original. Clearly mark each copy to identify the products or models applicable to this project. Indicate all optional equipment and delete any non-pertinent data. Submittals for components or electrical equipment and systems shall identify the equipment to which they apply on each submittal sheet. Markings shall be made bold and clear with arrows or circles (highlighting is not acceptable). The Contractor is solely responsible for delays in the project that accrue directly or indirectly from late submissions or resubmissions of submittals.
- e. The data submitted shall be sufficient, in the opinion of the Resident Engineer, to determine compliance with the contract documents. The Contractor's submittals shall be neatly bound in a properly sized 3-ring binder or in an electronic pdf file format, tabbed by specification section. The Resident Engineer reserves the right to reject any and all equipment, materials or procedures that do not meet the system design and the standards and codes, specified in this document.
- f. All equipment and materials furnished and installed in this section shall be guaranteed against defects in materials and workmanship for at least 12 months from the date of final

acceptance by the Department. The defective materials and/or equipment shall be repaired or replaced, at the Department's discretion, at the Contractor's expense.

- 101-2.2 Beacon.** The beacon shall be of the type and size as specified in the contract documents meeting the requirements of the current Federal Aviation Administration Advisory Circular (AC) 150/5345-12, *Specification for Airport and Heliport Beacons*.
- 101-2.3 Beacon installation.** Installation shall be as specified in the contract documents meeting the requirements of the current Federal Aviation Administration Advisory Circular (AC) 150/5340-30, *Design and Installation Details for Airport Visual Aids*. Provide two (2) lamp sets as spares.
- 101-2.4 Panel boards and breakers.** Panel boards and breakers shall conform to the requirements of Federal Specification W-P-115, Panel, Power Distribution.
- 101-2.5 Weatherproof cabinets.** The weatherproof cabinets shall conform to National Electrical Manufacturers Association Standards (NEMA) and shall be constructed of steel not less than No. 16 United States Standard (USS) gauge.
- 101-2.6 Electrical wire and cable.** For ratings up to 600 volts, moisture and heat resistant thermoplastic wire conforming to Commercial Item Description A-A-59544A Type THWN-2 shall be used. Cable rated up to 5,000 volts shall conform to the current Federal Aviation Administration Advisory Circular (AC) 150/5345-7, *Specification for L-824 Underground Electrical Cable for Airport Lighting Circuits*. The wires shall be the type, size, number of conductors, and voltage specified in the contract documents.
- 101-2.7 Conduit.** Rigid steel conduit and fittings shall be per Underwriters Laboratories Standards 6, 514B, and 1242.
- 101-2.8 Paint.**
- a. Priming paint for non-galvanized metal surfaces shall be a high solids alkyd primer compatible with the manufacturer's recommendations for the intermediate or topcoat.
  - b. Priming paint for galvanized metal surfaces shall be a zinc-rich epoxy primer paint per MIL-DTL-24441/19C, Formula 159, Type III. Use MIL-24441 thinner per paint manufacturer's recommendations.
  - c. Orange paint for the body and the finish coats on metal and wood surfaces shall consist of a ready-mixed non-fading paint meeting the requirements of Master Painter's Institute (MPI) Reference #9 (gloss). The color shall be per Federal Standard 595, International Orange Number 12197.
  - d. White paint for body and finish coats on metal and wood surfaces shall be ready-mixed paint per the Master Painter's Institute, Reference #9, Exterior Alkyd, Gloss, volatile organic content (VOC) Range E2.
  - e. Priming paint for wood surfaces shall be mixed on the job by thinning the above-specified orange or white paint with one-half (1/2) pint of raw linseed oil to each gallon.
- 101-2.9 Refurbishing.** The Contractor shall remove the existing beacon from the tower and perform the following items of work in accordance with current FAA requirements and specifications:
- a. Completely dismantle the beacon, including glass and lenses.
  - b. Sandblast the frame and assemblies.
  - c. Replace the bearings and seals in the spindle.
  - d. Replace the wiring with No. 14 Teflon or silicon high-temperature insulated wire.
  - e. Install new terminal strips.
  - f. Remove existing plug fuse holder and replace with a double cartridge type fuse holder. Fuse light and motor separately with fuse rated for 200,000 RMS interrupting capacity at 240 VAC.

- g.** The motor shall be removed. Conversion to a belt drive unit shall be provided. A new motor shall be provided and shall be UL Listed, one-quarter (1/4) horsepower at 115 volts AC, 60 hertz, 1.10 service factor, with maximum amperage not to exceed 2.4 amps. The gear reducer shall provide the beacon RPM specified and have a minimum full torque of 200 inch-pounds.
- h.** The beacon main drive shaft shall be completely dismantled and cleaned. New bearings and races shall be provided on the main drive shaft. All bearings shall be filled with grease at the time of re- assembly.
- i.** Grease fittings shall be provided on the edge of the mounting plate that holds the beacon head support ring and in the side of the bearing support shaft casing to provide grease for both the top and bottom bearings.
- j.** All removed glass shall be cleaned and resealed back in its original place on the beacon. Provide new cork or rubber cushions for each glass element. The sealing material shall have a guaranteed pliable life of at least 20 years.
- k.** The existing 1,000-watt incandescent lamp system shall be replaced with an FAA approved high output, pulse-start metal halide lamp system delivering 44,000 lumens of output and carrying a two (2) year warranty. Provide an FAA approved color filter to correct for the type of light emitted by the metal halide lamp.
- l.** Lighting assembly shall be converted to a stationary, non-rotating type. The light socket shall be mounted on a minimum one-half (1/2) inch galvanized or plated pipe securely fastened to proper support members inside the beacon base. Support shall be centered in the beacon head assembly.
- m.** Lamp holder assembly shall be properly aligned, centered and leveled so that the lamp is in proper focus. Lamp holder shall be adjustable both vertically and horizontally and calibrated with permanent degree markings. The beam angle shall be set at three (3) degrees.
- n.** The refurbished beacon shall be fitted with two (2) L-810 obstruction lights mounted on top of the beacon, or remotely mounted on the platform. These obstruction lights shall be operated from a photocontrol integral to the beacon power pack that operates the beacon lamp, and which automatically de-energizes the obstruction lights when the beacon lamp reaches 60-70% brightness.
- o.** Provide all new fastening hardware including but not limited to, stainless steel bolts, lock washers, and nuts. Plated fasteners will not be allowed.
- p.** Repaint beacon – International orange.
- q.** After the beacon is reassembled, it shall be test-operated for at least two (2) hours. Any irregularities shall be corrected. The Resident Engineer and the Airport Management shall witness this test.
- r.** Only approved vendors may furnish equipment and materials complying with this specification.

After the beacon is refurbished, the Contractor shall replace the beacon back on top of the tower and connect it to the proposed wiring.

The Contractor may obtain beacon refurbishing services from an approved vendor. If this option is chosen, the Contractor shall perform crating and shipping as required by the refurbishing vendor and shall pay all shipping and refurbishing costs. The Contractor shall retain full responsibility for the satisfactory completion of this item. Any damage to the beacon caused by the Contractor or their agents while removing, refurbishing, or replacing the beacon, or incurred in transit from or to the airport, will be repaired at the Contractor's expense to the satisfaction of the Department and the Resident Engineer.

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## CONSTRUCTION METHODS

- 101-3.1 Placing the beacon.** The beacon shall be mounted as specified in the contract documents.
- 101-3.2 Hoisting and mounting.** The beacon shall be hoisted to the mounting platform by using suitable slings and hoisting tackle. Before fastening the beacon to the mounting platform, the mounting holes shall be checked for correct spacing. Beacon base or mounting legs shall not be strained or forced out of position to fit incorrect spacing of mounting holes. The beacon base shall be raised first, set in position, and bolted in place. The drum shall then be raised and assembled to the base.
- 101-3.3 Leveling.** After the beacon has been mounted, it shall be accurately leveled following the manufacturer's instructions. The leveling shall be checked in the presence of the Resident Engineer and shall be to the Resident Engineer's satisfaction.
- 101-3.4 Servicing.** Before placing the beacon in operation, the Contractor shall check the manufacturer's manual for proper servicing requirements. Follow the manufacturer's servicing instructions for each size of beacon.
- 101-3.5 Beam adjustment.** After the beacon has been mounted and leveled, the elevation of the beam shall be adjusted. The final beam adjustments shall be made at night so that results can be readily observed. The beams shall be adjusted to the elevation directed by the Resident Engineer or as specified in the contract documents. See the current Federal Aviation Administration Advisory Circular (AC) 150/5340-30, *Design and Installation Details for Airport Visual Aids* for additional information about airport beacon beam adjustment.
- 101-3.6 Beacon mounting platform.** Where the beacon is to be mounted at a location other than the beacon tower and where a special mounting platform is required, the construction of the mounting platform and any necessary lightning protection equipment shall be per the details shown in the plans.
- 101-3.7 Wiring.** The Contractor shall furnish all necessary labor and materials and shall make complete above ground electrical connections per the wiring diagram furnished with the contract documents. The electrical installation shall conform to the requirements of the latest edition of National Fire Protection Association, NFPA-70, National Electrical Code (NEC).
- If underground cable for the power feed from the transformer vault to the beacon site and duct for this cable installation is required, the cable, ground rods and duct shall be installed as specified in the contract documents.
- If specified in the contract documents, the Contractor shall connect the tell-tale relay mechanism in the beacon to energize the tower obstruction light circuit when failure of the beacon service (primary) lamp occurs.
- If lightning protection is specified in the contract documents, it shall be installed per Item 103 titled AIRPORT BEACON TOWERS, paragraph 103-2.3 titled LIGHTNING PROTECTION.
- For beacon replacement, all cables associated with the existing rotating beacon that conflict with the installation of the proposed beacon shall be removed by the Contractor and disposed of off airport property. Existing underground cables that do not conflict shall be abandoned in place.
- 101-3.8 Panel and cabinet.** If specified in the contract documents, the Contractor shall furnish and install at the top of the beacon tower or mounting platform a circuit-breaker panel consisting of four (4) 15 ampere breakers mounted in a weather-proof cabinet to provide separate protection for the circuits to the beacon lamps, motor, obstruction lights, and other equipment. The cabinet shall be located on the side of the beacon platform as specified in the contract documents or as directed by the Resident Engineer.

For refurbishing beacons, the Contractor shall remove one (1) existing platform circuit breaker panel and furnish and install a proposed weatherproof panel at the base of the beacon tower, consisting of four (4) 15 ampere breakers mounted in a weather-proof cabinet to provide

separate protection for the circuits to the beacon lamps, motor, obstruction lights, and other equipment. The panel shall be located as specified in the contract documents.

At the platform, provide a weatherproof safety switch mounted in place of the existing panel.

- 101-3.9 Conduit.** All exposed wiring shall be run in not less than three-quarters (3/4) inch galvanized rigid steel conduit. Outdoor rated, liquid-tight, flexible metal conduit may be used for final connection at the beacon equipment. No conduit shall be installed on top of a beacon platform floor. All conduits shall be installed to provide for drainage. If mounted on a steel beacon tower, the conduit shall be fastened to the tower members with Wraplock® straps (or equivalent), clamps, or approved fasteners, spaced approximately five (5) feet apart. The conduit shall be fastened to wooden structures with galvanized pipe straps and with galvanized wood screws not less than No. 8 or less than 1-1/4 inches long. There shall be at least two (2) fastenings for each ten (10) feet length.

For refurbished beacons, all exposed wiring shall be run in not less than on-half (1/2) inch liquid-tight metallic flexible conduit. Such conduit shall be UL Listed for grounding, with a copper strip factory-embedded in the metallic coil. Fittings shall be waterproof and compatible with this type of conduit.

- 101-3.10 Booster transformer.** If required to compensate for voltage drop to the beacon, a booster transformer shall be installed in a suitable weatherproof housing under or on the tower platform or at the base of the tower as specified in the in the contract documents meeting the requirements of the current Federal Aviation Administration Advisory Circular (AC) 150/5340-30, *Design and Installation Details for Airport Visual Aids*.

If a booster transformer is required for installation, it shall be installed in accordance with and paid for as described in Item 109 titled AIRPORT TRANSFORMER VAULT AND VAULT EQUIPMENT.

- 101-3.11 Photoelectric control.** If specified in the contract documents, the Contractor shall furnish and install an automatic control switch at the location specified in the contract documents. The switch shall be a photoelectric type. It shall be a standard commercially available unit that will energize when the illumination on a vertical surface facing North decreases to 25 to 35 foot-candles. The photoelectric switch should de-energize when the illumination rises to 50 to 60 foot-candles. The photoelectronic switch shall be installed, connected, and adjusted per the manufacturer's instructions.

- 101-3.12 Obstruction lights.** Unless otherwise specified, the Contractor shall install on the top of the beacon tower or mounting platform two (2) L-810 obstruction lights on opposite corners, or optionally on top of the rotating beacon. If mounted on the platform, these lights shall be mounted on conduit extensions to a height of not less than four (4) inches above the top of the beacon.

- 101-3.13 Painting.** If construction of a wooden mounting platform is stipulated in the proposal as part of this item, all wooden parts of the platform shall be given one (1) priming coat of white or international-orange paint after fabrication but before erection and one (1) body and one (1) finish coat of international-orange paint after erection. Steel mounting platforms shall be given one (1) priming coat of corrosion-inhibiting primer before erection and one (1) body and one (1) finish coat of international-orange paint after erection. All equipment installed under this contract and exposed to the weather shall be given one (1) body and one (1) finish coat of international-orange per Federal Standard 595, Number 12197 or white paint as required. This shall include the beacon (except glass surfaces), beacon base, breaker cabinet, all conduit, and transformer cases. It shall not include lightning protection system air terminals or obstruction light globes.

Apply the paint uniformly at the proper consistency by skilled painters. The finished paint shall be free from sags, holidays, and smears. Each coat of paint shall be given ample time to dry and harden before the next coat of paint is applied. A minimum of three (3) days shall be allowed for drying on wood surfaces, and a minimum of four (4) days shall be allowed for drying on metal surfaces. Painting shall not be performed in cold, damp, foggy, dusty, or frosty atmospheres, or

when the air temperature is below 40°F, nor started when the weather forecast indicates such conditions for the day.

All surfaces shall be cleaned before painting. The surfaces shall be dry and free from scale, grease, rust, dust, and dirt when paint is applied. All knots in wood surfaces shall be covered with shellac immediately before applying the priming coat of paint. Nail holes and permissible imperfections shall be filled with putty. The ready-mixed paint shall be thinned for the priming and body coats per the manufacturer's recommendations. In the absence of such recommendations, the following shall apply:

- a. Body coats (for both wood and steel surfaces) - add one-half (1/2) pint of turpentine to each gallon of ready-mixed paint for body coats.
- b. Finish coats (for both wood and steel surfaces) the ready-mixed paint shall be used as it comes from the container for finish coats.

For refurbishing beacons, painting as described in this section shall be required only for damage or marring of new metallic surfaces.

- 101-3.14 Testing.** The beacon installation shall be fully tested as a completed unit prior to acceptance. These tests shall include operation of the lamp-changer and performing insulation resistance and voltage readings. The insulation resistance to ground of the beacon power supply circuit shall be not less than 100 megohms when measured ungrounded. The Contractor must furnish testing equipment. Tests shall be conducted in the presence of the Resident Engineer and shall be to the Resident Engineer's satisfaction.

#### METHOD OF MEASUREMENT

- 101-4.1** The quantity of beacons shall be measured for payment by the number of each unit installed as specified, completed, ready for operation and accepted by the Resident Engineer.

#### BASIS OF PAYMENT

- 101-5.1** Payment for accepted quantities of work performed by the Contractor and measured by the Resident Engineer shall be made at the contract unit price as specified in paragraph 101-4.1 of this section. Payment shall be full compensation for furnishing all materials and for all preparation, assembly, and installation of these materials, and for all labor, equipment, tools, and incidentals necessary to complete the work as specified.

#### REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

##### Commercial Item Description

A-A-59544A	Cable and Wire, Electrical (Power, Fixed Installation)
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##### Federal Aviation Administration Advisory Circulars (AC)

AC 150/5345-7	Specification for L-824 Underground Cable for Airport Lighting Circuits
AC 150/5345-12	Specification for Airport and Heliport Beacons
AC 150/5340-30	Design and Installation Details for Airport Visual Aids
AC 150/5345-53	Airport Lighting Equipment Certification Program
AC 150/5390-2	Heliport Design

**Federal Specification (FED SPEC)**

FED SPEC W-P-115 Panel, Power Distribution

**Federal Standard (FED STD)**

FED STD 595 Colors Used in Government Procurement

**Master Painter Institute (MPI)**

MPI Reference #9 Alkyd, Exterior, Gloss (MPI Gloss Level 6)

**Mil Spec**

MIL-DTL-24441C/19C Paint, Epoxy-Polyamide, Zinc Primer, Formula 159, Type III

**National Fire Protection Association (NFPA)**

NFPA-70 National Electric Code (NEC)

NFPA-780 Standard for the Installation of Lightning Protection Systems

**Underwriters Laboratories (UL)**

UL Standard 6 Electrical Rigid Metal Conduit – Steel

UL Standard 514B Conduit, Tubing, and Cable Fittings

UL Standard 1242 Electrical Intermediate Metal Conduit - Steel

**END OF ITEM 101**

## Item 103 Airport Beacon Towers

### DESCRIPTION

- 103-1.1** This item shall consist of removal of existing beacon towers and furnishing and installing airport beacon towers. This work shall include the clearing of the site, erection of the tower, installation of lightning protection, painting, and all incidentals necessary to place the beacon towers in operating condition as completed units to the satisfaction of the Resident Engineer.

### EQUIPMENT AND MATERIALS

**103-2.1 General.**

- a. Airport lighting equipment and materials covered by advisory circulars shall be certified in the current Federal Aviation Administration Advisory Circular (AC) 150/5345-53, *Airport Lighting Equipment Certification Program (ALECP)* and listed in the ALECP Addendum. FAA certified airfield lighting shall be compatible with each other to perform in compliance with FAA criteria and the intended operation. If the Contractor provides equipment that does not perform as intended because of incompatibility with the system, the Contractor assumes all costs to correct the system for to operate properly.
- b. All equipment and materials covered by referenced specifications shall be subject to acceptance through manufacturer's certification of compliance (COC) with the applicable specification when requested by the Engineer.
- c. Manufacturer's certifications shall not relieve the Contractor of the responsibility to provide materials per these specifications. Materials supplied and/or installed that do not comply with these specifications shall be removed, when directed by the Resident Engineer, and replaced with materials, that are per these specifications, at the Contractor's cost.
- d. All materials and equipment used to construct this item shall be submitted to the Resident Engineer for approval prior to ordering the equipment. Submittals consisting of marked catalog sheets or shop drawings shall be provided. Submittal data shall be presented in a clear, precise and thorough manner. Original catalog sheets are preferred. Photocopies are acceptable provided they are as good a quality as the original. Clearly and boldly mark each copy to identify products or models applicable to this project. Indicate all optional equipment and delete any non-pertinent data. Submittals to components of electrical equipment and systems shall identify the equipment for which they apply on each submittal sheet. Markings shall be made bold and clear with arrows or circles (highlighting is not acceptable). The Contractor is solely responsible for delays in the project that may accrue directly or indirectly from late submissions or resubmissions of submittals.
- e. The data submitted shall be sufficient, in the opinion of the Resident Engineer, to determine compliance with the contract documents. The Contractor's submittals shall be neatly bound in a properly sized 3-ring binder or in an electronic pdf file format, tabbed by specification section. The Resident Engineer reserves the right to reject any and all equipment, materials or procedures that do not meet the system design and the standards and codes, specified in this document.
- f. All equipment and materials furnished and installed under this section shall be guaranteed against defects in materials and workmanship for at least 12 months from the date of final acceptance by the Department. The defective materials and/or equipment shall be repaired or replaced, at the Department's discretion, at the Contractor's expense.



- 103-2.2 Tower.** The beacon tower shall be of the type specified in the contract documents meeting the requirements of the current Federal Aviation Administration Advisory Circular (AC) 150/5340-30, *Design and Installation Details for Airport Visual Aids*.
- 103-2.3 Lightning protection.** Lightning protection shall comply with NFPA-780, Standard for the Installation of Lightning Protection Systems. All materials shall comply with NFPA 780 Class II material requirements regardless of the tower height.
- 103-2.4 Paint.**
- Priming paint for galvanized steel towers shall be zinc dust-zinc oxide primer paint per MIL-DTL-24441C/19B. Use MIL-24441 thinner per paint manufacturer's recommendations.
  - Priming paint for non-galvanized steel towers shall be a high solids alkyd primer per the Master Painter's Institute (MPI), Reference #9, Exterior Alkyd, Gloss.
  - Orange paint for the body and the finish coats on metal and wood surfaces shall consist of a ready-mixed non-fading paint MPI Reference #9 (gloss). The color shall be per Federal Standards 595, International Orange Number 12197.
  - White paint for a steel tower shall be ready-mixed paint per MPI #8.

### CONSTRUCTION METHODS

- 103-3.1 Clearing and grading.** The site on which the beacon tower is to be erected shall be cleared and leveled. All trees and brush shall be removed from the area within a distance of 25 feet from the tower or as specified in the contract documents. Stumps shall be removed to a depth of 18 inches below finished grade and the excavation filled with earth and tamped. If a transformer vault or other structure is included as part of the installation, the area shall be cleared to a distance of 25 feet from these structures. The ground near the tower shall be leveled to permit the operation of mowing machines. The leveling shall extend at least two (2) feet outside the tower legs. All debris removed from the tower site shall be disposed of by the Contractor to the satisfaction of the Resident Engineer and per federal, state, or local regulations.
- 103-3.2 Excavation and fill.** Excavation for the tower footings shall be carried to a minimum of four (4) inches below the footing depth. The excess excavation below the footing depth shall then be backfilled with gravel or crushed stone and compacted to the required level. The footing plates shall be installed, and a thickness of not less than 18 inches of the same gravel or crushed stone shall be placed immediately above the footing plates in layers of not over six (6) inches. Each layer above the footing plates shall be thoroughly tamped in place. The remainder of the backfill may be of excavated earth placed in layers not to exceed six (6) inches. Each layer shall be thoroughly compacted by tamping.

Where solid rock is encountered, which prevents the carrying of the foundation legs to the required depth but which is of sufficient strength to use hold-down bolts, the tower anchor posts shall be cut off at the required length and the hold-down bolts shall be installed as specified in the contract documents with the approval of the Resident Engineer. Each tower leg shall be anchored to the rock by means of two (2) seven-eighths (7/8) inch diameter by three (3)-feet long expansion or split bolts and shall be grouted with neat Portland cement into holes drilled into the natural rock. Except as required for rock foundations, the footing members shall not be cut off or shortened. If excavated material is of such consistency that it will not readily compact when backfilled, the Resident Engineer may order the excavation backfilled with concrete or other suitable material.

The concrete footing for tubular beacon towers shall be installed per the manufacturer's recommendations. Portions of the footing in the topsoil layer shall not be included in the footing height.

**103-3.3 Erection.** Tower erection as specified in the contract documents and detailed erection drawings furnished by the manufacturer shall be strictly followed during construction. All towers shall be erected in sections from the ground up unless otherwise specified. For final assembly, all bolts and fastenings shall be installed, and the structure shall be plumb, true, square, and level. Nuts shall be taken up to a firm bearing after which the bolts shall, if necessary, be cut to proper length to protrude three (3) full threads. Approved locknuts shall be placed on each bolt over the regular nut. Ladder bolts shall be inserted with the head to the outer face of the tower. Diagonal, leg, and handrail bolts shall be installed with nuts on the outer face of the tower, unless otherwise specified. Bent parts shall be straightened before erection without damage to the protective coating. Surfaces abraded or bared of protective coating shall be painted with the proper priming paint per these specifications.

The Contractor shall install the ladder on the side of the tower adjacent to the driveway or most accessible approach to the tower. Tubular beacon towers shall be erected per the manufacturer's recommendations. The safety cable shall be located on the side of the tower adjacent to the driveway or most accessible approach to the tower.

