
**Federal Aviation Administration
William J. Hughes Technical Center
National Airport Pavement Test Facility
Atlantic City International Airport, New Jersey**



SPECIFICATIONS

FOR

NAPTF – Construction Cycle 9 (CC9)

Revision 5

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Section 10MR Definition of Terms

Whenever 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 interpreted as follows:

10MR-01 AASHTO. The American Association of State Highway and Transportation Officials.

10MR-02 Access Road. The right-of-way, the roadway and all improvements constructed thereon connecting the airport to a public highway.

10MR-03 Advertisement. A public announcement, as required by local law, inviting bids for work to be performed and materials to be furnished.

10MR-04 Airport Improvement Program (AIP). A grant-in-aid program, administered by the Federal Aviation Administration (FAA).

10MR-05 Air Operations Area (AOA). For the purpose of these specifications, the term air operations area (AOA) shall mean any area of the airport used or intended to be used for the landing, 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.

10MR-06 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; and airport buildings and facilities located in any of these areas, and includes a heliport.

10MR-07 ASTM International (ASTM). Formerly known as the American Society for Testing and Materials (ASTM).

10MR-08 Award. The Owner's notice to the successful bidder of the acceptance of the submitted bid.

10MR-09 Bidder. Any individual, partnership, firm, or corporation, acting directly or through a duly authorized representative, who submits a proposal for the work contemplated.

10MR-10 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.

10MR-11 Calendar Day. Every day shown on the calendar.

10MR-12 Certificate of Analysis (COA). The COA is the manufacturer's COC including all applicable test results required by the specifications.

10MR-13 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.

10MR-14 Change Order. A written order to the Contractor covering changes in the plans, specifications, or proposal quantities and establishing the basis of payment and contract time adjustment, if any, for the work affected by such changes. The work, covered by a change order, must be within the scope of the contract.

10MR-15 Contract. The written agreement covering the work to be performed. The awarded contract shall include, but is not limited to: Advertisement, Contract Form, Proposal, Performance Bond, Payment Bond, any required insurance certificates, Specifications, Plans, and any addenda issued to bidders.

10MR-16 Contract Item (Pay Item). A specific unit of work for which a price is provided in the contract.

10MR-17 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 a number of calendar or working days, the contract shall be completed by that date.

10MR-18 Contractor. The individual, partnership, firm, or corporation 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.

10MR-19 Contractors Quality Control Facilities. The Contractor's QC facilities in accordance with the Contractor Quality Control Program (CQCP).

10MR-20 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.

10MR-21 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.

10MR-22 Drainage System. The system of pipes, ditches, and structures by which surface or subsurface waters are collected and conducted from the airport area.

10MR-23 Engineer. The individual, partnership, firm, or corporation duly authorized by the Owner to be responsible for engineering, inspection, and/or observation of the contract work and acting directly or through an authorized representative.

10MR-24 Equipment. All machinery, together with the necessary supplies for upkeep and maintenance, and also all tools and apparatus necessary for the proper construction and acceptable completion of the work.

10MR-25 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 Engineer to be necessary to complete the work within the intended scope of the contract as previously modified.

10MR-26 FAA. The Federal Aviation Administration of the U.S. Department of Transportation. When used to designate a person, FAA shall mean the Administrator or his or her duly authorized representative.

10MR-27 Federal Specifications. The Federal Specifications and Standards, Commercial Item Descriptions, and supplements, amendments, and indices thereto are prepared and issued by the General Services Administration of the Federal Government.

10MR-28 Force Account. Force account work is planning, engineering, or construction work done by the Owner's employees.

10MR-29 Inspector. An 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.

10MR-30 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 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, subject in each case to the final determination of the Owner. 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.

10MR-31 Quality Assurance (QA) Laboratory. The official quality assurance testing laboratories of the Owner or such other laboratories as may be designated by the Engineer. Also referred to as "Engineer's Laboratory."

10MR-32 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.

10MR-33 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.

10MR-34 Materials. Any substance specified for use in the construction of the contract work.

10MR-35 Modification of Standards (MOS). Any deviation from standard specifications applicable to material and construction in accordance with FAA Order 5100.1.

10MR-36 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.

10MR-37 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.

10MR-38 Passenger Facility Charge (PFC). Per 14 CFR Part 158 and 49 USC § 40117, a PFC is a charge imposed by a public agency on passengers enplaned at a commercial service airport it controls.

10MR-39 Pavement Structure. The combined surface course, base course(s), and subbase course(s), if any, considered as a single unit.