**103-3.4 Lightning protection.** The Contractor shall furnish and install a Class II lightning protection system in accordance with NFPA 780. Ground rods and underground cables shall be installed in accordance with the contract documents.

Down-conductor cables shall be securely fastened to the surface of the tower leg at five (5) feet intervals with suitable bronze fasteners having bronze or noncorrosive metal bolts. Sharp turns or bends in the down conductor will not be permitted.

All connections of cable to cable, cable to air terminals, and cable to ground plates or rods shall be made with solder-less connectors or noncorrosive metal approved by the Engineer and shall be of substantial construction.

The down-conductor cable shall be securely attached to ground rods or plates placed at least two (2) feet away from the tower foundations. The ground rod shall be driven into the ground so that the top is at least six (6) inches below grade. The down-conductor shall be firmly attached to the ground plate or rod by means of an exothermic weld only. Plates shall be embedded in an area of permanent moisture.

The complete lightning protection installation shall be accomplished to the satisfaction of the Resident Engineer. The resistance to ground of any part of the lightning protection system shall not exceed 25 ohms. If a single rod grounding electrode has a resistance to earth of over 25 ohms, then install one (1) supplemental rod not less than ten (10) feet from the first rod. If desired resistance to ground levels are still not achieved, see FAA-STD-019 for guidance on the application of coke breeze.

**103-3.5 Painting.** The Contractor shall furnish all materials and labor for painting the beacon tower. The color scheme for the steel tower shall be as specified in the contract documents.

**a. Parts to be painted.** Tower parts (except those parts to be exposed to earth) shall not be treated or primed before erection. All tower parts placed below ground level or within 12 inches above ground level shall be given two (2) coats of approved asphalt paint.

Apply the proper consistency of paint uniformly. The finished paint shall be free from sags, holidays, and smears. Division lines between colors shall be sharply defined. Each coat of paint shall be given ample time to dry and harden before the next coat is applied. A minimum of four (4) days shall be allowed for drying on metal surfaces. Painting shall not be done in cold, damp, foggy, or dusty atmospheres, or when air temperature is below 40°F, nor started when the weather forecast indicates such conditions for the day (24-hour period).

All surfaces shall be cleaned before painting. The surfaces shall be dry and free from scale, grease, rust, dust, and dirt when paint is applied.

The number of coats of paint applied shall be per the following instructions:

- b. **Steel towers, galvanized.** One (1) priming coat of zinc dust-zinc oxide primer after erection and one (1) body and one (1) finish of white or international-orange paint (as required by the color scheme) shall be applied after erection.
- c. **Steel towers, not galvanized.** One (1) priming coat of corrosion-inhibiting primer and one (1) body and one (1) finish coat of white or international-orange paint (as required by the color scheme) shall be applied after erection.

The above specified orange and white ready-mixed paints shall be thinned for the body coats per the manufacturer's recommendations. In the absence of such recommendations, the following shall apply:

- d. **Body coats.** Add not more than one-half (1/2) pint of turpentine to each gallon of ready-mixed paint for body coats.
- e. **Finish coats.** The ready-mixed paint shall be used as it comes from the container for finish coats.

#### METHOD OF MEASUREMENT

- 103-4.1** The quantity of airport beacon towers shall be measured for payment by the number of each unit installed as specified, completed, ready for operation, and accepted by the Resident Engineer.

#### BASIS OF PAYMENT

- 103-5.1** Payment for accepted quantities of work performed by the Contractor and measured by the Resident Engineer shall be made at the contract unit price as specified in paragraph 103-4.1 of this section. Payment shall be full compensation for furnishing all materials and for all preparation, assembly, and installation of these materials, and for all labor, equipment, tools, and incidentals necessary to complete the work as specified.

#### REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

##### Federal Aviation Administration Advisory Circulars (AC)

AC 150/5340-30 Installation and Design Details for Airport Visual Aids

##### Federal Aviation Administration Standard (FAA STD)

FAA-STD-019 Lightning and Surge Protection, Grounding, Bonding and Shielding Requirements for Facilities and Electronic Equipment

##### Federal Standard (FED STD)

FED STD 595 Colors Used in Government Procurement

##### Master Painter's Institute (MPI)

MPI Reference #8 Alkyd, Exterior, Flat (MPI Gloss Level 1)

MPI Reference #9 Alkyd, Exterior, Gloss (MPI Gloss Level 6)

##### Mil Standard

MIL-DTL-24441C/19B Paint, Epoxy-Polyamide, Zinc Primer, Formula 159, Type III

**National Fire Protection Association (NFPA)**

NFPA-780

Standard for the Installation of Lightning Protection Systems

**END OF ITEM 103**

## Item 106 Apron Lighting

### DESCRIPTION

**106-1.1** This item shall consist of furnishing and installing apron floodlights, light poles, light pole foundations, internal fusing, anchor bolts, fixture brackets, ballasts, and lamps. This work shall include aiming of the luminaires to obtain the light levels specified herein and testing of light fixtures with portable power supply, the installation of light pole foundations and all incidentals necessary to place the apron lighting in operating condition as a completed units to the satisfaction of the Resident Engineer

**106-1.2** Light pole locations are specified in the contract documents and deviation from these locations shall not be permitted without the written approval of the Engineer.

A scaled computer analysis showing expected light levels on the apron shall be provided with the luminaire shop drawings. The input sheet shall also be provided and shall show all luminaire locations, mounting heights, aiming directions and tilts. Tilts in excess of 20 degrees shall not be allowed. A computer disk with photometrics in I.E.S. format shall also be submitted.

**106-1.3** The shafts of the light pole foundations shall be cased to overcome unsuitable soil conditions and permit removal of water. The work shall be performed in a manner that will confine disturbance of surrounding materials to a minimum. The light pole foundations shall receive full lateral support from the surrounding materials.

Applicable standards include the latest revision of the following:

- a. ACI 336.01, Specification for Construction of Drilled Piers
- b. ASTM A252, Standard Specification for Welded and Seamless Steel Pipe Piles

The installer of the light pole foundations shall not have less than five (5) years of documented experience in similar installations.

Light pole foundation construction shall conform to the requirements of all codes, regulations, ordinances or laws as may apply thereto. The Contractor is also required to be familiar with and to comply with all OSHA, EPA, and any other federal, state or local requirements which pertain to this work. All tests, materials or additional work called for by said requirements shall be provided at no extra expense to the Airport. All poles supplied shall be certified to be vibration-free at all wind loads.

**106-1.4** All steel used in the construction of this item shall be of 100% domestic origin.

### EQUIPMENT AND MATERIALS

**106-2.1** **Light fixtures.** The apron floodlight fixture housing shall be formed from heavy gauge aluminum and shall be internally welded. All external hardware shall be stainless steel. The housing dimensions shall be as specified in the contract documents and the unit shall be UL listed for wet locations.

The lens frame shall be extruded, metered clear anodized aluminum and shall be welded into one (1) piece and permanently fastened to the housing with a full-length hinge.

The flat, thermal and shock resistant glass lens shall be sealed to the lens frame and secured with form corner keys.

The lens shall be silicone sealed in the extruded "U" channel lens frame. The lens frame shall be gasketed to the housing internal reinforcement ring with silicone impregnated Dacron type gasketing.

The luminaires shall have a type F reflector system. The reflector shall have a sharp cutoff at 70 degrees with maximum candlepower at 65 degrees. The multiple faceted, segmented reflector system shall be constructed of electro-brightened, anodized and sealed aluminum. Each reflector system shall be outfitted with porcelain base lamp holders and insulated lamp supports.

The reflector system shall also be fully enclosed. All photometric data shall be certified by an independent testing facility.

The fixture shall be mounted on the pole using the "K-swivel" knuckle for mounting on a pole with a 2.375-inch outer diameter tenon. The swivel knuckle's cast aluminum adjustable knuckle shall be serrated for positive locking in position. The knuckle shall be provided with a fully enclosed integral junction box.

The fixture shall be pretreated, primed, baked, covered with a high solid polyester finish and baked again. Contractor shall verify finish color before ordering. The double baked finish shall meet or exceed all AAMA requirements for 1,000-hour salt spray exposure.

Luminaires shall be suitable for use with 1,000-watt high pressure sodium lamps or equivalent light emitting diode (LED) lamps as approved by the Engineer. Luminaires shall operate at 240-volt AC.

It shall be the responsibility of the Contractor to aim the proposed luminaires as directed by the Engineer.

All lamps shall be 1,000-watt high pressure sodium or equivalent LED lamps as approved by the Engineer. One (1) spare lamp shall be provided. Lamps shall be installed by Contractor just prior to testing of the system to reduce the possibility of breakage. Broken lamps shall be replaced at the Contractor's expense.

Units shall have ballasts operating on 240-volt, 1 phase, 60 hertz and be capable of starting the lamps indicated herein down to a temperature of -20°F. Ballasts shall be of high-power factor autotransformer type. They shall be an integral but easily replaceable part of the luminaires.

It shall be the responsibility of the Contractor and his or her lighting supplier to provide any shielding and/or aiming of luminaires required to prevent glare from direct or reflected light in the pilot's field of vision.

**106-2.2 Light pole.** The proposed round tapered poles shall be of the type and height specified in the contract documents and shall be of one (1) or two (2) section design, unless otherwise shown in the plans. Each section shall be one (1) piece construction with a full-length longitudinal weld and shall be cylindrical in cross-section having a uniform taper of 0.14 inches of diameter change per foot of length.

The anchor base shall be fabricated from a structural quality hot rolled carbon steel plate that meets or exceeds a minimum yield strength of 36,000 pounds per square inch. The anchor base shall telescope the pole shaft and shall be circumferentially welded at top and bottom.

Anchor bolts shall also be supplied by the pole manufacturer. Anchor bolts shall be fabricated from a commercial quality hot rolled carbon steel bar that meets or exceeds a minimum yield strength of 50,000 pounds per square inch. Four (4) properly sized anchor bolts, each furnished with two (2) regular hex nuts and washers shall be furnished and shipped with the poles. Anchor bolts shall have the threaded end galvanized a minimum of eight (8) inches.

The pole shall also have a five (5) inch by eight (8) inch handhole and opening for receptacle located 18 inches above the base. Pole color shall be as specified in the contract documents. Poles shall come complete with mounting plates for mounting of proposed fixture brackets.

The Contractor shall verify finish color and size before ordering the proposed poles and shall submit shop drawings on all parts of the poles including the poles, brackets, tenons, handholes, mounting methods, colors, finish procedures and written warranties.

Brackets for light poles shall be as specified in the contract documents. Brackets, poles and fixtures shall be matched for a perfect fit. Bracket shall have mounting plate attached that matches mounting plate on proposed poles. Bracket stubs for installation of fixtures shall be suitable for the slipfitter furnished with floodlight fixture and shall come as a complete unit with any adapters which also may be required. Each bracket shall be capable of supporting two (2) fixtures and one (1) obstruction light.

**106-2.3 Lightning arresters.** Each pole shall be furnished with a 240-volt or 480-volt respectively, lightning arrester. Lightning arrester shall have 3,200-volt impulse sparkover and shall have a minimum of 10,000 ampere discharge current. Lightning arresters shall be installed in the light pole handholes.

**106-2.4 Light pole foundations.** Apron light pole foundations shall be as specified in the contract documents. Reinforcing steel shall be installed as specified in the contract documents.

Anchor bolts shall be supplied by the pole manufacturer and shall be installed according to their recommendations. Anchor bolts shall be "L" shaped and shall be minimum one (1) inch diameter, 36 inches long with seven (7) inch "L" unless otherwise recommended by the pole manufacturer.

Foundations shall conform to the applicable sections of Item 610 titled CONCRETE FOR MISCELLANEOUS STRUCTURES. Light pole foundations shall extend 30 inches above finished grade.

Breakaway couplings and skirt shall be provided for each base mounted pole.

**106-2.5 Internal wirings.** All fusing shall be accessible through the pole handhole for the light poles. The Contractor shall provide the waterproof splices, breakaway fuse holders, fuses and other miscellaneous items necessary for a complete installation. All splicing of wiring from main power wiring to No. 10 gauge wiring within pole shall be done at concrete handhole at each pole. All fuses and lightning arrestors shall be within the light pole handhole.

**106-2.6 Ground rods.** All light poles shall be furnished with a ground rod as specified in the contract documents. Ground rods shall be copper-clad steel. The ground rods shall be of the length and diameter specified on the plans, but in no case be less than ten (10) feet long and five-eighths (5/8) inch in diameter. The top of the rod shall be buried a minimum of 12 inches below finished grade. All the connections to the ground rod shall be buried minimum 12 inches below finished grade. All the connections to the ground rods shall be one (1) shot exothermic welding.

### CONSTRUCTION METHODS

**106-3.1 Poles and luminaires.** Poles and luminaires shall be assembled and wired on the ground, then lifted and bolted in place plumb. The pole shall be considered plumb when the center of the top is directly over the center of the base. Plumb is to be measured with a transit by the Contractor and checked by the Resident Engineer.

The wiring run from luminaire to pole base shall have a strain relief clamp provided at the entry to the luminaire to prevent the wires from pulling loose from their terminals at the luminaire.

The internal wiring of poles and luminaires including fuses and waterproof splices shall be considered incidental to the contract and as a subsidiary obligation of the Contractor.

The poles and luminaires shall be set on their foundations such that the luminaires aim in the direction as specified in the contract documents.

All proposed poles shall be grounded to ground rods. Contractor shall use one (1) shot exothermic weld.

**106-3.2 Light pole foundations.** The Contractor shall be responsible for the necessary concreting and formwork to install the foundations as specified in the contract documents.

The Contractor is referred to Item 610 titled CONCRETE FOR MISCELLANEOUS STRUCTURES, which covers the proper installation of the concrete.

Foundations as specified in the contract documents shall extend as below finished grade or pavement. Foundations shall extend 30 inches above finished grade.

Anchor bolts shall be set according to the bolt circle requirements of the poles supplied. They shall be so arranged that when the pole and luminaire are erected, the luminaire will be properly aimed.

**106-3.2 Power and control.** The location of power and control materials and work to be performed shall be as specified in the contract documents. Electrical cable shall conform to the requirements of Item 108 titled UNDERGROUND POWER CABLE FOR AIRPORTS. The Contractor shall furnish and install identifying tags on all wires at the point where they connect to the breaker indicating which lights the wires serve. The Contractor shall stencil an identifying label on the control panel enclosure.

**106-3.3 Restoration.** All areas disturbed by the light fixture installation, and storing of dirt and other, work shall be restored to its original condition. The restoration shall include any necessary top soiling, fertilizing, seeding or sodding and shall be performed in accordance with the Standard Turfing Specifications. The Contractor shall be held responsible for maintaining all disturbed surfaces and replacements until final acceptance.

#### METHOD OF MEASUREMENT

**106-4.1** The quantity of light poles shall be measured for payment by the number of each unit installed as specified, completed, ready for operation, and accepted by the Resident Engineer.

#### BASIS OF PAYMENT

**106-5.1** Payment for accepted quantities of work performed by the Contractor and measured by the Resident Engineer shall be made at the contract unit price as specified in paragraph 106-4.1 of this section. Payment shall be full compensation for furnishing all materials and for all preparation, assembly, and installation of these materials, and for all labor, equipment, tools, and incidentals necessary to complete the work as specified.

#### REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

##### **ASTM International (ASTM)**

ASTM A252                      Standard Specification for Welded and Seamless Steel Pipe Piles

##### **American Concrete Institute (ACI)**

ACI 336.01                      Specification for Construction of Drilled Piers

#### END OF ITEM 106



## Item 107 Airport Wind Cones

### DESCRIPTION

- 107-1.1** This item shall consist of removal of existing airport wind cones and furnishing and installing airport wind cones p. The work shall include the furnishing and installation of a support for mounting the wind cone, the specified interconnecting wire, and a concrete foundation. The item shall also include all cable connections, conduit and conduit fittings, the furnishing and installation of all lamps, ground rod and ground connection, the testing of the installation, and all incidentals necessary to place the wind cones in operating condition as a completed units to the satisfaction of the Resident Engineer.

### EQUIPMENT AND MATERIALS

**107-2.1 General.**

- a. Airport lighting equipment and materials covered by advisory circulars shall be certified in the current Federal Aviation Administration Advisory Circular (AC) 150/5345-53, *Airport Lighting Equipment Certification Program (ALECP)* and listed in the ALECP Addendum. FAA certified airfield lighting shall be compatible with each other to perform in compliance with FAA criteria and the intended operation. If the Contractor provides equipment that does not performs as intended because of incompatibility with the system, the Contractor assumes all costs to correct the system for to operate properly.
- b. All other equipment and materials covered by other referenced specifications shall be subject to acceptance through manufacturer's certification of compliance (COC) with the applicable specification when requested by the Engineer.
- c. Manufacturer's certifications shall not relieve the Contractor of the responsibility to provide materials per these specifications. Materials supplied and/or installed that do not comply with these specifications shall be removed, when directed by the Resident Engineer, and replaced with materials that comply with these specifications, at the Contractor's cost.
- d. All materials and equipment used to construct this item shall be submitted to the Resident Engineer for approval prior to ordering the equipment. Submittals consisting of marked catalog sheets or shop drawings shall be provided. Submittal data shall be presented in a clear, precise and thorough manner. Original catalog sheets are preferred. Photocopies are acceptable provided they are as good a quality as the original. Clearly and boldly mark each copy to identify products or models applicable to this project. Indicate all optional equipment and delete any non-pertinent data. Submittals for components of electrical equipment and systems shall identify the equipment to which they apply on each submittal sheet. Markings shall be made bold and clear with arrows or circles (highlighting is not acceptable). Contractor is solely responsible for delays in the project that may accrue directly or indirectly from late submissions or resubmissions of submittals.
- e. The data submitted shall be sufficient, in the opinion of the Resident Engineer, to determine compliance with the contract documents. The Contractor's submittals shall be neatly bound in a properly sized 3-ring binder, tabbed by specification section or in electronic pdf format, tabbed by specification section. The Resident Engineer reserves the right to reject any and all equipment, materials or procedures, that do not meet the system design and the standards and codes, specified in this document.

- f. All equipment and materials furnished and installed under this section shall be guaranteed against defects in materials and workmanship for at least 12 months from the date of final acceptance by the Department. The defective materials and/or equipment shall be repaired or replaced, at the Department's discretion, at the Contractor's expense.

**107-2.2 Wind cones.** The primary and/or supplemental wind cone assembly shall be of the type, style, and size specified in the contract documents meeting the requirements of the current Federal Aviation Administration Advisory Circular (AC) 150/5345-27, Specification for Wind Cone Assemblies.

The illuminated wind cone must present a constant brightness to the pilot. Where the series lighting circuit is used as a power source to the wind cone, a power adapter that converts constant current to constant voltage must be installed per manufacturer's recommendations. The output voltage must remain constant regardless of the input current.

**107-2.3 Electrical wire and cable.** For ratings up to 600 volts, moisture and heat resistant thermoplastic wire conforming to Commercial Item Description A-A-59544A Type THWN-2 shall be used. Cable rated up to 5,000 volts in conduit shall conform to the current Federal Aviation Administration Advisory Circular (AC) 150/5345-7, *Specification for L-824 Underground Electrical Cable for Airport Lighting Circuits*. The wires shall be of the type, size, number of conductors, and voltage specified in the contract documents.

**107-2.4 Conduit.** Rigid steel conduit and fittings shall conform to the requirements of Underwriters Laboratories Standards 6, 514B, and 1242.

**107-2.5 Plastic conduit (for use below grade only).** Plastic conduit and fittings shall conform to the following requirements:

- UL 514B covers W-C-1094-Conduit fittings all types, classes 1 thru 3 and 6 thru 10.
- UL 514C covers W-C-1094-all types, Class 5 junction box and cover in plastic (PVC).
- UL 651 covers W-C-1094-Rigid PVC Conduit, types I and II, Class 4.
- UL 651A covers W-C-1094-Rigid PVC Conduit and high-density polyethylene (HDPE) Conduit type III and Class 4.

Underwriters Laboratories Standards UL-651 shall be one (1) of the following, as specified in the contract documents:

- a. Type I—Schedule 40 PVC suitable for underground use either direct-buried or encased in concrete.
- b. Type II—Schedule 40 PVC suitable for either above ground or underground use.

Plastic conduit adhesive shall be a solvent cement manufactured specifically for the purpose of gluing the type of plastic conduit and fitting.

**107-2.6 Concrete.** The concrete for foundations shall be proportioned, placed, and cured per Item 610 titled CONCRETE FOR MISCELLANEOUS STRUCTURES.

**107-2.7 Paint.**

- a. Priming paint for non-galvanized metal surfaces shall be a high solids alkyd primer compatible with the manufacturer's recommendations for the intermediate or topcoat.
- b. Priming paint for galvanized metal surfaces shall be zinc dust-zinc oxide primer paint conforming to MIL-DTL-24441C/19B. Use MIL-24441 thinner per paint manufacturer's recommendations.
- c. Orange paint for the body and the finish coats on metal and wood surfaces shall consist of a ready-mixed non-fading paint per Master Painter's Institute (MPI) Reference #9 (gloss). The color shall be per Federal Standards 595, International Orange, Number 12197.

- d. White paint for body and finish coats on metal and wood surfaces shall be ready-mixed paint conforming to the MPI, Reference #9, Exterior Alkyd, Gloss.
- e. Priming paint for wood surfaces shall be mixed on the job by thinning the above specified aviation-orange or white paint by adding one-half (1/2) pint of raw linseed oil to each gallon.

### CONSTRUCTION METHODS

**107-3.1 Installation.** The hinged support or hinged pole shall be installed on a concrete foundation as specified in the contract documents meeting the requirements of the current Federal Aviation Administration Advisory Circular (AC) 150/5340-30, *Design and Installation Details for Airport Visual Aids*.

**107-3.2 Support pole erection.** The Contractor shall erect the pole on the foundation following the manufacturer's requirements and erection details. The pole shall be level and secure.

**107-3.3 Electrical connection.** The Contractor shall furnish all labor and materials and shall make complete electrical connections per the wiring diagram furnished with the contract documents. The electrical installation shall conform to the requirements of the latest edition of National Fire Protection Association, NFPA-70, National Electric Code (NEC).

Underground cable and duct for cable installation shall be installed in accordance with Item 108 titled UNDERGROUND POWER CABLES FOR AIRPORTS, and Item 110 titled AIRPORT UNDERGROUND ELECTRICAL DUCT BANKS AND CONDUITS in locations as specified in the contract documents.

**107-3.4 Booster transformer.** If required to compensate for voltage drop to the wind cone, a booster transformer shall be installed in a suitable weatherproof housing under or on the tower platform or at the base of the tower as specified in the contract documents meeting the requirements of the current Federal Aviation Administration Advisory Circular (AC) 150/5340-30, *Design and Installation Details for Airport Visual Aids*.

If the booster transformer is required for installation, it shall be installed in accordance with and paid for as described in Item 109 titled AIRPORT TRANSFORMER VAULT AND VAULT EQUIPMENT.

**107-3.5 Ground connection and ground rod.** The Contractor shall furnish and install a ground rod, grounding cable, and ground clamps for grounding the "A" frame of the 12-foot assembly or pipe support of the eight (8) foot support near the base. The ground rod shall be of the type, diameter and length specified in Item 108 titled UNDERGROUND POWER CABLE FOR AIRPORTS. The ground rod shall be driven into the ground adjacent to the concrete foundation (minimum distance from foundation of two (2) feet) so that the top is at least six (6) inches below grade. The grounding cable shall consist of American wire gauge (AWG) minimum stranded copper wire of the gauge size as specified in the contract documents or larger and shall be firmly attached to the ground rod by exothermic welding. If an exothermic weld is not possible, connections to the grounding bus shall be made by using connectors approved for direct burial in soil or concrete per UL 467. The other end of the grounding cable shall be securely attached to a leg of the frame or to the base of the pipe support with non-corrosive metal and shall be of substantial construction. The resistance to ground shall not exceed 25 ohms. If a single rod grounding electrode has a resistance to earth of over 25 ohms, then install one (1) supplemental rod not less than ten (10) feet from the first rod. If desired resistance to ground levels are still not achieved, see FAA-STD-019 for guidance on the application of coke breeze.

**107-3.6 Painting.** Three (3) coats of paint shall be applied (one (1) prime, one (1) body, and one (1) finish) to all exposed material installed under this item except the fabric cone, obstruction light globe, and lamp reflectors. The wind cone assembly, if already painted upon receipt, shall be given one (1) finish coat of paint in lieu of the three (3) coats specified above. The paint shall be per MPI Reference #9 (gloss). The color shall be per Federal Standard 595, International Orange, Number 12197.

- 107-3.7 Light sources.** The Contractor shall furnish and install lamps per the manufacturer's instruction book.
- 107-3.8 Chain and padlock.** The Contractor shall furnish and install a suitable operating chain for lowering and raising the hinged top section. The chain shall be attached to the pole support in a manner to prevent the light fixture assembly from striking the ground in the lowered position. A padlock shall also be furnished by the Contractor on the eight (8) foot wind cone for securing the hinged top section to the fixed lower section. Keys for the padlock shall be delivered to the Resident Engineer.
- 107-3.9 Segmented circle.** The segmented circle shall be constructed as specified in the contract documents meeting the requirements of the current Federal Aviation Administration Advisory Circular (AC) 150/5340-5, *Segmented Circle Airport Marker System*.

#### METHOD OF MEASUREMENT

- 107-4.1** The quantity of wind cones shall be measured for payment by the number of each unit installed as specified, completed, ready for operation, and accepted by the Resident Engineer.
- 107-4.2** The quantity of segmented circle airport marker systems shall be measured by the number of completed units in place, accepted, and ready for operation.

#### BASIS OF PAYMENT

- 107-5.1** Payment for accepted quantities of work performed by the Contractor and measured by the Resident Engineer shall be made at the contract unit price as specified in paragraphs 107-4.1 and 107-4.2 of this section. Payment shall be full compensation for furnishing all materials and for all preparation, assembly, and installation of these materials, and for all labor, equipment, tools, and incidentals necessary to complete the work as specified.

#### REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

##### Commercial Item Description

A-A-59544	Cable and Wire, Electrical (Power, Fixed Installation)
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##### Federal Aviation Administration Advisory Circulars (AC)

AC 150/5340-5	Segmented Circle Airport Marker System
AC 150/5340-30	Design and Installation Details for airport Visual Aids
AC 150/5345-7	Specification for L-824 Underground Electrical Cable for Airport Lighting Circuits
AC 150/5345-27	Specification for Wind Cone Assemblies
AC 150/5345-53	Airport Lighting Equipment Certification Program

##### Federal Aviation Administration Standard (FAA STD)

FAA-STD-019	Lightning and Surge Protection, Grounding, Bonding and Shielding Requirements for Facilities and Electronic Equipment
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##### Federal Standard (FED STD)

FED STD 595	Colors Used in Government Procurement
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**Master Painter's Institute (MPI)**

MPI Reference #9 Alkyd, Exterior, Gloss (MPI Gloss Level 6)

**Mil Standard**

MIL-DTL-24441C/19B Paint, Epoxy-Polyamide, Zinc Primer, Formula 159, Type III

**National Fire Protection Association (NFPA)**

NFPA-70 National Electric Code (NEC)

**Underwriters Laboratories (UL)**

UL Standard 6 Electrical Rigid Metal Conduit – Steel  
UL Standard 514B Conduit, Tubing, and Cable Fittings  
UL Standard 514C Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers  
UL Standard 651 Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings  
UL Standard 651A Type EB and A Rigid PVC Conduit and HDPE Conduit  
UL Standard 1242 Electrical Intermediate Metal Conduit - Steel

**END OF ITEM 107**

## Item 108 Underground Power Cable for Airports

### DESCRIPTION

- 108-1.1** This item shall consist of furnishing and installing power cables that are direct buried and furnishing and/or installing power cables within conduit or duct banks per these specifications at the locations specified in the contract documents. It includes excavation and backfill of trench for direct-buried cables only. Also included are the installation of counterpoise wires, ground wires, ground rods and connections, cable splicing, cable marking, cable testing, and all incidentals necessary to place the cable in operating condition as a completed unit to the satisfaction of the Resident Engineer. This item shall not include the installation of duct banks or conduit, trenching and backfilling for duct banks or conduit, or furnishing or installation of cable for FAA owned/operated facilities.

All installations shall be done at the locations as specified in the contract documents. In areas where there is a congestion of buried cable, the Contractor will be required to trench the proposed cable into place. When crossing existing circuits, the Contractor will be required to hand dig the trenches for the proposed cable. The hand digging and trenching or plowing of this cable shall be considered incidental to the contract and as a subsidiary obligation of the Contractor.

The Contractor shall label all airfield lighting cables in ducts, manholes and the vault as directed by the Resident Engineer. All costs of labeling shall be considered incidental to the contract and as a subsidiary obligation of the Contractor.

### EQUIPMENT AND MATERIALS

**108-2.1 General.**

- a. Airport lighting equipment and materials covered by advisory circulars (AC) shall be certified in the current Federal Aviation Administration Advisory Circular (AC) 150/5345-53, *Airport Lighting Equipment Certification Program (ALECP)* and listed in the ALECP Addendum. FAA certified airfield lighting shall be compatible with each other to perform in compliance with FAA criteria and the intended operation. If the Contractor provides equipment that does not perform as intended because of incompatibility with the system, the Contractor assumes all costs to correct the system for to operate properly.
- b. All other equipment and materials covered by other referenced specifications shall be subject to acceptance through manufacturer's certification of compliance (COC) with the applicable specification, when requested by the Engineer.
- c. Manufacturer's certifications shall not relieve the Contractor of the responsibility to provide materials per these specifications. Materials supplied and/or installed that do not comply with these specifications shall be removed, when directed by the Resident Engineer, and replaced with materials that comply with these specifications at the Contractor's cost.
- d. All materials and equipment used to construct this item shall be submitted to the Resident Engineer for approval prior to ordering the equipment. Submittals consisting of marked catalog sheets or shop drawings shall be provided. Submittal data shall be presented in a clear, precise and thorough manner. Original catalog sheets are preferred. Photocopies are acceptable provided they are as good a quality as the original. Clearly and boldly mark each copy to identify products or models applicable to this project. Indicate all optional equipment and delete any non-pertinent data. Submittals for components of electrical equipment and

systems shall identify the equipment to which they apply on each submittal sheet. Markings shall be made bold and clear with arrows or circles (highlighting is not acceptable). The Contractor is solely responsible for delays in the project that may accrue directly or indirectly from late submissions or resubmissions of submittals.

- e. The data submitted shall be sufficient, in the opinion of the Resident Engineer, to determine compliance with the contract documents. The Contractor's submittals shall be neatly bound in a properly sized 3-ring binder, tabbed by specification section or electronically submitted in pdf format. The Resident Engineer reserves the right to reject any and all equipment, materials, or procedures that do not meet the system design and the standards and codes, specified in this document.
- f. All equipment and materials furnished and installed under this section shall be guaranteed against defects in materials and workmanship for at least 12 months from the date of final acceptance by the Department. The defective materials and/or equipment shall be repaired or replaced, at the Department's discretion, at the Contractor's expense. The Contractor shall maintain a minimum insulation resistance in accordance with paragraph 108-3.10 e with isolation transformers connected in new circuits and new segments of existing circuits through the end of the contract warranty period when tested in accordance with the current Federal Aviation Administration Advisory Circular (AC) 150/5340-26, *Maintenance Airport Visual Aid Facilities*, paragraph 5.1.3.1 titled INSULATION RESISTANCE TEST.

Only Third-Party certified manufacturers, listed in the current Federal Aviation Administration Advisory Circular (AC) 150/5345-53, *Airport Lighting Equipment Certification Program (ALECP)* and Appendix 3 Addendum (as required) and meeting the BUY AMERICAN preference requirements can provide equipment and materials specified in the contract documents. Documentation certifying compliance with the BUY AMERICAN preference rules for Airport Improvement Program (AIP) cited in 49 USC §50101) shall be included with each equipment and material submittal.

- 108-2.2 Cable.** Underground cable for airfield lighting facilities (runway and taxiway lights and signs) shall conform to the requirements of the current Federal Aviation Administration Advisory Circular (AC) 150/5345-7, *Specification for L-824 Underground Electrical Cable for Airport Lighting Circuits*. Conductors for use on 6.6 ampere primary airfield lighting series circuits shall be single conductor, seven (7) strand, No. 8 American wire gauge (AWG), L-824 Type C, 5,000 volts, non-shielded, with cross-linked polyethylene insulation. Conductors for use on 20 ampere primary airfield lighting series circuits shall be single conductor, seven (7) strand, No. 6 AWG, L-824 Type C, 5,000 volts, non-shielded, with cross-linked polyethylene insulation. L-824 conductors for use on the L-830 secondary of airfield lighting series circuits shall be sized in accordance with the manufacturer's recommendations. All other conductors shall comply with FAA and National Electric Code (NEC) requirements. Conductor sizes noted above shall not apply to leads furnished by manufacturers on airfield lighting transformers and fixtures.

Wire for electrical circuits up to 600 volts shall comply with Specification L-824 and/or Commercial Item Description A-A-59544A and shall be type THWN-2, 75°C for installation in conduit and RHW-2, 75°C for direct burial installations. Conductors for parallel (voltage) circuits shall be type and size and installed in accordance with NFPA-70, National Electrical Code.

Unless noted otherwise, all 600 volt and less non-airfield lighting conductor sizes are based on a 75°C, THWN-2, 600-volt insulation, copper conductors, not more than three (3) single insulated conductors, in raceway, in free air. The conduit/duct sizes are based on the use of THWN-2, 600 volt insulated conductors. The Contractor shall make the necessary increase in conduit/duct sizes for other types of wire insulation. In no case shall the conduit/duct size be reduced. The minimum power circuit wire size shall be No. 12 AWG.

Conductor sizes may have been adjusted due to voltage drop or other engineering considerations. Equipment provided by the Contractor shall be capable of accepting the quantity and sizes of conductors specified in the contract documents. All conductors, pigtails, cable step-down adapters, cable step-up adapters, terminal blocks and splicing materials necessary to

complete the cable termination/splice shall be considered incidental to the respective pay items provided.

Cable type, size, number of conductors, strand and service voltage shall be as specified in the contract document.

- 108-2.3 Bare copper wire (counterpoise, bare copper wire ground and ground rods).** Wire for counterpoise or ground installations for airfield lighting systems shall be No. 6 AWG bare solid copper wire for counterpoise and/or No. 6 AWG insulated stranded for grounding bond wire per ASTM B3 and ASTM B8, and shall be bare copper wire. For voltage powered circuits, the equipment grounding conductor shall comply with NEC Article 250.

Ground rods shall be copper-clad steel. The ground rods shall be of the length and diameter specified on the plans, but in no case be less than ten (10) feet long and five-eighths (5/8) inch in diameter.

Where counterpoise conductors are to be installed and where soil conditions would adversely affect bare copper wire, thermoplastic wire conforming to Commercial Item Description A-A-5954, latest edition, Type TW, 600-volt, may be used.

- 108-2.4 Cable connections.** In-line connections or splices of underground primary cables shall be of the type specified in the contract documents and shall be one (1) of the types listed below. When the plans or the proposal permit a choice of connection, the Contractor shall indicate in the bid the type of connection proposed. Only L-823 connectors shall be used for all L-824 cable airfield lighting circuit connections. No separate payment will be made for cable connections.

- a. **Cast splice.** A cast splice, employing a plastic mold and using epoxy resin equivalent to that manufactured by 3M™ Company, "Scotchcast" Kit No. 82-B, or an approved equivalent, used for potting the splice is acceptable. This means of splicing is the only type approved for telephone control cable.
- b. **Field-attached plug-in splice.** Field attached plug-in splices shall be installed as specified in the contract documents. The Contractor shall determine the outside diameter of the cable to be spliced and furnish appropriately sized connector kits and/or adapters. Tape or heat shrink tubing with integral sealant shall be in accordance with the manufacturer's requirements. Primary Connector Kits manufactured by Amerace, "Super Kit", Integro "Complete Kit", or approved equal is acceptable.

A field attached plug-in splices meeting the requirements of the current Federal Aviation Administration Advisory Circular (AC) 150/5345-26, *Specification for L-823 Plug and Receptacle, Cable Connectors*, employing connector kits, is acceptable for field attachment to single conductor cable.

- c. **Factory-molded plug-in splice.** A factory-molded plug-in splices meeting the requirements of the current Federal Aviation Administration Advisory Circular (AC) 150/5345-26, *Specification for L-823 Plug and Receptacle, Cable Connectors*, Factory-Molded to Individual Conductors, is acceptable.
- d. **The taped or heat-shrink splice.** Taped splices employing field-applied rubber, or synthetic rubber tape covered with plastic tape is acceptable. The rubber tape should meet the requirements of ASTM D4388 and the plastic tape should comply with Military Specification MIL-I-24391 or Commercial Item Description A-A-55809. Heat shrinkable tubing shall be heavy-wall, self-sealing tubing rated for the voltage of the wire being spliced and suitable for direct-buried installations. The tubing shall be factory coated with a thermoplastic adhesive-sealant that will adhere to the insulation of the wire being spliced forming a moisture- and dirt-proof seal. Additionally, heat shrinkable tubing for multi-conductor cables, shielded cables, and armored cables shall be factory kits that are designed for the application. Heat shrinkable tubing and tubing kits shall be manufactured by Tyco Electronics/ Raychem Corporation, Energy Division, or approved equivalent.



In all the above cases, connections of cable conductors shall be made using crimp connectors using a crimping tool designed to make a complete crimp before the tool can be removed. All L-823/L-824 splices and terminations shall be made per the manufacturer's recommendations and listings.

All connections of counterpoise, grounding conductors and ground rods shall be made by the exothermic process or approved equivalent, except that a light base ground clamp connector shall be used for attachment to the light base. All exothermic connections shall be made per the manufacturer's recommendations and listings.

Methods of attaching a ground to a galvanized light base shall meet the requirements of the current Federal Aviation Administration Advisory Circular (AC) 150/5340-30, *Design and Installation Details for Airport Visual Aids*.

**108-2.5 Splicer qualifications.** Reserved.

**108-2.6 Concrete.** Concrete shall be proportioned, placed, and cured per Item 610 titled CONCRETE FOR MISCELLANEOUS STRUCTURES.

**108-2.7 Flowable backfill.** Flowable material used to backfill trenches for power cable trenches shall conform to the requirements of Item 153 titled CONTROLLED LOW STRENGTH MATERIAL.

**108-2.8 Cable identification tags.** Cable identification tags shall be made from a non-corrosive material with the circuit identification stamped or etched onto the tag. The tags shall be of the type as specified in the contract documents.

**108-2.9 Tape.** Electrical tapes shall be Scotch™ Electrical Tapes –Scotch™ 88 (1-1/2-inch wide) and Scotch™ 130C® linerless rubber splicing tape (two (2) inch wide), as manufactured by the Minnesota Mining and Manufacturing Company (3M™), or an approved equivalent.

**108-2.10 Electrical coating.** Electrical coating shall be Scotchkote™ as manufactured by 3M™, or an approved equivalent.

**108-2.11 Existing circuits.** Whenever the scope of work requires connection to an existing circuit, the existing circuit's insulation resistance shall be tested, in the presence of the Resident Engineer. The test shall be performed per this item and prior to any activity that will affect the respective circuit. The Contractor shall record the results on forms acceptable to the Engineer. When the work affecting the circuit is complete, the circuit's insulation resistance shall be checked again, in the presence of the Resident Engineer. The Contractor shall record the results on forms acceptable to the Engineer. The second reading shall be equal to or greater than the first reading or the Contractor shall make the necessary repairs to the existing circuit to bring the second reading above the first reading. All repair costs including a complete replacement of the L-823 connectors, L-830 transformers and L-824 cable, if necessary, shall be borne by the Contractor. All test results shall be submitted in the operation and maintenance manual.

Standard and alternative methods, and safety practices for measuring insulation resistance shall meet the requirements of the current Federal Aviation Administration Advisory Circular (AC) 150/5340-26, *Maintenance of Airport Visual Aid Facilities*.

**108-2.12 Detectable warning tape.** Plastic, detectable, American Public Works Association (APWA) Red (electrical power lines, cables, conduit and lighting cable) with continuous legend tape shall be polyethylene film with a metalized foil core and shall be three (3) to six (6) inches wide. Detectable tape is incidental to the respective bid item. Detectable warning tape for communication cables shall be orange. Detectable warning tape color code shall comply with the APWA Uniform Color Code.

## CONSTRUCTION METHODS

**108-3.1 General.** The Contractor shall install the specified cable at the approximate locations specified in the contract documents. Unless otherwise shown on the plans, all cable required to cross under pavements expected to carry aircraft loads shall be installed in concrete encased duct banks. Cable shall be run without splices, from fixture to fixture.

Cable connections between lights will be permitted only at the light locations for connecting the underground cable to the primary leads of the individual isolation transformers. The Contractor shall be responsible for providing cable in continuous lengths for home runs or other long cable runs without connections unless otherwise authorized in writing by the Engineer or specified in the contract documents.

In addition to connectors being installed at individual isolation transformers, L-823 cable connectors for maintenance and test points shall be installed at locations specified in the contract documents. Cable circuit identification markers shall be installed on both sides of the L-823 connectors installed and on both sides of slack loops where a future connector would be installed.

Provide not less than three (3) feet of cable slack on each side of all connections, isolation transformers, light units, and at points where cable is connected to field equipment. Where provisions must be made for testing or for future above grade connections, provide enough slack to allow the cable to be extended at least one (1) foot vertically above the top of the access structure. This requirement also applies where primary cable passes through empty light bases, junction boxes, and access structures to allow for future connections, or as designated by the Resident Engineer.

Primary airfield lighting cables installed shall have cable circuit identification markers attached on both sides of each L-823 connector and on each airport lighting cable entering or leaving cable access points, such as manholes, hand holes, pull boxes, junction boxes, etc. Markers shall be of sufficient length for imprinting the cable circuit identification legend on one (1) line, using letters not less than one-quarter (1/4) inch in size. The cable circuit identification shall match the circuits specified in the contract documents.

**108-3.2 Installation in duct banks or conduits.** This item includes the installation of the cable in duct banks or conduit per the following paragraphs. The maximum number and voltage ratings of cables installed in each single duct or conduit, and the current-carrying capacity of each cable shall be per the latest version of the National Electric Code, or the code of the local agency or authority having jurisdiction.

The Contractor shall make no connections or splices of any kind in cables installed in conduits or duct banks.

Unless otherwise designated in the plans, where ducts are in tiers, use the lowest ducts to receive the cable first, with spare ducts left in the upper levels. Check duct routes prior to construction to obtain assurance that the shortest routes are selected and that any potential interference is avoided.

Duct banks or conduits shall be installed as a separate item per Item 110 titled AIRPORT UNDERGROUND ELECTRICAL DUCT BANKS AND CONDUIT. The Contractor shall run a mandrel through duct banks or conduit prior to installation of cable to ensure that the duct bank or conduit is open, continuous and clear of debris. The mandrel size shall be compatible with the conduit size. The Contractor shall swab out all conduits/ducts and clean light bases, manholes, etc., interiors immediately prior to pulling cable. Once cleaned and swabbed, the light bases and all accessible points of entry to the duct/conduit system shall be kept closed except when installing cables. Cleaning of ducts, light bases, manholes, etc., is incidental to the pay item of the item being cleaned. All raceway systems left open, after initial cleaning, for any reason shall be re-cleaned at the Contractor's expense. The Contractor shall verify existing ducts proposed for use in this project as clear and open. The Contractor shall notify the Resident Engineer of any blockage in the existing ducts.

The cable shall be installed in a manner that prevents harmful stretching of the conductor, damage to the insulation, or damage to the outer protective covering. The ends of all cables shall be sealed with moisture-seal tape providing moisture-tight mechanical protection with minimum bulk, or alternately, heat shrinkable tubing before pulling into the conduit and it shall be left sealed until connections are made. Where more than one (1) cable is to be installed in a conduit, all cable shall be pulled in the conduit at the same time. The pulling of a cable through duct banks or conduits may be accomplished by hand winch or power winch with the use of cable grips or pulling eyes. Maximum pulling tensions shall not exceed the cable manufacturer's recommendations. A non-hardening cable-pulling lubricant recommended for the type of cable being installed shall be used where required.

The Contractor shall submit the recommended pulling tension values to the Resident Engineer prior to any cable installation. If required by the Engineer, pulling tension values for cable pulls shall be monitored by a dynamometer in the presence of the Resident Engineer. Cable pull tensions shall be recorded by the Contractor and reviewed by the Resident Engineer. Cables exceeding the maximum allowable pulling tension values shall be removed and replaced by the Contractor at the Contractor's expense.

The manufacturer's minimum bend radius or NEC requirements (whichever is more restrictive) shall apply. Cable installation, handling and storage shall be per manufacturer's recommendations. During cold weather, particular attention shall be paid to the manufacturer's minimum installation temperature. Cable shall not be installed when the temperature is at or below the manufacturer's minimum installation temperature. At the Contractor's option, the Contractor may submit a plan, for review by the Engineer, for heated storage of the cable and maintenance of an acceptable cable temperature during installation when temperatures are below the manufacturer's minimum cable installation temperature.

Cable shall not be dragged across base can or manhole edges, pavement or earth. When cable must be coiled, lay cable out on a canvas tarp or use other appropriate means to prevent abrasion to the cable jacket.

**108-3.3 Installation of direct-buried cable in trenches.** Unless otherwise specified, the Contractor shall not use a cable plow for installing the cable. Cable shall be unreeled uniformly in place alongside or in the trench and shall be carefully placed along the bottom of the trench. The cable shall not be unreeled and pulled into the trench from one (1) end. Slack cable sufficient to provide strain relief shall be placed in the trench in a series of S curves. Sharp bends or kinks in the cable shall not be permitted. Not less than one (1) foot of cable slack shall be left on each side of all connections, isolation transformers, light units, and at all other points where cable is connected to field equipment. Additional slack cable shall be left in runway light bases, handholes, manholes, etc., where it is required to bring the cable above ground level to make connections. The amount of slack cable shall be as specified in the contract documents or stipulated by the Resident Engineer.

Where cables must cross over each other, a minimum of three (3) inches vertical displacement shall be provided with the topmost cable depth at or below the minimum required depth below finished grade.

**a. Trenching.** Where turf is well established and the sod can be removed, it shall be carefully stripped and properly stored. Trenches for cables may be excavated manually or with mechanical trenching equipment. Walls of trenches shall be essentially vertical so that a minimum of surface is disturbed. Graders shall not be used to excavate the trench with their blades. The bottom surface of trenches shall be essentially smooth and free from coarse aggregate. Unless otherwise specified, cable trenches shall be excavated to a minimum depth of 18 inches below finished grade per NEC Table 300.5, except as follows:

- When off the airport or crossing under a roadway or driveway, the minimum depth shall be 36 inches unless otherwise specified.

- Minimum cable depth when crossing under a railroad track, shall be 42 inches unless otherwise specified.

The Contractor shall excavate all cable trenches to a width not less than six (6) inches. Unless otherwise specified on the plans, all cables in the same location and running in the same general direction shall be installed in the same trench. Where two (2) or more cables are laid parallel in the same trench, they shall be placed laterally a minimum distance of three (3) inches apart, and the trench shall be widened sufficiently to accomplish this.

When rock is encountered, the rock shall be removed to a depth of at least three (3) inches below the required cable depth and it shall be replaced with bedding material of earth or sand containing no mineral aggregate particles that would be retained on a one-quarter (1/4-inch sieve. Flowable backfill material may alternatively be used.

Duct bank or conduit markers temporarily removed for trench excavations shall be replaced as required.

It is the Contractor's responsibility to locate existing utilities within the work area prior to excavation. Where existing active cables cross proposed installations, the Contractor shall ensure that these cables are adequately protected. Where crossings are unavoidable, no splices will be allowed in the existing cables, except as specified in the contract documents. At locations, such as in an existing duct or wireway, or near an existing light location, where existing cable to be replaced might obstruct or interfere with efficient operation of the electrical systems, it shall be removed and disposed of by the Contractor. The cost of removing and disposing of this existing cable shall be considered incidental to the contract and as a subsidiary obligation of the Contractor. Installation of new cable where such crossings must occur shall proceed as follows:

- (1) Existing cables shall be located manually. Unearthed cables shall be inspected to assure absolutely no damage has occurred.
- (2) Trenching, etc., in cable areas shall then proceed, with approval of the Resident Engineer, with care taken to minimize possible damage or disruption of existing cable, including careful backfilling in area of cable.

In the event that any previously identified cable is damaged during the course of construction, the Contractor shall be responsible for the complete replacement of the entire length of damaged cable between lights.

- b. Backfilling.** On all areas outside of the pavement areas, the bottom of the trench shall be built up with suitable compacted backfill material so the conduit will have a smooth bed. Backfill material shall be free of brick, rock, or any material that could damage the conduit. Backfill material shall meet the approval of the Engineer. Backfill shall be deposited in uniform lifts not exceeding six (6) inches thick loose measure. The material in each lift shall be mechanically compacted to the satisfaction of the Resident Engineer by ramming or tamping with power tools approved by the Engineer in such a manner as not to disturb or damage the conduit. Flowable backfill may alternatively be used.

If the cable is to be installed in locations or areas under pavements, backfill with controlled low strength material (CLSM) in accordance with Item 153 titled CONTROLLED LOW STRENGTH MATERIAL.

Trenches shall not contain pools of water during backfilling operations. The trench shall be completely backfilled and tamped level with the adjacent surface, except that when turf is to be established over the trench, the backfilling shall be stopped at an appropriate depth consistent with the type of turving operation to be accommodated. A proper allowance for settlement shall also be provided. Any excess excavated material shall be removed and disposed of as specified in the contract documents.

Underground electrical warning (caution) tape shall be installed in the trench above all direct-buried cable. Contractor shall submit a sample of the proposed warning tape for

acceptance by the Resident Engineer. If not shown on the plans, the warning tape shall be located six (6) inches above the direct-buried cable or the counterpoise wire if present. A three (3) to six (6) inch wide polyethylene film detectable tape, with a metalized foil core, shall be installed above all direct buried cable or counterpoise. The tape shall be of the color and have a continuous legend as specified in the contract documents. The tape shall be installed eight (8) inches minimum below finished grade.

- c. Restoration.** Following restoration of all trenching near airport movement surfaces, the Contractor shall visually inspect the area for foreign object debris (FOD) and remove any that is found. Where soil and/or sod has been removed, it shall be replaced as soon as possible after the backfilling is completed. All areas disturbed by work shall be restored to its original condition. The restoration shall include any necessary sodding, topsoiling, fertilizing, liming, seeding, sprigging, mulching, or other landscaping as specified in the contract documents. All such work shall be performed in accordance with Part 12 titled TURFING. The Contractor shall be held responsible for maintaining all disturbed surfaces and replacements until final acceptance. When trenching is through paved areas, restoration shall be equal to existing conditions. The cost of restoration shall be considered incidental to the contract and as a subsidiary obligation of the Contractor.

- 108-3.4 Cable markers for direct-buried cable.** The location of direct buried circuits shall be marked by a concrete slab marker, two (2) feet square and four (4) to six (6) inch thick, extending approximately one (1) inch above the surface. Each cable run from a line of lights and signs to the equipment vault shall be marked at approximately every 200 feet along the cable run, with an additional marker at each change of direction of cable run. All other direct-buried cable shall be marked in the same manner. Cable markers shall be installed directly above the cable. The Contractor shall impress the word "CABLE" and directional arrows on each cable marking slab. The letters shall be approximately four (4) inches high and three (3) inches wide, with width of stroke one-half (1/2) inch and one-quarter (1/4) inch deep. Stencils shall be used for cable marker lettering; no hand lettering shall be permitted.

At the location of each underground cable connection/splice, except at lighting units, or isolation transformers, or power, a concrete marker slab shall be installed to mark the location of the connection/splice. The Contractor shall impress the word "SPLICE" on each slab. The Contractor also shall impress additional circuit identification symbols on each slab as directed by the Resident Engineer. All cable markers and splice markers shall be painted international orange. Paint shall be specifically manufactured for uncured exterior concrete. After placement, all cable or splice markers shall be given one (1) coat of high-visibility aviation orange paint as approved by the Resident Engineer. Furnishing and installation of cable markers is incidental to the respective cable pay item.

- 108-3.5 Splicing.** Connections of the type specified in the contract documents shall be made by experienced personnel regularly engaged in this type of work and shall be made as follows:
- a. Cast splices.** These shall be made by using crimp connectors for jointing conductors. Molds shall be assembled, and the compound shall be mixed and poured per the manufacturer's instructions and to the satisfaction of the Resident Engineer.
- b. Field-attached plug-in splices.** These shall be assembled per the manufacturer's instructions. These splices shall be made by plugging directly into mating connectors. The joint where the connectors come together shall be finished by one (1) of the following methods: (1) wrapped with at least one (1) layer of rubber or synthetic rubber tape and one (1) layer of plastic tape, one-half (1/2) lapped, extending at least 1-1/2 inches on each side of the joint (2) Covered with heat shrinkable tubing with integral sealant extending at least 1-1/2 inches on each side of the joint or (3) On connector kits equipped with water seal flap; roll-over water seal flap to sealing position on mating connector.
- c. Factory-molded plug-in splices.** These shall be made by plugging directly into mating connectors. The joint where the connectors come together shall be finished by one (1) of the following methods: (1) Wrapped with at least one (1) layer of rubber or synthetic rubber

tape and one (1) layer of plastic tape, one-half (1/2) lapped, extending at least 1-1/2 inches on each side of the joint. (2) Covered with heat shrinkable tubing with integral sealant extending at least 1-1/2 inches on each side of the joint. or (3) On connector kits so equipped with water seal flap; roll-over water seal flap to sealing position on mating connector.

**d. Taped or heat-shrink splices.** A taped splice shall be made in the following manner:

Bring the cables to their final position and cut so that the conductors will butt. Remove insulation and jacket allowing for bare conductor of proper length to fit compression sleeve connector with one-quarter (1/4) inch of bare conductor on each side of the connector. Prior to splicing, the two (2) ends of the cable insulation shall be penciled using a tool designed specifically for this purpose and for cable size and type. Do not use emery paper on splicing operation since it contains metallic particles. The copper conductors shall be thoroughly cleaned. Join the conductors by inserting them equidistant into the compression connection sleeve. Crimp conductors firmly in place with crimping tool that requires a complete crimp before tool can be removed. Test the crimped connection by pulling on the cable. Scrape the insulation to assure that the entire surface over which the tape will be applied (plus three (3) inches on each end) is clean. After scraping, wipe the entire area with a clean lint-free cloth. Do not use solvents.

Apply high-voltage rubber tape one-half (1/2) lapped over bare conductor. This tape should be tensioned as recommended by the manufacturer. Voids in the connector area may be eliminated by highly elongating the tape, stretching it just short of its breaking point. The manufacturer's recommendation for stretching tape during splicing shall be followed. Always attempt to exactly half-lap to produce a uniform buildup. Continue buildup to 1-1/2 times cable diameter over the body of the splice with ends tapered a distance of approximately one (1) inch over the original jacket. Cover rubber tape with two (2) layers of vinyl pressure-sensitive tape one-half (1/2) lapped. Do not use glyptol or lacquer over vinyl tape as they react as solvents to the tape. No further cable covering or splice boxes are required.

Heat shrinkable tubing shall be installed following manufacturer's instructions. Direct flame heating shall not be permitted unless recommended by the manufacturer. Cable surfaces within the limits of the heat-shrink application shall be clean and free of contaminants prior to application.

Splices will be allowed in new circuits only at fixtures, handholes and splice cans as detailed on plans. No direct burial of splices will be allowed.

**e. Assembly.** Surfaces of equipment or conductors being terminated or connected shall be prepared in accordance with industry standard practice and manufacturer's recommendations. All surfaces to be connected shall be thoroughly cleaned to remove all dirt, grease, oxides, nonconductive films, or other foreign material. Paints and other nonconductive coatings shall be removed to expose base metal. Clean all surfaces at least one-quarter (1/4) inch beyond all sides of the larger bonded area on all mating surfaces. Use a joint compound suitable for the materials used in the connection. Repair painted/coated surface to original condition after completing the connection.

**108-3.6 Bare counterpoise wire installation for lightning protection and grounding.** If specified in the contract documents, bare solid No. 6 AWG copper counterpoise wire shall be installed for lightning protection of the underground cables. The Project Engineer shall select one (1) of two (2) methods of lightning protection for the airfield lighting circuit based upon sound engineering practice and lightning strike density.

**a. Equipotential Method.** The counterpoise size is as specified in the contract documents. The equipotential method is applicable to all airfield lighting systems; runway, taxiway, apron, touchdown zone, centerline, edge, threshold and approach lighting systems. The equipotential method is also successfully applied to provide lightning protection for power, signal and communication systems. The light bases and counterpoise are bonded together and bonded to the vault power system ground loop/electrode.

Counterpoise wire shall be installed in the same trench for the entire length of buried cable, conduits and duct banks that are installed to contain airfield cables. The counterpoise is centered over the cable/conduit/duct to be protected. Counterpoise wire shall not be installed in conduit

The counterpoise conductor shall be installed no less than eight (8) inches minimum or 12 inches maximum above the raceway or cable to be protected, except as permitted below:

- (1) The minimum counterpoise conductor height above the raceway or cable to be protected shall be permitted to be adjusted subject to coordination with the airfield lighting and pavement designs.
- (2) The counterpoise conductor height above the protected raceway or cable shall be calculated to ensure that the raceway or cable is within a 45-degree area of protection, (45 degrees on each side of vertical creating a 90-degree angle).

The counterpoise conductor shall be bonded to each metallic light base, mounting stake, and metallic airfield lighting component.

All metallic airfield lighting components in the field circuit on the output side of the constant current regulator (CCR) or other power source shall be bonded to the airfield lighting counterpoise system.

All components rise and fall at the same potential; with no potential difference, no damaging arcing and no damaging current flow.

The Equipotential Method of lightning protection shall meet the requirements of the current Federal Aviation Administration Advisory Circular (AC) 150/5340-30, *Design and Installation Details for Airport Visual Aids* and NFPA 780, *Standard for the Installation of Lightning Protection Systems*, Chapter 11.

- b. Isolation Method.** Counterpoise size is as specified in the contract documents. The isolation method is an alternate method for use only with edge lights installed in turf and stabilized soils and raceways installed parallel to and adjacent to the edge of the pavement. NFPA 780 uses 15 feet to define "adjacent to".

The counterpoise conductor shall be installed halfway between the pavement edge and the light base, mounting stake, raceway, or cable being protected.

The counterpoise conductor shall be installed eight (8) inches minimum below grade. The counterpoise is not connected to the light base or mounting stake. An additional grounding electrode is required at each light base or mounting stake. The grounding electrode is bonded to the light base or mounting stake with a No. 6 AWG solid copper conductor.

The Isolation Method of lightning protection shall meet the requirements of the current Federal Aviation Administration Advisory Circular (AC) 150/5340-30, *Design and Installation Details for Airport Visual Aids* and NFPA 780, *Standard for the Installation of Lightning Protection Systems*, Chapter 11.

- c. Common installation requirements.** When a metallic light base is used, the grounding electrode shall be bonded to the metallic light base or mounting stake with a No. 6 AWG bare, annealed or soft drawn, solid copper conductor.

When a nonmetallic light base is used, the grounding electrode shall be bonded to the metallic light fixture or metallic base plate with a No. 6 AWG bare, annealed or soft drawn, solid copper conductor.

Grounding electrodes may be rods, ground dissipation plates, radials, or other electrodes listed in the NFPA 70 (NEC) or NFPA 780.

Where raceway is installed by the directional bore, jack and bore, or other drilling method, the counterpoise conductor shall be permitted to be installed concurrently with the directional bore, jack and bore, or other drilling method raceway, external to the raceway or sleeve.

The counterpoise wire shall also be exothermically welded to ground rods installed as shown on the plans but not more than 500 feet apart around the entire circuit. The counterpoise system shall be continuous and terminate at the transformer vault or at the power source. It shall be securely attached to the vault or equipment external ground ring or other made electrode-grounding system. The connections shall be made as specified in the contract documents.

Where an existing airfield lighting system is being extended or modified, the new counterpoise conductors shall be interconnected to existing counterpoise conductors at each intersection of the new and existing airfield lighting counterpoise systems.

- d. Parallel voltage systems.** Provide grounding and bonding in accordance with NFPA 70, National Electrical Code.

- 108-3.7 Counterpoise installation above multiple conduits and duct banks.** Counterpoise wires shall be installed above multiple conduits/duct banks for airfield lighting cables, with the intent being to provide a complete area of protection over the airfield lighting cables. When multiple conduits and/or duct banks for airfield cable are installed in the same trench, the number and location of counterpoise wires above the conduits shall be adequate to provide a complete area of protection measured 45 degrees each side of vertical.

Where duct banks pass under pavement to be constructed in the project, the counterpoise shall be placed above the duct bank as specified in the contract documents.

- 108-3.8 Counterpoise installation at existing duct banks.** When airfield lighting cables are specified in the contract documents to be routed through existing duct banks, the new counterpoise wiring shall be terminated at ground rods at each end of the existing duct bank where the cables being protected enter and exit the duct bank. The new counterpoise conductor shall be bonded to the existing counterpoise system.

- 108-3.9 Exothermic bonding.** Bonding of counterpoise wire shall be by the exothermic welding process or equivalent method accepted by the Engineer. Only personnel experienced in and regularly engaged in this type of work shall make these connections.

Contractor shall demonstrate to the satisfaction of the Resident Engineer, the welding kits, materials and procedures to be used for welded connections prior to any installations in the field. The installations shall comply with the manufacturer's recommendations and the following:

- a. All slag shall be removed from welds.
- b. Using an exothermic weld to bond the counterpoise to a lug on a galvanized light base is not recommended unless the base has been specially modified. Consult the manufacturer's installation directions for proper methods of bonding copper wire to the light base. See Galvanized light base exceptions shall meet the requirements of the current Federal Aviation Administration Advisory Circular (AC) 150/5340-30, *Design and Installation Details for Airport Visual Aids*.
- c. If specified in the contract documents, all buried copper and weld material at weld connections shall be thoroughly coated with one-quarter (1/4) inch of 3M™ Scotchkote™, or approved equivalent, or coated with coal tar Bitumastic® material to prevent surface exposure to corrosive soil or moisture.

- 108-3.10 Testing.** The Contractor shall furnish all necessary equipment and appliances for testing the airport electrical systems and underground cable circuits before and after installation. The Contractor shall perform all tests in the presence of the Resident Engineer. The Contractor shall demonstrate the electrical characteristics to the satisfaction of the Resident Engineer. All costs



for testing are incidental to the respective item being tested. For phased projects, the tests must be completed by phase. The Contractor must maintain the test results throughout the entire project as well as during the warranty period that meet the following:

- a. Earth resistance testing methods shall be submitted to the Engineer for approval. Earth resistance testing results shall be recorded on an approved form and testing shall be performed in the presence of the Resident Engineer. All such testing shall be at the sole expense of the Contractor.
- b. Should the counterpoise or ground grid conductors be damaged or suspected of being damaged by construction activities the Contractor shall test the conductors for continuity with a low resistance ohmmeter. The conductors shall be isolated such that no parallel path exists and tested for continuity. The Engineer shall approve of the test method selected. All such testing shall be at the sole expense of the Contractor.

After installation, the Contractor shall test and demonstrate to the satisfaction of the Resident Engineer the following:

- c. That all affected lighting power and control circuits (existing and new) are continuous and free from short circuits.
- d. That all affected circuits (existing and new) are free from unspecified grounds.
- e. That the insulation resistance to ground of all new non-grounded high voltage series circuits or cable segments is not less than 50 megohms. Verify continuity of all series airfield lighting circuits prior to energization.
- f. That the insulation resistance to ground of all new non-grounded conductors of new multiple circuits or circuit segments is not less than 100 megohms.
- g. That all affected circuits (existing and new) are properly connected per applicable wiring diagrams.
- h. That all affected circuits (existing and new) are operable. Tests shall be conducted that include operating each control not less than ten (10) times and the continuous operation of each lighting and power circuit for not less than one-half (1/2) hour.
- i. That the impedance to ground of each ground rod does not exceed 25 ohms prior to establishing connections to other ground electrodes. The fall-of-potential ground impedance test shall be used, as described by American National Standards Institute/Institute of Electrical and Electronic Engineers (ANSI/IEEE) Standard 81, to verify this requirement. As an alternate, clamp-on style ground impedance test meters may be used to satisfy the impedance testing requirement. Test equipment and its calibration sheets shall be submitted for review and approval by the Engineer prior to performing the testing.

Two (2) copies of tabulated results of all cable tests performed shall be supplied by the Contractor to the Resident Engineer. Where connecting new cable to existing cable, insulation resistance tests shall be performed on the new cable prior to connection to the existing circuit.

There are no approved "repair" procedures for items that have failed testing other than complete replacement.

**108-3.11 Locating of existing cables.** The location, size, and type of material of existing underground and/or aboveground utilities indicated in the contract documents are not represented as being accurate, sufficient, or complete. Neither the Department nor the Engineer assumes any responsibility whatever in respect to the accuracy, completeness, or sufficiency of the information. There is no guarantee, either expressed or implied, that the locations, size, and type of material of existing underground utilities indicated are representative of those to be encountered in the construction. It shall be the Contractor's responsibility to determine the actual location of all such facilities, including service connections to underground utilities. Prior to construction, the Contractor shall notify the utility companies of their operational plans, and shall

obtain, from the respective utility companies, detailed information and assistance relative to the location of their facilities and the working schedule of the companies for removal or adjustment, where required. In the event an unexpected utility interference is encountered during construction, the Contractor shall immediately notify the utility company of jurisdiction. The Resident Engineer shall also be immediately notified. Any damage to such mains and services shall be restored to service at once at the Contractor's expense.

All utility cables and lines shall be located by the respective utility. Contact Joint Utility Location Information for Excavators (JULIE) for utility information, phone: 1-800-892-0123. Contact the Federal Aviation Administration (FAA) for assistance in locating FAA cables and utilities. Location of FAA power, control, and communication cables shall be coordinated with and/or located by the FAA. Contact the Airport for assistance in locating underground Airport cables and/or utilities.

Contractor is responsible for the repairs of any utilities, lines, and/or cables damaged as a result of his operations.

Payment for locating and marking underground utilities and cables will not be paid for separately but shall be considered incidental to the respective pay item.

#### **METHOD OF MEASUREMENT**

- 108-4.1** The quantity of trenching, including excavation, backfill, and restoration shall be measured for payment by the linear feet as specified, completed, and accepted by the Resident Engineer. When specified, separate measurement shall be made for trenches of various specified widths.

The cost of all excavation, backfill, dewatering and restoration regardless of the type of material encountered shall be included in the unit price bid for the work.

- 108-4.2** The quantity of cable or counterpoise wire installed in trench, duct bank or conduit, including grounding connectors and trench marking tape, shall be measured for payment by the number of linear feet as specified, completed, and accepted by the Resident Engineer.

Separate measurement shall be made for each cable or counterpoise wire installed in trench, duct bank or conduit. The measurement for this item shall not include additional quantities required for slack.

Cable and counterpoise slack are considered incidental to this item and is included in the Contractor's unit price. No separate measurement or payment will be made for cable or counterpoise slack.

#### **BASIS OF PAYMENT**

- 108-5.1** Payment for accepted quantities of work performed by the Contractor and measured by the Resident Engineer shall be made at the contract unit price as specified in paragraphs 108-4.1 and 108-4.2 of this section. Payment shall be full compensation for furnishing all materials and for all preparation and installation of these materials, and for all labor, equipment, tools, and incidentals, including ground rods and ground connectors and trench marking tape, necessary to complete the work as specified.

#### **REFERENCES**

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

##### **ASTM International (ASTM)**

ASTM B3	Standard Specification for Soft or Annealed Copper Wire
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ASTM B8	Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM B33	Standard Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes
ASTM D4388	Standard Specification for Nonmetallic Semi-Conducting and Electrically Insulating Rubber Tapes

**American National Standards Institute (ANSI)/Institute of Electrical and Electronics Engineers (IEEE)**

ANSI/IEEE STD 81	IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System
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**Commercial Item Description**

A-A-59544A	Cable and Wire, Electrical (Power, Fixed Installation)
A-A-55809	Insulation Tape, Electrical, Pressure-Sensitive Adhesive, Plastic

**Federal Aviation Administration Advisory Circulars (AC)**

AC 150/5340-26	Maintenance of Airport Visual Aid Facilities
AC 150/5340-30	Design and Installation Details for Airport Visual Aids
AC 150/5345-7	Specification for L-824 Underground Electrical Cable for Airport Lighting Circuits
AC 150/5345-26	Specification for L-823 Plug and Receptacle, Cable Connectors
AC 150/5345-53	Airport Lighting Equipment Certification Program

**Federal Aviation Administration Standard (FAA STD)**

FAA STD-019E	Lightning and Surge Protection, Grounding Bonding and Shielding Requirements for Facilities and Electronic Equipment
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**Mil Spec**

MIL-PRF-23586F	Performance Specification: Sealing Compound (with Accelerator), Silicone Rubber, Electrical
MIL-I-24391	Insulation Tape, Electrical, Plastic, Pressure Sensitive

**National Fire Protection Association (NFPA)**

NFPA-70	National Electrical Code (NEC)
NFPA-780	Standard for the Installation of Lightning Protection Systems

**END OF ITEM 108**

## Item 109 Airport Transformer Vault and Vault Equipment

### DESCRIPTION

- 109-1.1** This item shall consist of removing an existing airport transformer vault and equipment and constructing an airport transformer vault or a prefabricated metal as specified in the contract documents. This work shall also include the installation of conduits in the floor and foundation, painting and lighting of the vault or metal housing, and the furnishing of all incidentals that are necessary to produce a completed unit. Included as a separate part under this item or as a separate item where an existing vault is to be used shall be the furnishing of all vault equipment, wiring, electrical buses, cable, conduit, potheads, and grounding systems. This work shall also include the painting of equipment and conduit; the marking and labeling of equipment and the labeling or tagging of wires; the testing of the installation; and the furnishing of all incidentals necessary to place it in operating condition as a completed unit to the satisfaction of the Resident Engineer.

### EQUIPMENT AND MATERIALS

**109-2.1 General.**

- a. Airport lighting equipment and materials covered by advisory circulars (AC) shall be certified in the current Federal Aviation Administration Advisory Circular (AC) 150/5345-53, *Airport Lighting Equipment Certification Program (ALECP)* and listed in the ALECP Addendum. FAA certified airfield lighting shall be compatible with each other to perform in compliance with FAA criteria and the intended operation. If the Contractor provides equipment that does not perform as intended because of incompatibility with the system, the Contractor assumes all costs to correct the system for to operate properly.
- b. All other equipment and materials covered by other referenced specifications shall be subject to acceptance through manufacturer's certification of compliance (COC) with the applicable specification when requested by the Engineer.
- c. Manufacturer's certifications shall not relieve the Contractor of the responsibility to provide materials per these specifications. Materials supplied and/or installed that do not comply with these specifications shall be removed, when directed by the Resident Engineer, and replaced with materials that comply with these specifications at the Contractor's cost.
- d. All materials and equipment used to construct this item shall be submitted to the Resident Engineer for approval prior to ordering the equipment. Submittals consisting of marked catalog sheets or shop drawings shall be provided. Submittal data shall be presented in a clear, precise and thorough manner. Original catalog sheets are preferred. Photocopies are acceptable provided they are as good a quality as the original. Clearly and boldly mark each copy to identify products or models applicable to this project. Indicate all optional equipment and delete any non-pertinent data. Submittals for components of electrical equipment and systems shall identify the equipment to which they apply on each submittal sheet. Markings shall be made bold and clear with arrows or circles (highlighting is not acceptable). The Contractor is solely responsible for delays in the project that may accrue directly or indirectly from late submissions or resubmissions of submittals.
- e. The data submitted shall be sufficient, in the opinion of the Resident Engineer, to determine compliance with the contract documents. The Contractor's submittals shall be neatly bound in a properly sized 3-ring binder, tabbed by specification section or provided in electronic

pdf format, tabbed by specification section. The Resident Engineer reserves the right to reject any and all equipment, materials or procedures that do not meet the system design and the standards and codes, specified in this document.

- f. All equipment and materials furnished and installed under this section shall be guaranteed against defects in materials and workmanship for a period of at least 12 months from final acceptance by the Department. The defective materials and/or equipment shall be repaired or replaced, at the Department's discretion, at the Contractor's expense.
- 109-2.2 Electrical vault building.** The electrical vault building must comply with NEC Article 110.31, Enclosure for Electrical Installations, Item (A) Electrical Vaults. Construct the building of materials having adequate structural strength for the conditions and installed location, has a minimum fire rating of two (2) or three (3) hours as determined by the authority having jurisdiction (AHJ), and is bullet resistant to minimum UL 752 Level 4.
- 109-2.3 Concrete.** Concrete shall be proportioned, placed, and cured per Item 610 titled CONCRETE FOR MISCELLANEOUS STRUCTURES.
- 109-2.4 Precast concrete structures.** Precast concrete products shall be per the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 19-08, Quality Control/Quality Assurance Program for Precast Concrete Products and/or be on the current Illinois Department of Transportation's published Qualified Producer List of *Certified Precast Concrete Producers*.
- 109-2.5 Reinforcing steel.** Reinforcing steel bars shall be intermediate or structural grade deformed-type bars and shall be per ASTM A706 Grade 60 and shall be of 100% domestic origin.
- 109-2.6 Brick.** Brick shall be per ASTM C62, Grade SW.
- 109-2.7 Rigid steel conduit.** Rigid steel conduit and fittings shall be per Underwriters Laboratories Standards 6 and 514B.
- 109-2.8 Plastic Conduit and fittings.** Plastic Conduit and fittings shall conform to the requirements of UL-651 and UL-654 schedule 40 polyvinyl chloride (PVC) suitable for use above or below ground.
- 109-2.9 Lighting.** Vault or metal-housing light fixtures shall be of a vapor-proof type.
- 109-2.10 Outlets.** Convenience outlets shall be heavy-duty duplex units designed for industrial service.
- 109-2.11 Switches.** Vault or metal-housing light switches shall be single-pole switches.
- 109-2.12 Paint.**
- Priming paint for non-galvanized metal surfaces shall be a high solids alkyd primer compatible with the manufacturer's recommendations for the intermediate or topcoat.
  - White paint for body and finish coats on metal and wood surfaces shall be ready-mixed paint conforming to the Master Painter's Institute (MPI), Reference #9, Exterior Alkyd, Gloss.
  - Priming paint for wood surfaces shall be mixed on the job by thinning the specified white paint by adding one-half (1/2) pint of raw linseed oil to each gallon.
  - Paint for the floor, ceiling, and inside walls shall be per Porter Paint Company 69, 71, and 79 or equivalent. Walls and ceiling shall be light gray and the floor shall be medium gray.
  - The roof coating shall be hot asphalt material per ASTM D2823. Asbestos-free roof coating per ASTM D4479 may be substituted if required by local codes.
- 109-2.13 Ground bus.** Ground bus shall be one-eighth (1/8) inch by three-quarters (3/4) inch minimum copper bus bar.
- 109-2.14 Square duct.** Duct shall be square similar to that manufactured by the Square D Company (or equivalent), or the Trumbull Electric Manufacturing Company (or equivalent). The entire front of the duct on each section shall consist of hinged or removable cover for ready access to the

interior. The cross-section of the duct shall be not less than four (4) inches by four (4) inches except where otherwise shown in the plans.

**109-2.15 Ground rods.** Ground rods shall be in accordance with Item 108 titled UNDERGROUND POWER CABLE FOR AIRPORTS.

**109-2.16 Vault prefabricated metal housing.** The prefabricated metal housing shall be a commercially available unit. It shall include any electrical apparatus such as mounting rails, channels, metal bus clamps, insulators, bushings, clips and other applicable packages as may be required. The size and type of transclosure including the concrete pad shall be as specified in the contract documents.

**109-2.17 FAA-approved equipment.** Certain items of airport lighting equipment installed in vaults are covered by the current individual Federal Aviation Administration Advisory Circulars (AC) listed below:

- AC 150/5345-3 Specification for L-821, Panels for Remote Control of Airport Lighting
- AC 150/5345-5 Circuit Selector Switch
- AC 150/5345-7 Specification for L-824 Underground Electrical Cable for Airport Lighting Circuits
- AC 150/5345-10 Specification for Constant Current Regulators and Regulator Monitors
- AC 150/5345-13 Specification for L-841 Auxiliary Relay Cabinet Assembly for Pilot Control of Airport Lighting Circuits.
- AC 150/5345-49 Specification for L-854, Radio Control Equipment
- AC 150/5345-56 Specification for L-890 Airport Lighting Control and Monitoring System (ALCMS)

**109-2.18 Other electrical equipment.** Distribution transformers, oil switches, cutouts, relays, terminal blocks, transfer relays, circuit breakers, and all other regularly used commercial items of electrical equipment not covered by FAA equipment specifications and advisory circular shall conform to the applicable rulings and standards of the Institute of Electrical and Electronic Engineers (IEEE) or the National Electrical Manufacturers Association (NEMA). When specified, test reports from a testing laboratory indicating that the equipment meets the specifications shall be supplied. In all cases, equipment shall be new and a first-grade product. This equipment shall be supplied in the quantities required for the specific project and shall incorporate the electrical and mechanical characteristics specified in the contract documents. Equipment selected and installed by the Contractor shall maintain the interrupting current rating of the existing systems or specified rating whichever is greater.

**109-2.19 Electrical wire and cable.** For ratings up to 600 volts, moisture and heat resistant thermoplastic wire conforming to Commercial Item Description A-A-59544A Type THWN-2 shall be used. Cable rated up to 5,000 volts shall conform to the current Federal Aviation Administration Advisory Circular (AC) 150/5345-7, *Specification for L-824 Underground Electrical Cables for Airport Lighting Circuits*. The wires shall be of the type, size, number of conductors, and voltage specified in the contract documents.

**a. Control circuits.** Unless otherwise indicated on the plans, wire shall be not less than No. 12 American wire gauge (AWG) and shall be insulated for 600 volts. If telephone control cable is specified, No. 19 AWG telephone cable per ANSI/Insulated Cable Engineers Association (ICEA) S-85-625 specifications shall be used.

**b. Power circuits.**

(1) 600 volts maximum – Wire shall be No. 6 AWG or larger and insulated for at least 600 volts.

- (2) 3,000 volts maximum – Wire shall be No. 6 AWG or larger and insulated for at least 3,000 volts.
- (3) Over 3,000 volts-Wire shall be No. 6 AWG or larger and insulated for at least the circuit voltage.

**109-2.20 Short circuit / coordination / device evaluation / arc flash analysis.** The Contractor shall, based upon the equipment provided, include as a part of the submittal process the electrical system “Short Circuit / Coordination / Device evaluation / Arc Flash Analysis”. The analysis shall be performed by the equipment manufacturer and submitted in a written report. The analysis shall be signed and sealed by a registered professional Engineer that is in good standing with the Illinois Department of Financial and Professional Regulation. The analysis shall comply with NFPA-70E and IEEE 1584.

The analysis will include: one (1) line diagrams, short circuit analysis, coordination analysis, equipment evaluation, arc flash analysis and arc flash labels containing at a minimum, equipment name, voltage/current rating, available incident energy and flash protection boundary.

The selected firm’s field service Engineer shall perform data gathering for analysis completion and device settings, perform device setting as recommended by the analysis and will furnish and install the arc flash labels. The components worst case incident energy will be considered the available arc flash energy at that specific point in the system. Submit three (3) written copies and one (1) electronic copy of the report.

## CONSTRUCTION METHODS

### CONSTRUCTION OF VAULT AND PREFABRICATED METAL HOUSING

**109-3.1 General.** The Contractor shall construct the transformer vault or prefabricated metal housing at the location specified in the contract documents. Vault construction shall be reinforced concrete, concrete masonry, or brick wall as specified. The metal housing shall be prefabricated equipment enclosure to be supplied in the size specified. The mounting pad or floor details, installation methods, and equipment placement are specified in the contract documents. Precast concrete structures shall be per the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 19-08, Quality Control/Quality Assurance Program for Precast Concrete Products and/or be on the current Illinois Department of Transportation’s published Qualified Producer List of *Certified Precast Concrete Producers*.

The Contractor shall clear, grade, and seed the area around the vault or metal housing for a minimum distance of ten (10) feet on all sides. The slope shall be not less than one-half (1/2) inch per foot away from the vault or metal housing in all directions.

The vault shall provide adequate protection against weather elements, including rain, wind-driven dust, snow, ice and excessive heat. The vault shall have sufficient filtered ventilation, to assure that the interior room temperatures and conditions do not exceed the recommended limits of the electrical equipment to be installed in the vault. The Contractor is responsible for contacting the manufacturer of the equipment to be installed to obtain environmental limitations of the equipment to be installed. Refer to the electrical vault detail plan sheets for construction requirements. The prefabricated building shall include roof, walls and floor in accordance with the details and these specifications.

**109-3.2 Foundation and walls.**

- a. **Reinforced concrete construction.** The Contractor shall construct the foundation and walls as specified in the contract documents. Unless otherwise specified, internal ties shall be of the mechanical type so that when the forms are removed the ends of the ties shall be at least one (1) inch beneath the concrete surface; the holes shall be plugged and finished

to prevent discoloration. Reinforcing steel shall be placed, as shown in the drawings, and secured in position to prevent displacement during the concrete placement.

The external surfaces of the concrete shall be thoroughly worked during the placing operation to force all coarse aggregate from the surface. Thoroughly work the mortar against the forms to produce a smooth finish free from air pockets and honeycomb.

The surface film of all pointed surfaces shall be removed before setting occurs. As soon as the pointing has set sufficiently, the entire surface inside and outside of the vault shall be thoroughly wet with water and rubbed with a No. 16 carborundum stone, or equivalent quality abrasive, bringing the surface to a paste. All form marks and projections shall be removed. The surface produced shall be smooth and dense without pits or irregularities. The materials which have been ground into a paste during the rubbing process shall be spread or brushed uniformly over the entire surface (except the interior surfaces that are to be painted shall have all paste removed by washing before painting) and permitted to reset. Final exterior finish shall be obtained by rubbing with No. 30 carborundum stone, or an equivalent quality abrasive. The surface shall be rubbed until the entire surface is smooth and uniform in color.

- b. Brick and concrete construction.** When this type of construction is specified, the foundation shall be concrete specified in the contract documents. The outer edge of the foundation at the floor level shall be beveled 1-1/2 inches at 45 degrees. Brick walls shall be eight (8) inches thick, laid in running bond with every sixth course a header course. Brick shall be laid in cement mortar (one (1) part masonry cement and three (3) parts sand) with full mortar bed and shoved joints. All joints shall be completely filled with mortar and facing brick shall be back-parged with mortar as work progresses. All joints shall be three-eighths (3/8) inch thick, exterior joints tooled concave, and interior joints struck flush. Both interior and exterior brick surfaces shall be cleaned, and nail holes, cracks and other defects filled with mortar. When specified, a nonfading mineral pigment mortar coloring shall be added to the mortar. Steel reinforcing bars, three-eighths (3/8) inch in diameter and 12 inches long, shall be set vertically in the center of the brick wall on not more than two (2) feet centers to project 2-1/2 inches into the concrete roof slab. Lintels for supporting the brickwork over doors, windows, and louvers shall consist of two (2) four (4) inch by three (3) inch by three-eighths (3/8) inch steel angles. Lintels shall be painted with one coat of corrosion-inhibiting primer before installation, and all exposed parts shall be painted similar to doors and window sash after installation.

Windowsills may be concrete poured in place or precast concrete as specified in the contract documents. All exposed surfaces shall have a rubbed finish as specified under reinforced concrete construction. After completion, all interior and exterior faces of walls shall be scrubbed with a solution of muriatic acid and water in the proportions of not less than one (1) part acid to ten (10) parts of water. All traces of efflorescence, loose mortar, and mortar stain shall be removed, and the walls washed down with clear water.

- c. Concrete masonry construction.** When this type of construction is specified, the foundation shall be concrete as specified in the contract documents. The concrete masonry units shall be standard sizes and shapes and shall conform to ASTM C90 and shall include the closures, jambs, and other shapes required by the construction as specified in the contract documents. Standard construction practice shall be followed for this type of work including mortar, joints, reinforcing steel for extensions into roof slab, etc. Plaster for interior walls, if specified, shall be Portland cement plaster.

- 109-3.3 Roof.** The roof shall be reinforced concrete as specified in the contract documents. Reinforcing steel shall be placed as shown in the drawing and secured in position to prevent displacement during the pouring of the concrete. The concrete shall be poured monolithically and shall be free of honeycombs and voids. The surface shall have a steel-troweled finish and shall be sloped as shown in the drawing. The underside of the roof slab shall be finished in the same manner as specified for walls.



One (1) brush or mop coat of hot asphalt roof coating shall be applied to the top surface of the roof slab. The asphalt material shall be heated to within the range specified by the manufacturer and immediately applied to the roof. The finished coat shall be continuous over the roof surface and free from holidays and blisters. Smears and dribbles of asphalt on the roof edges and building walls shall be removed.

- 109-3.4 Floor.** Construct the building foundation as specified in the contract documents. The floor shall be reinforced concrete as shown in the drawings. When present, all sod, roots, refuse, and other perishable material shall be removed from the area under the floor to a depth of eight (8) inches, unless a greater depth is specified in the invitation for bids. This area shall be backfilled with materials consisting of sand, cinders, gravel, or stone. Fill shall be placed in layers not to exceed four (4) inches and shall be thoroughly compacted by tamping or rolling. A layer of building paper shall be placed over the fill prior to placing concrete. The floor surfaces shall have a steel-troweled finish. The floor shall be level unless a drain is specified, in which case the floor shall be pitched one-quarter (1/4) inch per foot downward toward the drain. A one-quarter (1/4) inch asphalt felt expansion joint shall be placed between floor and foundation walls. The floor shall be poured monolithically and shall be free of honeycombs and voids.
- 109-3.5 Floor drain.** If specified in the contract documents, a floor drain and dry well shall be installed in the center of the floor of the equipment room. The dry well shall be excavated four (4) feet by four (4) feet square and to a depth of four (4) feet below the finished floor elevation and shall be backfilled to the elevation of the underside of the floor with gravel - which shall all pass a two (2) inch mesh sieve and shall all be retained on a one-quarter (1/4) inch mesh sieve. The gravel backfill shall be placed in six (6) inch maximum layers, and the entire surface of each layer shall be tamped either with a mechanical tamper or with a hand tamper weighing not less than 25 pounds and having a face area of not more than 36 square inches nor less than 16 square inches. The drain inlet shall be set flush in the concrete floor. The drain shall have a clear opening of not less than eight (8) inches in diameter.
- 109-3.6 Conduits in floor and foundation.** Conduits shall be installed in the floor and through the foundation walls as specified in the contract documents. All underground conduit shall be painted with an asphalt compound. Conduit shall be installed with a coupling or metal conduit adapter flush with the top of the floor. All incoming conduit shall be closed with a pipe plug to prevent the entrance of foreign material during construction. Space conduit entrances shall be left closed.
- 109-3.7 Doors.** Doors shall be metal-clad fireproof Class A (three (3) hour rated) doors conforming to requirements of the National Electrical Code (NEC) and local electrical codes. Panic bar exit hardware shall be installed per NEC requirements. Refer to the new electrical vault detail plan sheets for construction requirements.
- 109-3.8 Painting.** The floor, ceiling, and inside walls of concrete construction shall first be given a hardening treatment, after which the Contractor shall apply two (2) coats of paint as specified below, except that interior face brick walls need not be painted. The hardening treatment shall consist of applying two (2) coats of either a commercial floor hardener or a solution made by dissolving two (2) pounds of magnesium fluorosilicate or zinc sulfate crystals in one (1) gallon of water. Each coat shall be allowed to dry at least 48 hours before the next application. After the second treating coat has dried, the surfaces shall be brushed clean of all crystals and thoroughly washed with clear water. Paint for walls and ceiling shall be a light gray color approved by the Project Engineer. The floor paint shall be a medium gray color approved by the Project Engineer. Before painting, the surfaces shall be dry and clean. The first coat shall be thinned by adding two-thirds (2/3) quart of spar varnish and one-third (1/3) quart of turpentine to each gallon of paint. The second coat shall be applied without thinning. All doors, lintels, and windows shall be cleaned to remove any rust or foreign material and shall be given one (1) body and one (1) finish coat of white paint. Bare metal surfaces shall be given a prime coat of corrosion-inhibiting primer prior to the body and finish coats.

- 109-3.9 Lights and switches.** The Contractor shall furnish and install a minimum of two (2) duplex convenience outlets in the vault room. Where a control room is specified, at least two (2) duplex outlets shall be installed.

#### INSTALLATION OF EQUIPMENT IN VAULT OR PREFABRICATED METAL HOUSING

- 109-4.1 General.** The Contractor shall furnish, install, and connect all equipment, equipment accessories, conduit, cables, wires, buses, grounds, and support necessary to ensure a complete and operable electrical distribution center for the airport lighting system as specified in the contract documents. When specified, an emergency power supply and transfer switch shall be provided and installed.

The equipment installation and mounting shall comply with the requirements of the National Electrical Code (NEC) and local code agency having jurisdiction. All electrical work shall comply with the NEC and local code agency having jurisdiction including the separation of under 600-volt work from 5,000 volt work.

- 109-4.2 Power supply equipment.** Transformers, regulators, booster transformers, and other power supply equipment items shall be furnished and installed at the location specified in the contract documents or as directed by the Resident Engineer. The power supply equipment shall be set on steel "H" sections, "I" beams, channels, or concrete blocks to provide a minimum space of 1-1/2 inch between the equipment and the floor. The equipment shall be placed so as not to obstruct the oil-sampling plugs of the oil-filled units; and name-plates shall, so far as possible, not be obscured.

If specified in the contract documents, equipment for an alternate power source or an emergency power generator shall be furnished and installed. The alternate power supply installation shall include all equipment, accessories, an automatic changeover switch, and all necessary wiring and connections. The emergency power generator set shall be the size and type specified.

- 109-4.3 Switchgear and panels.** Oil switches, fused cutouts, relays, transfer switches, panels, panel boards, and other similar items shall be furnished and installed at the location specified in the contract documents or as directed by the Resident Engineer. Wall or ceiling mounted items shall be attached to the wall or ceiling with galvanized bolts of not less than three-eighths (3/8) inch diameter engaging metal expansion shields or anchors in masonry or concrete vaults.

- 109-4.4 Duct and conduit.** The Contractor shall furnish and install square-type exposed metallic ducts with hinged covers for the control circuits in the vault. These shall be mounted along the walls behind all floor-mounted equipment and immediately below all wall-mounted equipment. The hinged covers shall be placed to open from the front side with the hinges at the front bottom.

Wall brackets for square ducts shall be installed at all joints two (2) feet or more apart with intermediate brackets as specified. Conduit shall be used between square ducts and equipment or between different items of equipment when the equipment is designed for conduit connection. When the equipment is not designed for conduit connection, conductors shall enter the square-type control duct through insulating bushings in the duct or on the conduit risers.

- 109-4.5 Wiring and connections.** The Contractor shall make all necessary electrical connections in the vault per the wiring diagrams furnished and as directed by the Resident Engineer. In wiring to the terminal blocks, the Contractor shall leave sufficient extra length on each control lead to make future changes in connections at the terminal block. This shall be accomplished by running each control lead the longest way around the box to the proper terminal. Leads shall be neatly laced in place.

The Contractor shall remove the existing wiring and appurtenant equipment as shown in the plans in preparation for installation of the new or relocated electrical wireways and equipment. This shall include the reinstallation and/or repair of any lighting circuits which require temporary disconnection as a result of the work.

- 109-4.6 Marking and labeling.** All equipment, control wires, terminal blocks, etc., shall be tagged, marked, or labeled as specified below:
- a. Wire identification.** The Contractor shall furnish and install self-sticking wire labels or identifying tags on all control wires at the point where they connect to the control equipment or to the terminal blocks. Wire labels, if used, shall be of the self-sticking preprinted type and of the manufacturer's recommended size for the wire involved. Identification -markings specified in the contract documents shall be followed. Tags, if used, shall be of fiber not less than three-quarters (3/4) inch in diameter and not less than 1/32 inch thick. Identification markings specified in the contract documents shall be stamped on tags by means of small tool dies. Each tag shall be securely tied to the proper wire by a nonmetallic cord.
  - b. Labels.** The Contractor shall stencil identifying labels on the cases of regulators, breakers, and distribution and control relay cases with white oil paint as designated by the Resident Engineer. The letters and numerals shall be not less than one (1) inch in height and shall be of proportionate width. The Contractor shall also mark the correct circuit designations per the wiring diagram on the terminal marking strips, which are a part of each terminal block.
- 109-4.7 Existing equipment relocations and removals.** The Contractor shall relocate the existing equipment as specified in the contract documents. The Contractor shall be held responsible for any damage to the existing equipment caused by this relocation and shall repair such damage immediately to the satisfaction of the Resident Engineer at the Contractor's expense.
- 109-4.8 Testing.** The installation shall be tested in operation as a completed unit prior to acceptance. Tests shall include resistance, voltage and current readings, as specified. Testing equipment shall be furnished by the Contractor. Tests shall be conducted as directed by the Project Engineer and shall be to his or her satisfaction. The Contractor shall be responsible for all equipment and conduit in place which will be connected to the new equipment and any equipment or materials found to be defective or damaged shall be replaced by the Contractor at the Contractor's expense.

#### METHOD OF MEASUREMENT

- 109-5.1** The quantity of vaults shall be measured for payment by the number of each unit constructed in place as specified, completed, and accepted by the Resident Engineer.
- 109-5.2** The quantity of prefabricated metal housings shall be measured for payment by the number of each unit constructed in place as specified, completed, and accepted by the Resident Engineer.
- 109-5.3** The quantity of equipment shall be measured for payment by the lump sum for all equipment installed and connected as specified, completed, ready for operation, and accepted by the Resident Engineer.

#### BASIS OF PAYMENT

- 109-6.1** Payment for accepted quantities of work performed by the Contractor and measured by the Resident Engineer shall be made at the contract unit price as specified in paragraphs 109-5.1 through 109-5.3 of this section. Payment shall be full compensation for furnishing all materials and for all preparation, assembly, and installation of these materials, and for all labor, equipment, tools, and incidentals necessary to complete the work as specified.

#### REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

**ASTM International (ASTM)**

ASTM A706	Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement
ASTM C62	Standard Specification for Building Brick (Solid Masonry Units Made from Clay or Shale)
ASTM C90	Standard Specification for Loadbearing Concrete Masonry Units
ASTM D2823	Standard Specification for Asphalt Roof Coatings, Asbestos Containing
ASTM D4479	Standard Specification for Asphalt Roof Coatings – Asbestos-Free

**American National Standards Institute / Insulated Cable Engineers Association (ANSI/ICEA)**

ANSI/ICEA S-85-625	Standard for Telecommunications Cable Aircore, Polyolefin Insulated, Copper Conductor Technical Requirements
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**Commercial Item Description (CID)**

A-A 59544	Cable and Wire, Electrical (Power, Fixed Installation) Institute of Electrical and Electronic Engineers (IEEE)
IEEE 1584	Guide for Performing Arc-Flash Hazard Calculations

**Federal Aviation Administration Advisory Circulars (AC)**

AC 150/5340-30	Design and Installation Details for Airport Visual Aids
AC 150/5345-3	Specification for L-821, Panels for Remote Control of Airport Lighting
AC 150/5345-5	Circuit Selector Switch
AC 150/5345-7	Specification for L-824 Underground Electrical Cable for Airport Lighting Circuits
AC 150/5345-10	Specification for Constant Current Regulators and Regulator Monitors
AC 150/5345-13	Specification for L-841 Auxiliary Relay Cabinet Assembly for Pilot Control of Airport Lighting Circuits
AC 150/5345-49	Specification L-854, Radio Control Equipment;
AC 150/5345-53	Airport Lighting Equipment Certification Program

**Illinois Department of Transportation, Bureau of Materials Qualified Product List**

Certified Precast Concrete Producers

**Illinois Department of Transportation, Bureau of Materials Policy Memoranda (PM)**

PM 19-08	Quality Control/Quality Assurance Program for Precast Concrete Products
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**Master Painter's Institute (MPI)**

MPI Reference #9	Alkyd, Exterior, Gloss (MPI Gloss Level 6)
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**National Fire Protection Association (NFPA)**

NFPA-70	National Electrical Code (NEC)
NFPA-70E	Standard for Electrical Safety in the Workplace
NFPA-780	Standard for the Installation of Lightning Protection Systems

**Underwriters Laboratories (UL)**

UL Standard 6	Electrical Rigid Metal Conduit – Steel
UL Standard 514B	Conduit, Tubing, and Cable Fittings

UL Standard 514C	Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers
UL Standard 651	Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings
UL Standard 651A	Type EB and A Rigid PVC Conduit and HDPE Conduit

**END OF ITEM 109**

## Item 110 Airport Underground Electrical Duct Banks and Conduits

### DESCRIPTION

- 110-1.1** This item shall consist of underground electrical conduits and duct banks (single or multiple conduits encased in concrete or buried in sand) installed per this specification at the locations and per the dimensions, designs, and details specified in the contract documents. This item shall include furnishing and installing of all underground electrical duct banks and individual and multiple underground conduits and removal of existing duct banks. It shall also include all turfing trenching, backfilling, removal, and restoration of any paved or turfed areas; concrete encasement, mandrelling, pulling lines, duct markers, plugging of conduits, and the testing of the installation as a completed system ready for installation of cables as specified in the contract documents. This item shall also include furnishing and installing conduits and all incidentals for providing positive drainage of the system. Verification of existing ducts is incidental to the pay items provided in this specification.

### EQUIPMENT AND MATERIALS

**110-2.1 General.**

- a. Airport lighting equipment and materials covered by advisory circulars shall be certified in the current Federal Aviation Administration Advisory Circular (AC) 150/5345-5, *Airport Lighting Equipment Certification Program (ALECP)* and listed in the ALECP Addendum. FAA certified airfield lighting shall be compatible with each other to perform in compliance with FAA criteria and the intended operation. If the Contractor provides equipment that does not perform as intended because of incompatibility with the system, the Contractor assumes all costs to correct the system for to operate properly.
- b. All equipment and materials covered by referenced specifications shall be subject to acceptance through manufacturer's certification of compliance (COC) with the applicable specification when requested by the Engineer.
- c. Manufacturer's certifications shall not relieve the Contractor of the responsibility to provide materials per these specifications. Materials supplied and/or installed that do not comply with these specifications shall be removed, when directed by the Resident Engineer, and replaced with materials, that comply with these specifications, at the Contractor's cost.
- d. All materials and equipment used to construct this item shall be submitted to the Resident Engineer for approval prior to ordering the equipment. Submittals consisting of marked catalog sheets or shop drawings shall be provided. Submittal data shall be presented in a clear, precise and thorough manner. Original catalog sheets are preferred. Photocopies are acceptable provided they are as good a quality as the original. Clearly and boldly mark each copy to identify products or models applicable to this project. Indicate all optional equipment and delete non-pertinent data. Submittals for components of electrical equipment and systems shall identify the equipment for which they apply on each submittal sheet. Markings shall be made bold and clear with arrows or circles (highlighting is not acceptable). The Contractor is solely responsible for delays in project that accrue directly or indirectly from late submissions or resubmissions of submittals.
- e. The data submitted shall be sufficient, in the opinion of the Resident Engineer, to determine compliance with the contract documents. The Contractor's submittals shall be neatly bound in a properly sized 3-ring binder, tabbed by specification section or electronically submitted

in PDF format, tabbed by specification section. The Resident Engineer reserves the right to reject any and all equipment, materials or procedures that do not meet the system design and the standards and codes specified in this document.

- f. All equipment and materials furnished and installed under this section shall be guaranteed against defects in materials and workmanship for a period of at least 12 months from final acceptance by the Department. The defective materials and/or equipment shall be repaired or replaced, at the Department's discretion, at the Contractor's expense.

**110-2.2 Steel conduit.** Rigid galvanized steel (RGS) conduit and fittings shall be hot dipped galvanized inside and out and conform to the requirements of Underwriters Laboratories Standards 6, 514B, and 1242. All RGS conduits or RGS elbows installed below grade, in concrete, permanently wet locations or other similar environments shall be painted with a ten (10) mil thick coat of asphaltum sealer or shall have a factory-bonded polyvinyl chloride (PVC) cover. Any exposed galvanizing or steel shall be coated with ten (10) mils of asphaltum sealer. When using PVC coated RGS conduit, care shall be exercised not to damage the factory PVC coating. Damaged PVC coating shall be repaired per the manufacturer's written instructions. In lieu of PVC coated RGS, corrosion wrap tape shall be permitted to be used where RGS is in contact with direct earth."

**110-2.3 Plastic conduit.** Plastic conduit and fittings shall conform to the following requirements:

- UL 514B covers W-C-1094-Conduit fittings all types, classes 1 thru 3 and 6 thru 10.
- UL 514C covers W-C-1094-all types, Class 5 junction box and cover in plastic (PVC).
- UL 651 covers W-C-1094-Rigid PVC Conduit, types I and II, Class 4.
- UL 651A covers W-C-1094-Rigid PVC Conduit and high-density polyethylene (HDPE) Conduit type III and Class 4.

Underwriters Laboratories Standards UL-651 and Article 352 of the current National Electrical Code shall be one (1) of the following, as specified in the contract documents:

- a. Type I—Schedule 40 and Schedule 80 PVC suitable for underground use either direct-buried or encased in concrete.
- b. Type II—Schedule 40 PVC suitable for either above ground or underground use.
- c. Type III – Schedule 80 PVC suitable for either above ground or underground use either direct-buried or encased in concrete.
- d. Type III –HDPE pipe, minimum standard dimensional ratio (SDR) 11, suitable for placement with directional boring under pavement.

The type of solvent cement shall be as recommended by the conduit/fitting manufacturer.

**110-2.4 Split conduit.** Split conduit shall be pre-manufactured for the intended purpose and shall be made of steel or plastic.

**110-2.5 Conduit spacers.** Conduit spacers shall be prefabricated interlocking units manufactured for the intended purpose. They shall be of double wall construction made of high grade, high density polyethylene (HDPE) complete with interlocking cap and base pads. They shall be designed to accept No. 4 reinforcing bars installed vertically.

**110-2.6 Concrete.** Concrete shall be proportioned, placed, and cured per Item 610 titled CONCRETE FOR MISCELLANEOUS STRUCTURES.

**110-2.7 Precast concrete structures.** Precast concrete products shall be per the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 19-08, Quality Control/Quality Assurance Program for Precast Concrete Products and/or be on the current Illinois Department of Transportation's published Qualified Producer List of *Certified Precast Concrete Producers*.

- 110-2.8 Reinforcing steel.** Reinforcing steel bars shall be intermediate or structural grade deformed-type bars and shall be per ASTM A706 Grade 60 and shall be of 100% domestic origin.
- 110-2.9 Flowable backfill.** Flowable material used to back fill conduit and duct bank trenches shall conform to the requirements of Item 153 titled CONTROLLED LOW STRENGTH MATERIAL.
- 110-2.10 Detectable warning tape.** Plastic, detectable, American Public Works Association (APWA) red (electrical power lines, cables, conduit and lighting cable), orange (telephone/fiber optic cabling) with continuous legend magnetic tape shall be polyethylene film with a metallized foil core and shall be three (3) to six (6) inches wide. Detectable tape is incidental to the respective bid item.

### CONSTRUCTION METHODS

- 110-3.1 General.** The Contractor shall install underground duct banks and conduits at the approximate locations specified in the contract documents. The Resident Engineer shall indicate specific locations as the work progresses, if required to differ from the contract documents. Duct banks and conduits shall be of the size, material, and type specified in the contract documents. Where no size is specified in the contract documents, conduits shall be not less than two (2) inches inside diameter or comply with the National Electrical Code based on cable to be installed, whichever is larger. All duct bank and conduit lines shall be laid so as to grade toward access points and duct or conduit ends for drainage. Unless shown otherwise on the plans, grades shall be at least three (3) inches per 100 feet. On runs where it is not practicable to maintain the grade all one (1) way, the duct bank and conduit lines shall be graded from the center in both directions toward access points or conduit ends, with a drain into the storm drainage system. Pockets or traps where moisture may accumulate shall be avoided. Under pavement, the top of the duct bank shall not be less than 18 inches below the subgrade; in other locations, the top of the duct bank or underground conduit shall be not less than 18 inches below finished grade.

The Contractor shall mandrel each individual conduit whether the conduit is direct-buried or part of a duct bank. An iron-shod mandrel, not more than one-quarter (1/4) inch smaller than the bore of the conduit shall be pulled or pushed through each conduit. The mandrel shall have a leather or rubber gasket slightly larger than the conduit hole.

The Contractor shall swab out all conduits/ducts and clean base can, manhole, pull boxes, etc., interiors immediately prior to pulling cable. Once cleaned and swabbed the light bases, manholes, pull boxes, etc., and all accessible points of entry to the duct/conduit system shall be kept closed except when installing cables. Cleaning of ducts, base cans, manholes, etc., is incidental to the pay item of the item being cleaned. All raceway systems left open, after initial cleaning, for any reason shall be recleaned at the Contractor's expense. All accessible points shall be kept closed when not installing cable. The Contractor shall verify existing ducts proposed for use in this project as clear and open. The Contractor shall notify the Resident Engineer of any blockage in the existing ducts.

For pulling the permanent wiring, each individual conduit, whether the conduit is direct-buried or part of a duct bank, shall be provided with a 200-pound test polypropylene pull rope. The ends shall be secured, and sufficient length shall be left in access points to prevent it from slipping back into the conduit. Where spare conduits are installed, as specified in the contract documents, the open ends shall be plugged with removable tapered plugs, designed for this purpose.

All conduits shall be securely fastened in place during construction and shall be plugged to prevent contaminants from entering the conduits. Any conduit section having a defective joint shall not be installed. Ducts shall be supported and spaced apart using approved spacers at intervals not to exceed five (5) feet.

Unless otherwise specified in the contract documents, concrete encased duct banks shall be used when crossing under pavements expected to carry aircraft loads, such as runways,



taxiways, taxilanes, ramps and aprons. When under paved shoulders and other paved areas, conduit and duct banks shall be encased using flowable fill for protection.

All conduits within concrete encasement of the duct banks shall terminate with female ends for ease in current and future use. Install factory plugs in all unused ends. Do not cover the ends or plugs with concrete.

Where turf is well established and the sod can be removed, it shall be carefully stripped and properly stored.

Trenches for conduits and duct banks may be excavated manually or with mechanical trenching equipment unless in pavement, in which case they shall be excavated with mechanical trenching equipment. Walls of trenches shall be essentially vertical so that a minimum of shoulder surface is disturbed. Blades of graders shall not be used to excavate the trench.

When rock is encountered, the rock shall be removed to a depth of at least three (3) inches below the required conduit or duct bank depth and it shall be replaced with bedding material of earth or sand containing no mineral aggregate particles that would be retained on a one-quarter (1/4) inch sieve. Flowable backfill may alternatively be used. All such rock removal shall be performed and paid for under Item 152 titled EXCAVATION, SUBGRADE, AND EMBANKMENT.

Underground electrical warning (Caution) tape shall be installed in the trench above all underground duct banks and conduits in unpaved areas. Contractor shall submit a sample of the proposed warning tape for approval by the Project Engineer. If not shown on the plans, the warning tape shall be located six (6) inches above the duct/conduit or the counterpoise wire if present.

Joints in plastic conduit shall be prepared per the manufacturer's recommendations for the particular type of conduit. Plastic conduit shall be prepared by application of a plastic cleaner and brushing a plastic solvent on the outside of the conduit ends and on the inside of the couplings. The conduit fitting shall then be slipped together with a quick one-quarter (1/4) turn twist to set the joint tightly. Where more than one (1) conduit is placed in a single trench, or in duct banks, joints in the conduit shall be staggered a minimum of two (2) feet.

Changes in direction of runs exceeding ten (10) degrees, either vertical or horizontal, shall be accomplished using manufactured sweep bends.

Whether or not specifically indicated on the drawings, where the soil encountered at established duct bank grade is an unsuitable material, as determined by the Resident Engineer, the unsuitable material shall be removed per Item 152 titled EXCAVATION, SUBGRADE, AND EMBANKMENT and replaced with suitable material. Additional duct bank supports shall be installed, as approved by the Engineer.

All excavation shall be unclassified. The cost of excavation, dewatering necessary for duct installation, and erosion per federal, state, and local requirements shall be considered incidental to the contract and as a subsidiary obligation of the Contractor.

Unless otherwise specified, excavated materials that are deemed by the Resident Engineer to be unsuitable for use in backfill or embankments shall be removed and disposed of offsite.

Any excess excavation shall be filled with suitable material approved by the Resident Engineer and compacted per Item 152 titled EXCAVATION, SUBGRADE, AND EMBANKMENT.

It is the Contractor's responsibility to locate existing utilities within the work area prior to excavation. Where existing active cables cross proposed installations, the Contractor shall ensure that these cables are adequately protected. Where crossings are unavoidable, no splices will be allowed in the existing cables, except as specified in the contract documents. Installation of new cable where such crossings must occur shall proceed as follows:

- a. Existing cables shall be located manually. Unearthed cables shall be inspected to assure absolutely no damage has occurred

- b. Trenching, etc., in cable areas shall then proceed with approval of the Resident Engineer, with care taken to minimize possible damage or disruption of existing cable, including careful backfilling in area of cable.

In the event that any previously identified cable is damaged during the course of construction, the Contractor shall be responsible for the complete repair.

- 110-3.2 Duct banks.** Unless otherwise shown in the plans, duct banks shall be installed so that the top of the concrete envelope is not less than 18 inches below the bottom of the base or stabilized base course layers where installed under runways, taxiways, aprons, or other paved areas, and not less than 18 inches below finished grade where installed in unpaved areas.

Unless otherwise shown on the plans, duct banks under paved areas shall extend at least three (3) feet beyond the edges of the pavement or three (3) feet beyond any under drains that may be installed alongside the paved area. Trenches for duct banks shall be opened the complete length before concrete is placed so that if any obstructions are encountered, provisions can be made to avoid them. Unless otherwise shown on the plans, all duct banks shall be placed on a layer of concrete not less than three (3) inches thick prior to its initial set. The Contractor shall space the conduits not less than three (3) inches apart (measured from outside wall to outside wall). All such multiple conduits shall be placed using conduit spacers applicable to the type of conduit. As the conduit laying progresses, concrete shall be placed around and on top of the conduits not less than three (3) inches thick unless otherwise shown on the plans. All conduits shall terminate with female ends for ease of access in current and future use. Install factory plugs in all unused ends. Do not cover the ends or plugs with concrete.

Conduits forming the duct bank shall be installed using conduit spacers. No. 4 reinforcing bars shall be driven vertically into the soil a minimum of six (6) inches to anchor the assembly into the earth prior to placing the concrete encasement. For this purpose, the spacers shall be fastened down with locking collars attached to the vertical bars. Spacers shall be installed at five (5) foot intervals. Spacers shall be in the proper sizes and configurations to fit the conduits. Locking collars and spacers shall be submitted to the Resident Engineer for review prior to use.

When specified, the Contractor shall reinforce the bottom side and top of encasements with steel reinforcing mesh or fabric or other approved metal reinforcement. When directed, the Contractor shall supply additional supports where the ground is soft and boggy, where ducts cross under roadways, or where specified in the contract documents. Under such conditions, the complete duct structure shall be supported on reinforced concrete footings, piers, or piles located at approximately five (5) foot intervals.

All pavement surfaces that are to have ducts installed therein shall be neatly saw cut to form a vertical face. All excavation shall be included in the contract with price for the duct.

Install a plastic, detectable, color as noted, three (3) to six (6) inches wide tape, eight (8) inches minimum below grade above all underground conduit or duct lines not installed under pavement. Utilize the three (3) inch wide tape only for single conduit runs. Utilize the six (6) inch wide tape for multiple conduits and duct banks. For duct banks equal to or greater than 24 inches in width, utilize more than one (1) tape for sufficient coverage and identification of the duct bank as required.

When existing cables are to be placed in split duct, encased in concrete, the cable shall be carefully located and exposed by hand tools. Prior to being placed in duct, the Resident Engineer shall be notified so that they may inspect the cable and determine that it is in good condition. Where required, split duct shall be installed as shown on the drawings or as required by the Resident Engineer.

- 110-3.3 Conduits without concrete encasement.** Trenches for single-conduit lines shall be not less than six (6) inches nor more than 12 inches wide. The trench for two (2) or more conduits installed at the same level shall be proportionately wider. Trench bottoms for conduits without concrete encasement shall be made to conform accurately to grade so as to provide uniform support for the conduit along its entire length.

Unless otherwise shown on plans, conduits shall be installed so that the tops of all conduits within the Airport's secured area where trespassing is prohibited are at least 18 inches below the finished grade. Conduits outside the Airport's secured area shall be installed so that the tops of the conduits are at least 24 inches below the finished grade per National Electric Code (NEC), Table 300.5.

When two (2) or more individual conduits intended to carry conductors of equivalent voltage insulation rating are installed in the same trench without concrete encasement, they shall be spaced not less than four (4) inches apart (measured from outside wall to outside wall) in a horizontal direction and not less than six (6) inches apart in a vertical direction. Where two (2) or more individual conduits intended to carry conductors of differing voltage insulation rating are installed in the same trench without concrete encasement, they shall be placed not less than four (4) inches apart (measured from outside wall to outside wall) in a horizontal direction and not less than six (6) inches apart in a vertical direction.

Trenches shall be opened the complete length between normal termination points before conduit is installed so that if any unforeseen obstructions are encountered, proper provisions can be made to avoid them.

Conduits shall be installed using conduit spacers. No. 4 reinforcing bars shall be driven vertically into the soil a minimum of six (6) inches to anchor the assembly into the earth while backfilling. For this purpose, the spacers shall be fastened down with locking collars attached to the vertical bars. Spacers shall be installed at five (5) foot intervals. Spacers shall be in the proper sizes and configurations to fit the conduits. Locking collars and spacers shall be submitted to the Resident Engineer for review prior to use.

**110-3.4 Markers.** The location of each end and of each change of direction of conduits and duct banks shall be marked by a concrete slab marker two (2) feet square and four (4) inches to six (6) inches thick extending approximately one (1) inch above the surface. The markers shall also be located directly above the ends of all conduits or duct banks, except where they terminate in a junction/access structure or building. Each cable or duct run from a line of lights and signs to the equipment vault must be marked at approximately every 200 feet along the cable or duct run, with an additional marker at each change of direction of cable or duct run.

The Contractor shall impress the word "DUCT" or "CONDUIT" on each marker slab. Impression of letters shall be done in a manner, approved by the Engineer, for a neat, professional appearance. All letters and words must be neatly stenciled. After placement, all markers shall be given one (1) coat of high-visibility orange paint, as approved by the Resident Engineer. The Contractor shall also impress on the slab the number and size of conduits beneath the marker along with all other necessary information as determined by the Resident Engineer. The letters shall be four (4) inches high and three (3) inches wide with width of stroke one-half (1/2) inch and one-quarter (1/4) inch deep or as large as the available space permits. Furnishing and installation of duct markers is incidental to the respective duct pay item.

**110-3.5 Backfilling for conduits.** On all areas outside of the pavement areas, the bottom of the trench shall be built up with suitable compacted backfill material so the conduit will have a smooth bed. Backfill material shall be free of brick, rock, or any material that could damage the conduit. Backfill material shall meet the approval of the Engineer. Backfill shall be deposited in uniform lifts not exceeding six (6) inches thick loose measure. The material in each lift shall be mechanically compacted to the satisfaction of the Resident Engineer by ramming or tamping with power tools approved by the Engineer in such a manner as not to disturb or damage the conduit. Flowable backfill may alternatively be used.

If the cable is to be installed in locations or areas under pavements, backfill with controlled low strength material (CLSM) in accordance with Item 153 titled CONTROLLED LOW STRENGTH MATERIAL.

Trenches shall not contain pools of water during back filling operations.

The trench shall be completely backfilled and tamped level with the adjacent surface; except that, where sod is to be placed over the trench, the backfilling shall be stopped at a depth equal to the thickness of the sod to be used, with proper allowance for settlement.

Any excess excavated material shall be removed and disposed of per instructions issued by the Resident Engineer.

- 110-3.6 Backfilling for duct banks.** After the concrete has cured, the remaining trench shall be built up with suitable compacted backfill material so the conduit will have a smooth bed. Backfill material shall be free of brick, rock, or any material that could damage the conduit. Backfill material shall meet the approval of the Engineer. Backfill shall be deposited in uniform lifts not exceeding six (6) inches thick loose measure. The material in each lift shall be mechanically compacted to the satisfaction of the Resident Engineer by ramming or tamping with power tools approved by the Engineer in such a manner as not to disturb or damage the conduit. Flowable backfill may alternatively be used.

If the cable is to be installed in locations or areas under pavements, backfill with controlled low strength material (CLSM) in accordance with Item 153 titled CONTROLLED LOW STRENGTH MATERIAL.

Trenches shall not contain pools of water during backfilling operations.

The trench shall be completely backfilled and tamped level with the adjacent surface; except that, where sod is to be placed over the trench, the backfilling shall be stopped at a depth equal to the thickness of the sod to be used, with proper allowance for settlement.

Any excess excavated material shall be removed and disposed of per instructions issued by the Resident Engineer.

- 110-3.7 Restoration.** Following restoration of all trenching near airport movement surfaces, the Contractor shall thoroughly visually inspect the area for foreign object debris (FOD) and remove any such FOD that is found. Where soil and/or sod has been removed, it shall be replaced as soon as possible after the backfilling is completed. All areas disturbed by the work shall be restored to its original condition. The restoration shall include any necessary sodding, topsoiling, fertilizing, liming, seeding, sprigging, mulching or other landscaping specified in the contract documents. All such work shall be performed in accordance with Part 12 titled TURFING. The Contractor shall be held responsible for maintaining all disturbed surfaces and replacements until final acceptance. The cost of restoration shall be considered incidental to the contract and as a subsidiary obligation of the Contractor.

#### METHOD OF MEASUREMENT

- 110-4.1** The quantity of underground conduits and duct banks, including encasement, locator tape, trenching and backfill with designated material, and restoration shall be measured for payment by the number of linear feet as specified, completed, and accepted by the Resident Engineer. Separate measurement shall be made for the various types and sizes.

No separate measurement or payment will be made for individual ducts in a multi-way duct system.

#### BASIS OF PAYMENT

- 110-5.1** Payment for accepted quantities of work performed by the Contractor and measured by the Resident Engineer shall be made at the contract unit price as specified in paragraph 110-4.1 of this section. Payment shall be full compensation for removal and disposal of existing duct banks and conduits specified in the contract documents, furnishing all materials and for all preparation, assembly, and installation of these materials, and for all labor, equipment, tools, and incidentals necessary to complete the work as specified.

## REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

### **ASTM International (ASTM)**

ASTM A706	Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement
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### **Federal Aviation Administration Advisory Circular (AC)**

AC 150/5340-30	Design and Installation Details for Airport Visual Aids
AC 150/5345-53	Airport Lighting Equipment Certification Program

### **Illinois Department of Transportation, Bureau of Materials Qualified Product List**

Certified Precast Concrete Producers

### **Illinois Department of Transportation, Bureau of Materials Policy Memoranda (PM)**

PM 19-08	Quality Control/Quality Assurance Program for Precast Concrete Products
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### **National Fire Protection Association (NFPA)**

NFPA-70	National Electrical Code (NEC)
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### **Underwriters Laboratories (UL)**

UL Standard 6	Electrical Rigid Metal Conduit - Steel
UL Standard 514B	Conduit, Tubing, and Cable Fittings
UL Standard 514C	Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers
UL Standard 1242	Electrical Intermediate Metal Conduit Steel
UL Standard 651	Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings
UL Standard 651A	Type EB and A Rigid PVC Conduit and HDPE Conduit

**END OF ITEM 110**

## Item 115 Electrical Manholes and Junction Structures

### DESCRIPTION

- 115-1.1** This item shall consist of electrical manholes and junction structures (hand holes, pull boxes, junction cans, etc.) installed at the indicated locations and conforming to the lines, grades and dimensions as specified in the contract documents or as required by the Resident Engineer. This item shall include the installation of each electrical manhole and/or junction structures with all associated excavation, backfilling, sheeting and bracing, concrete, reinforcing steel, ladders, appurtenances, testing, dewatering and restoration of surfaces to the satisfaction of the Resident Engineer including removal of existing manholes and junction structures as specified in the contract documents.

### EQUIPMENT AND MATERIALS

**115-2.1 General.**

- a. Airport lighting equipment and materials covered by advisory circulars shall be certified in the current Federal Aviation Administration Advisory Circular (AC) 150/5345-53, *Airport Lighting Equipment Certification Program (ALECP)* and listed in the ALECP Addendum. FAA certified airfield lighting shall be compatible with each other to perform in compliance with FAA criteria and the intended operation. If the Contractor provides equipment that does not perform as intended because of incompatibility with the system, the Contractor assumes all costs to correct the system for to operate properly.
- b. All equipment and materials covered by referenced specifications shall be subject to acceptance through manufacturer's certification of compliance (COC) with the applicable specification when so requested by the Engineer.
- c. Manufacturer's certifications shall not relieve the Contractor of the responsibility to provide materials per these specifications. Materials supplied and/or installed that do not comply with these specifications shall be removed, when directed by the Resident Engineer, and replaced with materials that comply with these specifications at the Contractor's cost.
- d. All materials and equipment used to construct this item shall be submitted to the Resident Engineer for approval prior to ordering the equipment. Submittals consisting of marked catalog sheets or shop drawings shall be provided. Submittal data shall be presented in a clear, precise and thorough manner. Original catalog sheets are preferred. Photocopies are acceptable provided they are as good a quality as the original. Clearly and boldly mark each copy to identify products or models applicable to this project. Indicate all optional equipment and delete any non-pertinent data. Submittals for components of electrical equipment and systems shall identify the equipment to which they apply on each submittal sheet. Markings shall be made bold and clear with arrows or circles (highlighting is not acceptable). The Contractor is solely responsible for delays in the project that may accrue directly or indirectly from late submissions or resubmissions of submittals.
- e. The data submitted shall be sufficient, in the opinion of the Resident Engineer, to determine compliance with the contract documents. The Contractor's submittals shall be neatly bound in a properly sized 3-ring binder, tabbed by specification section or electronically submitted in pdf format, tabbed by specification section. The Resident Engineer reserves the right to reject any and all equipment, materials or procedures that do not meet the system design and the standards and codes, specified in this document.

- f. All equipment and materials furnished and installed under this section shall be guaranteed against defects in materials and workmanship for a period of at least 12 months from the date of final acceptance by the Department. The defective materials and/or equipment shall be repaired or replaced, at the Department's discretion, at the Contractor's expense.

**115-2.2 Concrete structures.** Concrete shall be proportioned, placed, and cured per Item 610 titled CONCRETE FOR MISCELLANEOUS STRUCTURES.

**115-2.3 Precast concrete structures.** Precast concrete products shall be per the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 19-08, Quality Control/Quality Assurance Program for Precast Concrete Products and/or be on the current Illinois Department of Transportation's published Qualified Producer List of *Certified Precast Concrete Producers*.

Provide precast concrete structures as specified in the contract documents. Precast units shall have mortar or bitumastic sealer placed between all joints to make them watertight. Openings or knockouts shall be provided in the structure as specified in the contract documents. Threaded inserts and pulling eyes shall be cast in as specified in the contract documents.

If the Contractor chooses to propose a different structural design, signed and sealed shop drawings, design calculations, and other information requested by the Engineer shall be submitted by the Contractor to allow for a full evaluation by the Project Engineer.

**115-2.4 Junction boxes.** Junction boxes shall be L-867 Class 1 (non-load bearing) or L-868 Class 1 (load bearing) airport light bases that are encased in concrete. The light bases shall have a L-894 blank cover, gasket, and stainless-steel hardware. All bolts, studs, nuts, lock washers, and other similar fasteners used for the light fixture assemblies must be fabricated from 316L (equivalent to EN 1.4404), 18-8, 410, or 416 stainless steel. If 18-8, 410, or 416 stainless steel is utilized it shall be passivated and be free from any discoloration. Covers shall be three-eighths (3/8) inch (thickness for L-867 and three-quarters (3/4) inch thickness for L-868. All junction boxes shall be provided with both internal and external ground lugs.

**115-2.5 Mortar.** The mortar shall be composed of one (1) part of cement and two (2) parts of mortar sand, by volume. The cement shall be per the requirements in AASHTO M 85, Type I. The sand shall be per the requirements per the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 11-08, *Aggregate Gradation Control System (AGCS)*. Hydrated lime may be added to the mixture of sand and cement in an amount not to exceed 15% of the weight of cement used. The hydrated lime shall meet the requirements of ASTM C206. Water shall be potable, reasonably clean and free of oil, salt, acid, alkali, sugar, vegetable, or other substances injurious to the finished product.

**115-2.6 Concrete.** All concrete used in structures shall conform to the requirements of Item 610 titled CONCRETE FOR MISCELLANEOUS STRUCTURES.

**115-2.7 Frames and covers.** The frames shall conform to one (1) of the following requirements:

- a. ASTM A48      Gray iron castings
- b. ASTM A47      Malleable iron castings
- c. ASTM A27      Steel castings
- d. ASTM A283, Grade D      Structural steel for grates and frames
- e. ASTM A536      Ductile iron castings
- f. ASTM A897      Austempered ductile iron castings

All castings or structural steel units shall conform to the dimensions specified in the contract documents and shall be designed to support the loadings specified.

Each frame and cover unit shall be provided with fastening members to prevent it from being dislodged by traffic, but which will allow easy removal for access to the structure.

All castings shall be thoroughly cleaned. After fabrication, structural steel units shall be galvanized to meet the requirements of ASTM A123.

Each cover shall have the word "ELECTRIC" or other approved designation cast on it. Each frame and cover shall be as specified in the contract documents or approved equivalent. No cable notches are required.

Each manhole shall be provided with a "DANGER -- PERMIT-REQUIRED CONFINED SPACE, DO NOT ENTER" safety warning sign as specified in the contract documents and in accordance with OSHA 1910.146 (c)(2).

- 115-2.8 Ladders.** Ladders shall be galvanized steel or as specified in the contract documents.
- 115-2.9 Reinforcing steel.** All reinforcing steel shall be deformed bars of new billet steel meeting the requirements of ASTM A615 Grade 60 and shall be of 100% domestic origin.
- 115-2.10 Bedding/special backfill.** Bedding or special backfill shall be as specified in the contract documents.
- 115-2.11 Flowable backfill.** Flowable material used to backfill shall conform to the requirements of Item 153 titled CONTROLLED LOW STRENGTH MATERIAL.
- 115-2.12 Cable trays.** Cable trays shall be of galvanized steel, plastic, or aluminum. Cable trays shall be located as specified in the contract documents.
- 115-2.13 Plastic conduit.** Plastic conduit shall comply with Item 110 titled AIRPORT UNDERGROUND ELECTRICAL DUCT BANKS AND CONDUITS.
- 115-2.14 Conduit terminators.** Conduit terminators shall be pre-manufactured for the specific purpose and sized as required or as specified in the contract documents.
- 115-2.15 Pulling-in irons.** Pulling-in irons shall be manufactured with seven-eighths (7/8) inch diameter hot-dipped galvanized steel or stress-relieved carbon steel roping designed for concrete applications (seven (7) strand, one-half (1/2) inch diameter with an ultimate strength of 270,000 pounds per square inch). Where stress-relieved carbon steel roping is used, a rustproof sleeve shall be installed at the hooking point and all exposed surfaces shall be encapsulated with a polyester coating to prevent corrosion.
- 115-2.16 Ground rods.** Ground rods shall be one (1) piece, copper clad steel. The ground rods shall be of the length and diameter specified in the contract documents, but in no case shall they be less than ten (10) feet long nor less than five-eighths (5/8) inch in diameter.
- 115-2.17 Backfill.** The gradation of the backfill material shall meet the requirements of the gradation given in the following table when tested per the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 11-08, *Aggregate Gradation Control System (AGCS)*.

#### Fine Aggregate Gradation

Sieve Size	Gradation Percent Passing	
	FA 1	FA 2
3/8	100	100
No. 4	97±3	97±3
No. 16	65±20	65±20
No. 50	16±13	20±10
No. 100	5±5	5±5



## CONSTRUCTION METHODS

**115-3.1 Unclassified excavation.** It is the Contractor's responsibility to locate existing utilities within the work area prior to excavation. Damage to utility lines, through lack of care in excavating, shall be repaired or replaced to the satisfaction of the Resident Engineer without additional expense to the Department.

The Contractor shall perform excavation for structures and structure footings to the lines and grades or elevations shown on the plans or as staked by the Resident Engineer. The excavation shall be of sufficient size to permit the placing of the full width and length of the structure or structure footings shown.

All excavation shall be unclassified. The cost of excavation and dewatering necessary for structure installation and erosion per federal, state, and local requirements shall be considered incidental to the contract and as a subsidiary obligation of the Contractor.

Boulders, logs and all other objectionable material encountered in excavation shall be removed. All rock and other hard foundation material shall be cleaned of all loose material and cut to a firm surface either level, stepped or serrated, as directed by the Resident Engineer. All seams, crevices, disintegrated rock and thin strata shall be removed. When concrete is to rest on a surface other than rock, special care shall be taken not to disturb the bottom of the excavation. Excavation to final grade shall not be made until just before the concrete or reinforcing is to be placed.

The Contractor shall provide all bracing, sheeting and shoring necessary to implement and protect the excavation and the structure as required for safety or conformance to governing laws. The cost of bracing, sheeting and shoring shall be included in the unit price bid for the structure.

Unless otherwise provided, bracing, sheeting and shoring involved in the construction of this item shall be removed by the Contractor after the completion of the structure. Removal shall be effected, in a manner that will not disturb or mar finished masonry. The cost of removal shall be included in the unit price bid for the structure.

After each excavation is completed, the Contractor shall notify the Resident Engineer. Structures shall be placed after the Resident Engineer has approved the depth of the excavation and the suitability of the foundation material.

Prior to installation the Contractor shall provide a minimum of six (6) inches of sand or a material approved by the Resident Engineer as a suitable base to receive the structure. The base material shall be compacted and graded level and at proper elevation to receive the structure in proper relation to the conduit grade or ground cover requirements, as specified in the contract documents.

**115-3.2 Concrete structures.** Concrete structures shall be built on prepared foundations conforming to the dimensions and form as specified in the contract documents. The concrete and construction methods shall conform to the requirements specified in Item 610 titled CONCRETE FOR MISCELLANEOUS STRUCTURES. Any reinforcement required shall be placed as specified in the contract documents and shall be approved by the Resident Engineer before the concrete is placed.

**115-3.3 Precast unit installations.** Precast units shall be installed plumb and true. Joints shall be made watertight by use of sealant at each tongue-and-groove joint and at roof of manhole. Excess sealant shall be removed and severe surface projections on exterior of neck shall be removed.

**115-3.4 Placement and treatment of castings, frames and fittings.** All castings, frames and fittings shall be placed in the positions specified in the contract documents or as directed by the Resident Engineer and shall be set true to line and to correct elevation. If frames or fittings are to be set in concrete or cement mortar, all anchors or bolts shall be in place and position before the concrete or mortar is placed. The unit shall not be disturbed until the mortar or concrete has set.

Field connections shall be made with bolts, unless indicated otherwise. Welding will not be permitted unless shown otherwise on the approved shop drawings and written approval is granted by the casting manufacturer. Erection equipment shall be suitable and safe for the workman. Errors in shop fabrication or deformation resulting from handling and transportation that prevent the proper assembly and fitting of parts shall be reported immediately to the Resident Engineer and approval of the method of correction shall be obtained. Approved corrections shall be made at Contractor's expense.

Anchor bolts and anchors shall be properly located and built into connection work. Bolts and anchors shall be preset by the use of templates or such other methods as may be required to locate the anchors and anchor bolts accurately.

Pulling-in irons shall be located opposite all conduit entrances into structures to provide a strong, convenient attachment for pulling-in blocks when installing cables. Pulling-in irons shall be set directly into the concrete walls of the structure.

**115-3.5 Installation of ladders.** Ladders shall be installed such that they may be removed if necessary. Mounting brackets shall be supplied top and bottom and shall be cast in place during fabrication of the structure or drilled and grouted in place after erection of the structure.

**115-3.6 Removal of sheeting and bracing.** In general, all sheeting and bracing used to support the sides of trenches or other open excavations shall be withdrawn as the trenches or other open excavations are being refilled. That portion of the sheeting extending below the top of a structure shall be withdrawn, unless otherwise directed, before more than six (6) inches of material is placed above the top of the structure and before any bracing is removed. Voids left by the sheeting shall be carefully refilled with selected material and rammed tight with tools especially adapted for the purpose or otherwise as may be approved.

The Resident Engineer may direct the Contractor to delay the removal of sheeting and bracing if, in his judgment, the installed work has not attained the necessary strength to permit placing of backfill.

**115-3.7 Backfilling.** After a structure has been completed, the area around it shall be backfilled in horizontal layers not to exceed six (6) inches in thickness measured after compaction to the density requirements in Item 152 titled EXCAVATION, SUBGRADE, AND EMBANKMENT. Each layer shall be deposited all around the structure to approximately the same elevation. The top of the fill shall meet the elevation shown on the plans or as directed by the Resident Engineer.

Backfill shall not be placed against any structure until approval is given by the Resident Engineer. In the case of concrete, such approval shall not be given until tests made by the laboratory under supervision of the Resident Engineer establish that the concrete has attained sufficient strength to provide a factor of safety against damage or strain in withstanding any pressure created by the backfill or the methods used in placing it.

Where required, the Resident Engineer may direct the Contractor to add, at the Contractor's own expense, sufficient water during compaction to assure a complete consolidation of the backfill. The Contractor shall be responsible for all damage or injury done to conduits, duct banks, structures, property or persons due to improper placing or compacting of backfill.

**115-3.8 Connection of duct banks.** To relieve stress of joint between concrete-encased duct banks and structure walls, reinforcement rods shall be placed in the structure wall and shall be formed and tied into duct bank reinforcement at the time the duct bank is installed.

**115-3.9 Grounding.** A ground rod shall be installed in the floor of all concrete structures so that the top of rod extends six (6) inches above the floor. The ground rod shall be installed within one (1) foot of a corner of the concrete structure. Ground rods shall be installed prior to casting the bottom slab. Where the soil condition does not permit driving the ground rod into the earth without damage to the ground rod, the Contractor shall drill a four (4) inch diameter hole into the earth to receive the ground rod. The hole around the ground rod shall be filled throughout its

length, below slab, with Portland cement grout. Ground rods shall be installed in precast bottom slab of structures by drilling a hole through bottom slab and installing the ground rod. Bottom slab penetration shall be sealed watertight with Portland cement grout around the ground rod.

A grounding bus of 4/0 bare stranded copper shall be exothermically bonded to the ground rod and loop the concrete structure walls. The ground bus shall be a minimum of one (1) foot above the floor of the structure and separate from other cables. No. 2 American wire gauge (AWG) bare copper pigtailed shall bond the grounding bus to all cable trays and other metal hardware within the concrete structure. Connections to the grounding bus shall be exothermic. If an exothermic weld is not possible, connections to the grounding bus shall be made by using connectors approved for direct burial in soil or concrete per UL 467. Hardware connections may be mechanical, using a lug designed for that purpose.

- 115-3.10 Cleanup and repair.** After erection of all galvanized items, damaged areas shall be repaired by applying a liquid cold-galvanizing compound per MIL-P-21035. Surfaces shall be prepared, and compound applied per the manufacturer's recommendations.

After all work is completed, the Contractor shall remove all tools and other equipment, leaving the entire site free, clear and in good condition. Prior to acceptance, the entire structure shall be cleaned of all dirt and debris.

- 115-3.11 Restoration.** After the backfill is completed, the Contractor shall dispose of all surplus material, dirt and rubbish from the site. Following restoration of all trenching near airport movement surfaces, the Contractor shall thoroughly visually inspect the area for foreign object debris (FOD) and remove any such FOD that is found. Where soil and/or sod has been removed, it shall be replaced as soon as possible after the backfilling is completed. All areas disturbed by the work shall be restored to its original condition. The restoration shall include any necessary sodding, topsoiling, fertilizing, liming, seeding, sprigging, mulching, or other landscaping specified in the contract documents. All such work shall be performed in accordance with Part 12 titled TURFING. The Contractor shall be held responsible for maintaining all disturbed surfaces and replacements until final acceptance. The cost of restoration shall be considered incidental to the contract and as a subsidiary obligation of the Contractor.

The Contractor shall grade around structures as required to provide positive drainage away from the structure.

Areas with special surface treatment, such as roads, sidewalks, or other paved areas shall have backfill compacted to match surrounding areas, and surfaces shall be repaired using materials comparable to original materials.

- 115-3.12 Inspection.** Prior to final approval, the electrical structures shall be thoroughly inspected for conformance with the contract documents. Any indication of defects in materials or workmanship shall be further investigated and corrected. The earth resistance to ground of each ground rod shall not exceed 25 ohms. Each ground rod shall be tested using the fall-of-potential ground impedance test per American National Standards Institute / Institute of Electrical and Electronic Engineers (ANSI/IEEE) Standard 81. This test shall be performed prior to establishing connections to other ground electrodes.

- 115-3.13 Manhole elevation adjustments.** The Contractor shall adjust the tops of existing manholes in areas designated in the contract documents to the new elevations shown. The Contractor shall be responsible for determining the exact height adjustment required to raise or lower the top of each manhole to the new elevations. The existing top elevation of each manhole to be adjusted shall be determined in the field and subtracted/added from the proposed top elevation.

The Contractor shall remove/extend the existing top section or ring and cover on the manhole structure or manhole access. The Contractor shall install precast concrete sections or grade rings of the required dimensions to adjust the manhole top to the new proposed elevation or shall cut the existing manhole walls to shorten the existing structure, as required by final grades. The Contractor shall reinstall the manhole top section or ring and cover on top and check the new top elevation.

The Contractor shall construct a concrete slab around the top of adjusted structures located in graded areas that are not to be paved. The concrete slab shall conform to the dimensions specified in the contract documents.

- 115-3.14 Duct extension to existing ducts.** Where existing concrete encased ducts are to be extended, the duct extension shall be concrete encased plastic conduit. The fittings to connect the ducts together shall be standard manufactured connectors designed and approved for the purpose. The duct extensions shall be installed according to the concrete encased duct detail and as specified in the contract documents.

#### METHOD OF MEASUREMENT

- 115-4.1** The quantity of electrical manholes and junction structures shall be measured for payment by the number of each unit installed as specified, completed, and accepted by the Resident Engineer. The following items shall be included in the price of each unit: All required excavation and dewatering; sheeting and bracing; all required backfilling with on-site materials; restoration of all surfaces and finished grading and turfing; all required connections; temporary cables and connections; and ground rod testing.
- 115-4.2** The quantity of manhole elevation adjustments shall be measured for payment by the number of each unit as specified, completed, and accepted by the Resident Engineer. Separate measurement shall not be made for the various types and sizes.

#### BASIS OF PAYMENT

- 115-5.1** Payment for accepted quantities of work performed by the Contractor and measured by the Resident Engineer shall be paid for at the contract unit price as specified in paragraphs 115-4.1 and 115-4.2 of this section. Payment shall be full compensation for furnishing all materials and for all preparation, excavation, backfilling and placing of the materials, furnishing and installation of appurtenances and connections to duct banks and other structures as may be required and for all preparation, assembly, and installation of these materials, and for all labor, equipment, tools and incidentals necessary, including but not limited to, spacers, concrete, rebar, dewatering, excavating, backfill, topsoil, sodding and pavement restoration, where required, to complete the work as specified.

#### REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

##### ASTM International (ASTM)

ASTM A27	Standard Specification for Steel Castings, Carbon, for General Application
ASTM A47	Standard Specification for Ferritic Malleable Iron Castings
ASTM A48	Standard Specification for Gray Iron Castings
ASTM A123	Standard Specification for Zinc (Hot Dip Galvanized) Coatings on Iron and Steel Products
ASTM A283	Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates
ASTM A536	Standard Specification for Ductile Iron Castings
ASTM A615	Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement

ASTM A897 Standard Specification for Austempered Ductile Iron Castings

ASTM C144 Standard Specification for Aggregate for Masonry Mortar

ASTM C206 Standard Specification for Finishing Hydrated Lime

**American Association of State Highway and Transportation Officials (AASHTO)**

AASHTO M 85 Standard Specification for Portland Cement

**American National Standards Institute / Insulated Cable Engineers Association (ANSI/ICEA)**

ANSI/IEEE STD 81 IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System

**Commercial Item Description (CID)**

A-A 59544 Cable and Wire, Electrical (Power, Fixed Installation)

**Federal Aviation Administration Advisory Circular (AC)**

AC 150/5345-7 Specification for L-824 Underground Electrical Cable for Airport Lighting Circuits

AC 150/5345-26 Specification for L-823 Plug and Receptacle, Cable Connectors

AC 150/5345-42 Specification for Airport Light Bases, Transformer Housings, Junction Boxes, and Accessories

AC 150/5340-30 Design and Installation Details for Airport Visual Aids

AC 150/5345-53 Airport Lighting Equipment Certification Program

**Illinois Department of Transportation, Bureau of Materials Qualified Product List**

Certified Precast Concrete Producers

**Illinois Department of Transportation, Bureau of Materials Policy Memoranda (PM)**

PM 11-08 Aggregate Gradation Control System (AGCS)

PM 19-08 Quality Control/Quality Assurance Program for Precast Concrete Products

**Mil Spec**

MIL-P-21035 Paint High Zinc Dust Content, Galvanizing Repair

**National Fire Protection Association (NFPA)**

NFPA-70 National Electrical Code (NEC)

**END OF ITEM 115**

## Item 119 Airport Obstruction Lights

### DESCRIPTION

- 119-1.1** This item shall consist of furnishing and installing obstruction lights as specified in the contract documents. Included in this item shall be the furnishing and installing of wood poles, steel or iron pipes, or other supports as specified in the contract documents and in accordance with the requirements in the current Federal Aviation Administration Advisory Circular (AC) 70/7460-1, *Obstruction Marking and Lighting*.

This item shall also include all wire and cable connections, the furnishing and installing of all necessary conduits and fittings, insulators, pole steps, pole cross arms, and the painting of poles and pipes. In addition, it includes the furnishing and installing of all lamps and, if required, the furnishing and installing of insulating transformers, the servicing and testing of the installation and all incidentals necessary to place the lights in operation as completed units to the satisfaction of the Resident Engineer including the removal of existing obstruction lights as specified in the contract documents.

### EQUIPMENT AND MATERIALS

**119-2.1 General.**

- a. Airport lighting equipment and materials covered by specifications shall be certified under the current Federal Aviation Administration Advisory Circular (AC) 150/5345-53, *Airport Lighting Equipment Certification Program (ALECP)* and listed in the ALECP Addendum. FAA certified airfield lighting shall be compatible with each other to perform in compliance with FAA criteria and the intended operation. If the Contractor provides equipment that does not perform as intended because of incompatibility with the system, the Contractor assumes all costs to correct the system for to operate properly.
- b. All other equipment and materials covered by other referenced specifications shall be subject to acceptance through manufacturer's certification of compliance (COC) with the applicable specification when requested by the Engineer.
- c. Manufacturer's certifications shall not relieve the Contractor of the responsibility to provide materials per these specifications. Materials supplied and/or installed that do not comply with these specifications shall be removed, when directed by the Resident Engineer, and replaced with materials that comply with these specifications at the Contractor's cost.
- d. All materials and equipment used to construct this item shall be submitted to the Resident Engineer for approval prior to ordering the equipment. Submittals consisting of marked catalog sheets or shop drawings shall be provided. Submittal data shall be presented in a clear, precise and thorough manner. Original catalog sheets are preferred. Photocopies are acceptable provided they are as good a quality as the original. Clearly and boldly mark each copy to identify products or models applicable to this project. Indicate all optional equipment and delete any non-pertinent data. Submittals for components of electrical equipment and systems shall identify the equipment to which they apply on each submittal sheet. Markings shall be made bold and clear with arrows or circles (highlighting is not acceptable). Contractor is solely responsible for delays in the project that accrue directly or indirectly from late submissions or resubmissions of submittals.
- e. The data submitted shall be sufficient, in the opinion of the Resident Engineer, to determine compliance with the contract documents. The Contractor's submittals shall be neatly bound

in a properly sized 3-ring binder, tabbed by specification section or submitted electronically in pdf format, tabbed by specification section. The Resident Engineer reserves the right to reject any and all equipment, materials or procedures that do not meet the system design and the standards and codes, specified in this document.

- f. All equipment and materials furnished and installed under this section shall be guaranteed against defects in materials and workmanship for at least 12 months from final acceptance by the Department. The defective materials and/or equipment shall be repaired or replaced, at the Department's discretion, at the Contractor's expense.
- 119-2.2 Obstruction lights.** The obstruction lighting assembly shall be of the type as specified in the contract documents meeting the requirements of the current Federal Aviation Administration Advisory Circular (AC) 150/5345-43, *Specification for Obstruction Lighting Equipment*.
- 119-2.3 Isolation transformers.** Where required for series circuits, the isolation transformers shall conform to the requirements of the current Federal Aviation Administration Advisory Circular (AC) 150/5345-47, *Specification for Series to Series Isolation Transformers for Airport Lighting Systems*.
- 119-2.4 Transformer housing. If specified,** transformer housings shall conform to the requirements of the current Federal Aviation Administration Advisory Circular (AC) 150/5345-42, *Specification for Airport Light Bases, Transformer Housings, Junction Boxes, and Accessories*.
- 119-2.5 Conduit.** Steel conduit and fittings shall be per Underwriters Laboratories Standards 6, 514B, and 1242.
- 119-2.6 Plastic conduit (for use below grade only).** Plastic conduit and fittings shall be per:
- UL 514B covers W-C-1094 - Conduit fittings all types, classes 1 through 3 and 6 through 10
  - UL 514C covers W-C-1094 - all types, class 5 junction box and cover in plastic (PVC)
  - UL 651 covers W-C-1094 - Rigid PVC Conduit, types I and II, class 4
  - UL 651A covers W-C-1094 - Rigid PVC Conduit and high-density polyethylene (HDPE) Conduit type III and class 4
- And must be one (1) of the following, as specified in the contract documents:
- a. Type I—Schedule 40 PVC suitable for underground use either direct-buried or encased in concrete.
- b. Type II—Schedule 40 PVC suitable for either above ground or underground use.
- 119-2.7 Electrical wire and cable.** For ratings up to 600 volts, moisture and heat resistant thermoplastic wire conforming to Commercial Item Description A-A-59544A, Type THWN-2, shall be used. Overhead line wire from pole to pole, where specified, shall be per American National Standards Institute/Insulated Cable Engineers Association (ANSI/ICEA) S-70-547-2007. The wires shall be of the type, size, number of conductors, and voltage specified in the contract documents.
- 119-2.8 Miscellaneous.** Paint, poles, pole steps, insulators, and all other miscellaneous materials necessary for the completion of this item shall be new and first-grade commercial products. These products shall be as specified in the contract documents.

## CONSTRUCTION METHODS

- 119-3.1 Placing the obstruction lights.** The Contractor shall furnish and install single-or double-obstruction lights as specified in the contract documents. The obstruction lights shall be mounted on poles, buildings, or towers at the approximate location specified in the contract documents. The exact location shall be approved by the Resident Engineer in accordance with the requirements in the current Federal Aviation Administration Advisory Circular (AC) 70/7460-1, *Obstruction Marking and Lighting*.

**119-3.2 Installation on poles.** Where obstruction lights are to be mounted on poles, each obstruction light shall be installed with its hub at least as high as the top of the pole. All wiring shall be run in not less than one (1) inch galvanized rigid steel conduit. If specified, pole steps shall be furnished and installed, the lowest step being five (5) feet above ground level. Steps shall be installed alternately on diametrically opposite sides of the pole to give a rise of 18 inches for each step. Conduit shall be fastened to the pole with galvanized steel pipe straps and shall be secured by galvanized lag screws. Poles shall be painted as specified in the contract documents.

When obstruction lights are installed on existing telephone or power poles, a large fiber insulating sleeve of adequate diameter and not less than four (4) feet long, shall be installed to extend six (6) inches above the conductors on the upper cross arm. In addition, the sleeve shall be at least 18 inches below the conductors on the lower cross arm. The details of this installation shall be as specified in the contract documents.

**119-3.3 Installation on beacon tower.** Where obstruction lights are installed on a beacon tower, two (2) obstruction lights shall be mounted on top of the beacon tower using one (1) inch conduit. The conduit shall screw directly into the obstruction light fixtures and shall support them at a height of not less than four (4) inches above the top of the rotating beacon. If obstruction lights are specified at lower levels, the Contractor shall install not less than one (1) inch galvanized rigid steel conduit with standard conduit fittings for mounting the fixtures. The fixtures shall be mounted in an upright position in all cases. The conduit shall be fastened to the tower members with Wraplock® straps (or equivalent), clamps, or approved fasteners spaced approximately five (5) feet apart. Three (3) coats of international orange paint per Federal Specification 595, Number 12197 shall be applied (one (1) prime, one (1) body, and one (1) finish coat) to all exposed material installed.

**119 3.4 Installation on buildings, towers, smokestacks, etc.** Where obstruction lights are to be installed on buildings or similar structures, the installation shall be made per the details specified in the contract documents. The hub of the obstruction light shall be not less than one (1) foot above the highest point of the obstruction except in the case of smokestacks where the uppermost units shall be mounted not less than five (5) feet , nor more than ten (10) feet below the top of the stack. Conduit supporting the obstruction light units shall be fastened to wooden structures with galvanized steel pipe straps and shall be secured by 1-1/2-inch No. 10 galvanized wood screws. Conduit shall be fastened to masonry structures by the use of expansion shields, screw anchors, or toggle bolts using No. 10, or larger, galvanized wood or machine screws. Conduit fastened to structural steel shall have the straps held with not less than No. 10 roundhead machine screws in drilled and tapped holes. Fastenings shall be approximately five (5) feet apart. Three (3) coats of paint shall be applied (one (1) prime, one (1) body, and one (1) finish coat) with color per Federal Specification 595, international orange, number 12197 paint to all exposed material installed.

**119-3.5 Series isolation transformers.** If it is designed for use in a series lighting circuit, the L-810 series obstruction light does not include a film cutout. Therefore, an isolation transformer is required with each series lamp. Double series units of this type require two (2) isolation transformers. The transformer shall be housed in a light base per paragraph 119-2.4 titled TRANSFORMER HOUSING or buried directly in the earth as specified in the contract documents.

**119-3.6 Wiring.** The Contractor shall furnish all necessary labor and materials. The Contractor shall make complete electrical connections from the underground cable or other source of power per the wiring diagram furnished with the contract documents. If underground cable is required for the power feed and if duct is required under paved areas, the cable and duct shall be installed per and paid for as described in Item 108 titled UNDERGROUND POWER CABLE FOR AIRPORTS, and Item 110 titled AIRPORT UNDERGROUND ELECTRICAL DUCT BANKS AND CONDUIT.



- 119-3.7 Lamps.** The Contractor shall furnish and install in each unit one (1) or two (2) lamps that are per the manufacturer's requirements. Provide two (2) lamp sets as spares.
- 119-3.8 Tests.** The installation shall be fully tested by continuous operation for not less than one-half (1/2) hour as a completed unit prior to acceptance. These tests shall include the functioning of each control not less than ten (10) times.

#### **METHOD OF MEASUREMENT**

- 119-4.1** The quantity of obstruction lights shall be measured for payment by the number of each unit installed as specified, completed, and accepted by the Resident Engineer.

#### **BASIS OF PAYMENT**

- 119-5.1** Payment for accepted quantities of work performed by the Contractor and measured by the Resident Engineer shall be made at the contract unit price as specified in paragraph 119-4.1 of this section. Payment shall be full compensation for furnishing all materials and for all preparation, assembly, and installation of these materials, and for all labor, equipment, tools, and incidentals necessary to complete the work as specified.

#### **REFERENCES**

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

##### **American National Standards Institute / Insulated Cable Engineers Association (ANSI/ICEA)**

- |                    |  |
|--------------------|--|
| ANSI/ICEA S-70-547 | Standards for Weather-Resistant Polyolefin Covered Connectors<br>Commercial Item Description (CID) |
| A-A-59544A         | Cable and Wire, Electrical (Power, Fixed Installation)   |

##### **Federal Aviation Administration Advisory Circulars (AC)**

- |                |   |
|----------------|---|
| AC 70/7460-1   | Obstruction Marking and Lighting  |
| AC 150/5340-30 | Design and Installation Details for Airport Visual Aids                                     |
| AC 150/5345-7  | Specification for L-824 Underground Electrical Cable for Airport Lighting Circuits          |
| AC 150/5345-42 | Specification for Airport Light Bases, Transformer Housing, Junction Boxes, and Accessories |
| AC 150/5345-43 | Specification for Obstruction Lighting Equipment  |
| AC 150/5345-47 | Specification for Series to Series Isolation Transformers for Airport Lighting Systems      |
| AC 150/5345-53 | Airport Lighting Equipment Certification Program  |

##### **Federal Standard (FED STD)**

- |             |                                       |
|-------------|---------------------------------------|
| FED STD 595 | Colors used in Government Procurement |
|-------------|---------------------------------------|

##### **National Fire Protection Association (NFPA)**

- |         |                                |
|---------|--------------------------------|
| NFPA-70 | National Electrical Code (NEC) |
|---------|--------------------------------|

##### **Underwriters Laboratories (UL)**

- |               |  |
|---------------|--|
| UL Standard 6 | Electrical Rigid Metal Conduit – Steel |
|---------------|--|

UL Standard 514B	Conduit, Tubing, and Cable Fittings Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers
UL Standard 651	Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings
UL Standard 651A	Type EB and A Rigid PVC Conduit and HDPE Conduit
UL Standard 1242	Electrical Intermediate Metal Conduit - Steel

**END OF ITEM 119**

## Item 125 Installation of Airport Lighting Systems

### DESCRIPTION

- 125-1.1** This item shall consist of airport lighting systems furnished and installed in accordance with the contract documents, and the applicable advisory circulars. The systems shall be installed at the locations and in accordance with the dimensions, design, and details as specified in the contract documents. This item shall include the furnishing of all equipment, materials, services, and incidentals necessary to place the systems in operation as completed units to the satisfaction of the Resident Engineer.

### EQUIPMENT AND MATERIALS

**125-2.1 General.**

- a. Airport lighting equipment and materials covered by advisory circulars shall be certified in the current Federal Aviation Administration Advisory Circular (AC) 150/5345-53, *Airport Lighting Equipment Certification Program (ALECP)* and listed in the ALECP Addendum. FAA certified airfield lighting shall be compatible with each other to perform in compliance with FAA criteria and the intended operation. If the Contractor provides equipment that does not perform as intended because of incompatibility with the system, the Contractor assumes all costs to correct the system for to operate properly.
- b. All other equipment and materials covered by other referenced specifications shall be subject to acceptance through manufacturer's certification of compliance (COC) with the applicable specification when requested by the Engineer
- c. Manufacturer's certifications shall not relieve the Contractor of their responsibility to provide materials in accordance with these specifications. Materials supplied and/or installed that do not comply with these specifications shall be removed, when directed by the Resident Engineer, and replaced with materials, which do comply with these specifications, at the sole cost of the Contractor.
- d. All materials and equipment used shall be submitted to the Resident Engineer for approval prior to ordering the equipment. Submittals consisting of marked catalog sheets or shop drawings shall be provided. Clearly mark each copy to identify pertinent products or models applicable to this project. Indicate all optional equipment and delete non-pertinent data. Submittals for components of electrical equipment and systems shall identify the equipment for which they apply on each submittal sheet. Markings shall be clearly made with arrows or circles (highlighting is not acceptable). The Contractor shall be responsible for delays in the project accruing directly or indirectly from late submissions or resubmissions of submittals.
- e. The data submitted shall be sufficient, in the opinion of the Resident Engineer, to determine compliance with the contract documents. The Contractor's submittals shall be submitted in a neatly bound, properly sized 3-ring binder, tabbed by specification section or electronic PDF format, tabbed by specification section. The Resident Engineer reserves the right to reject any or all equipment, materials or procedures, which, in the Resident Engineer's opinion, does not meet the system design and the standards and codes, specified herein.
- f. All equipment and materials furnished and installed under this section shall be guaranteed against defects in materials and workmanship for a period of at least 12 months from final

acceptance by the Department. The defective materials and/or equipment shall be repaired or replaced, at the Department's discretion, at the Contractor's expense.

- 125-2.2 Concrete.** The concrete for foundations shall be proportioned, placed, and cured per Item 610 titled CONCRETE FOR MISCELLANEOUS STRUCTURES.
- 125-2.3 Conduit and duct.** Conduit shall conform to Specification Item 110 titled AIRPORT UNDERGROUND ELECTRICAL DUCT BANKS AND CONDUITS.
- 125-2.4 Cable and counterpoise.** Cable and Counterpoise shall conform to Item 108 titled UNDERGROUND POWER CABLE FOR AIRPORTS.
- 125-2.5 Tape.** Electrical tapes shall be Scotch™ Electrical Tapes –Scotch™ 88 (1-1/2-inch wide) and Scotch™ 130C® linerless rubber splicing tape (two (2) inch wide), as manufactured by the Minnesota Mining and Manufacturing Company (3M™), or an approved equivalent.
- 125-2.6 Cable connections.** Cable connections shall conform to Item 108 titled INSTALLATION OF UNDERGROUND CABLE FOR AIRPORTS.
- 125-2.7 Retroreflective markers.** If specified, Retroreflective markers shall be type L-853 and shall conform to the requirements of the current Federal Aviation Administration Advisory Circular (AC) 150/5345-39, *Specification for L-853, Runway and Taxiway Retroreflective Markers*.
- 125-2.8 Runway and taxiway lights.** Runway and taxiway lights shall be of the class, mode, style and options as specified in the contract documents meeting the requirements of the current Federal Aviation Administration Advisory Circular (AC) 150/5345-46, *Specification for Runway and Taxiway Light Fixtures*.
- a. Runway In-Pavement Lights.**
- (1) L-850A Runway Centerline of the class, mode, style and options as specified.
  - (2) L-850B Runway Touchdown Zone of the class, mode, style and options as specified.
  - (3) L-850C Runway Edge of the class, mode, style and options as specified.
  - (4) L-850D Runway Threshold/end of the class, mode, style and options as specified.
  - (5) L-850E Medium Intensity Approach of the class, mode, style and options as specified.
  - (6) L-850F Land and Hold Short of the class, mode, style and options as specified.
- b. Taxiway In-Pavement Lights.**
- (1) L-852A Taxiway Centerline of the class and options as specified.
  - (2) L-852B Taxiway Centerline of the class and options as specified.
  - (3) L-852C Taxiway Centerline of the class and options as specified.
  - (4) L-852D Taxiway Centerline of the class and options as specified.
  - (5) L-852E Taxiway Intersections of the class and options as specified.
  - (6) L-852F Taxiway Intersections of the class and options as specified.
  - (7) L-852G Runway Guard of the class and options as specified.
  - (8) L-852S Stop Bar of the class, mode, style and options as specified.
  - (9) L-852T Taxiway Edge of the class, mode, style and options as specified.
- c. Runway and Taxiway Elevated Lights.**
- (1) L-804 Runway Guard of the mode as specified.
  - (2) L-861 Runway Edge of the options as specified. (non-precision IFR runways)

- (3) L-861E Runway Threshold/End of the options as specified. (non-precision IFR runways)
  - (4) L-861SE Runway Threshold/End of the options as specified. (non-precision IFR runways)
  - (5) L-861T Taxiway Edge of the options as specified.
  - (6) L-862 Runway Edge of the options as specified. (precision IFR runways)
  - (7) L-862E Runway Threshold/End of the options as specified. (precision IFR runways)
  - (8) L-862S Stop bar
- d. **Lamps and Filters.** Lamps shall be of size and type indicated, or as required by fixture manufacturer for each lighting fixture required under this contract. Filters shall be of colors conforming to the specification for the light concerned or to the standard referenced.
- 125-2.9 Runway and taxiway guidance signs.** Runway and Taxiway Guidance Signs shall be of the size, style, class and mode as specified in the contract documents meeting the requirements of the current Federal Aviation Administration Advisory Circular (AC) 150/5345-44, *Specification for Runway and Taxiway Signs*.
- a. L-858Y Direction Sign of the size, style, class and mode as specified.
  - b. L-858R Mandatory Sign of the size, style, class and mode as specified.
  - c. L-858L Location Sign of the size, style, class and mode as specified.
  - d. L-858B Runway Distance Remaining Sign of the size, class and mode as specified.
  - e. Type L-858Ba Dot Matrix Runway Distance Remaining Sign of the size, class and mode as specified.
  - f. Type L-858C Taxiway Ending Marker Sign of the size, style, class and mode as specified. (yellow 45-degree diagonal stripes on a black background).
  - g. Type L-858H One-Half Distance Remaining Sign of the size, class and mode as specified.
- 125-2.10 Runway end identifier light (REIL).** The REIL fixtures shall be of the type and style as specified in the contract documents meeting the requirements of the current Federal Aviation Administration Advisory Circular (AC) 150/5345-51, *Specification for Discharge-Type Flashing Light Equipment*.
- 125-2.11 Precision approach path indicator (PAPI).** The light units for the PAPI shall be of the type, style and class as specified in the contract documents meeting the requirements of the current Federal Aviation Administration Advisory Circular (AC) 150/5345-28, Precision Approach Path Indicator (PAPI) Systems.
- 125-2.12 Circuit selector cabinet.** The circuit selector cabinet shall be of the type, class, and size as specified in the contract documents meeting the requirements of the current Federal Aviation Administration Advisory Circular (AC) 150/5345-5, Airport Lighting Equipment Certification Program.
- 125-2.13 Light base and transformer housings.** Light Base and Transformer Housings shall be of the type, class, and size as specified in the contract documents meeting the requirements of the current Federal Aviation Administration Advisory Circular (AC) 150/5345-42, Specification for Airport Light Bases, Transformer Housings, Junction Boxes, and Accessories.
- 125-2.14 Isolation transformers.** Isolation Transformers shall be of the type and size as specified in the contract documents meeting the requirements of the current Federal Aviation Administration Advisory Circular (AC) 150/5345-47, Specification for Series to Series Isolation Transformers for Airport Lighting Systems.

- 125-2.15 Backfill.** The gradation of the backfill material shall meet the requirements of the gradation given in the following table when tested per the current Illinois Department of Transportation, Bureau of Materials Policy Memorandum (PM) 11-08, *Aggregate Gradation Control System (AGCS)*.

### Fine Aggregate Gradation

Sieve Size	Gradation Percent Passing	
	FA 1	FA 2
3/8	100	100
No. 4	97±3	97±3
No. 16	65±20	65±20
No. 50	16±13	20±10
No. 100	5±5	5±5

### CONSTRUCTION METHODS

- 125-3.1 Installation.** The Contractor shall furnish, install, connect and test all equipment, accessories, conduit, cables, wires, buses, grounds and support items necessary to ensure a complete and operable airport lighting system as specified in the contract documents.
- The equipment installation and mounting shall comply with the requirements of the National Electrical Code and state and local code agencies having jurisdiction.
- The Contractor shall install the specified equipment in accordance with the applicable advisory circulars and the details specified in the contract documents meeting the requirements of the current Federal Aviation Administration Advisory Circular (AC) 150/5340-30, *Design and Installation Details for Airport Visual Aids*.
- 125-3.2 Testing.** All lights shall be fully tested by continuous operation for not less than 24 hours as a completed system prior to acceptance. The test shall include operating the constant current regulator in each step not less than ten (10) times at the beginning and end of the 24-hour test. The fixtures shall illuminate properly during each portion of the test.
- 125-3.3 Shipping and storage.** Equipment shall be shipped in suitable packing material to prevent damage during shipping. Store and maintain equipment and materials in areas protected from weather and physical damage. Any equipment and materials, in the opinion of the Resident Engineer, damaged during construction or storage shall be replaced at the Contractor's expense. Painted or galvanized surfaces that are damaged shall be repaired in accordance with the manufacturer's recommendations.
- 125-3.4 Elevated and in-pavement lights.** Water, debris, and other foreign substances shall be removed prior to installing fixture base and light.
- A jig or holding device shall be used when installing each light fixture to ensure positioning to the proper elevation, alignment, level control, and azimuth control. Light fixtures shall be oriented with the light beams parallel to the runway or taxiway centerline and facing in the required direction. The outermost edge of fixture shall be level with the surrounding pavement. Surplus sealant or flexible embedding material shall be removed. The holding device shall remain in place until sealant has reached its initial set.

### METHOD OF MEASUREMENT

- 125-4.1** The quantity of reflective markers, runway and taxiway lights, guidance signage, runway end identifier lights, and precision approach path indicators shall be measured for payment by the number of each unit installed as specified, completed, ready for operation, and accepted by the Resident Engineer.

### BASIS OF PAYMENT

- 125-5.1** Payment for accepted quantities of work performed by the Contractor and measured by the Resident Engineer shall be made at the contract unit price as specified in paragraph 125-4.1 of this section. Payment shall be full compensation for furnishing all materials and for all preparation, assembly, and installation of these materials, and for all labor, equipment, tools and incidentals necessary to complete the work as specified.

### REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

#### Federal Aviation Administration Advisory Circulars (AC)

AC 150/5340-18	Standards for Airport Sign Systems
AC 150/5340-26	Maintenance of Airport Visual Aid Facilities
AC 150/5340-30	Design and Installation Details for Airport Visual Aids
AC 150/5345-5	Circuit Selector Switch
AC 150/5345-7	Specification for L-824 Underground Electrical Cable for Airport Lighting Circuits
AC 150/5345-26	Specification for L-823 Plug and Receptacle, Cable Connectors
AC 150/5345-28	Precision Approach Path Indicator (PAPI) Systems
AC 150/5345-39	Specification for L-853, Runway and Taxiway Retroreflective Markers
AC 150/5345-42	Specification for Airport Light Bases, Transformer Housings, Junction Boxes, and Accessories
AC 150/5345-44	Specification for Runway and Taxiway Signs
AC 150/5345-46	Specification for Runway and Taxiway Light Fixtures
AC 150/5345-47	Specification for Series to Series Isolation Transformers for Airport Lighting Systems
AC 150/5345-51	Specification for Discharge-Type Flashing Light Equipment
AC 150/5345-53	Airport Lighting Equipment Certification Program

#### Illinois Department of Transportation, Bureau of Materials Policy Memoranda (PM)

PM 11-08	Aggregate Gradation Control System (AGCS)
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**END OF ITEM 125**