10MR-40 Payment bond. The approved form of security furnished by the Contractor and his or her 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.

10MR-41 Performance bond. The approved form of security furnished by the Contractor and his or her surety as a guaranty that the Contractor will complete the work in accordance with the terms of the contract.

10MR-42 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.

10MR-43 Project. The agreed scope of work for accomplishing specific airport development with respect to a particular airport.

10MR-44 Proposal. The written offer of the bidder (when submitted on the approved proposal form) to perform the contemplated work and furnish the necessary materials in accordance with the provisions of the plans and specifications.

10MR-45 Proposal guaranty. The security furnished with a proposal to guarantee that the bidder will enter into a contract if his or her proposal is accepted by the Owner.

10MR-46 Runway. The area on the airport prepared for the landing and takeoff of aircraft.

10MR-47 Specifications. A part of the contract containing the written directions and requirements for completing the contract work. Standards for specifying materials or testing which are cited in the contract specifications by reference shall have the same force and effect as if included in the contract physically.

10MR-48 Sponsor. A Sponsor is defined in 49 USC § 47102(24) 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.

10MR-49 Structures. Airport facilities such as bridges; culverts; catch basins, inlets, retaining walls, cribbing; storm and sanitary sewer 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.

10MR-50 Subgrade. The soil that forms the pavement foundation.

10MR-51 Superintendent. The Contractor's executive representative who is present on the work during progress, authorized to receive and fulfill instructions from the Engineer, and who shall supervise and direct the construction.

10MR-52 Supplemental agreement. A written agreement between the Contractor and the Owner covering (1) work that would increase or decrease the total amount of the awarded contract, or any major contract item, by more than 25%, such increased or decreased work being within the scope of the originally awarded contract; or (2) work that is not within the scope of the originally awarded contract.

10MR-53 Surety. The corporation, partnership, or individual, other than the Contractor, executing payment or performance bonds that are furnished to the Owner by the Contractor.

10MR-54 Taxiway. For the purpose of this document, the term taxiway means 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.

10MR-55 Test Area Each CC is divided into independent test areas that are designed and constructed to meet specific test objective(s). For instance, there are four CC9 test areas: Strength and Fatigue, Overload, Geosynthetics, and Cement Treated Drainable Base.

10MR-56 Test Item Each test item represents one or more sections within a test area that is subjected to a unique traffic test. Test items are normally used to differentiate two sides of the test pavement, north and south.

10MR-57 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.

10MR-58 Working day. A working day shall be any day other than a legal holiday, Saturday, or Sunday on which the normal working forces of the Contractor may proceed with regular work for at least six (6) hours toward completion of the contract. When work is suspended for causes beyond the Contractor's control, it will not be counted as a working day. Saturdays, Sundays and holidays on which the Contractor's forces engage in regular work will be considered as working days.

END OF SECTION 10MR

Section 40MR Scope of Work

GENERAL REQUIREMENTS

40MR-01 Project description. The work consists of demolition of existing pavement sections, construction of new pavement test items, and incidental related efforts at the National Airport Pavement Test Facility (Building 296) in the William J. Hughes Technical Center, located at the Atlantic City International Airport in New Jersey. Typical tasks include:

- Careful demolition of existing pavement sections.
- Construction of new pavement test items and associated appurtenances.
- Use of specific construction techniques identified in the project documents for research purposes.

40MR-02 Intent of contract. The intent of the contract is to provide for construction and completion, in every detail, of the work described. It is further intended that the Contractor shall furnish all labor, materials, equipment, tools, transportation, and supplies required to complete the work in accordance with the plans, specifications, and terms of the contract.

40MR-03 Special research requirements. Construction work at the NAPTF is conducted to support research activities and is subject to unique requirements. Test items may be indicated in the project plans to be constructed indoors, with associated issues of lighting, equipment and material entry into and operation inside the building, sufficient overhead lighting, and adequate ventilation. Items are subject to intense testing and documentation. Demolition and construction items are to be constructed in the sequence that is indicated in project documents. Complete each item before commencing with subsequent items unless otherwise indicated in the project documents. Furnish items to NAPTF personnel for sampling and testing as indicated in project documents. Cease demolition and construction activities for the duration of testing at times indicated in the project documents. Expect a work stoppage of 1 to 3 days, or as indicated in project documents, after completion of each item to allow adequate time for the FAA to obtain samples and run tests. Coordinate activities with the NAPTF to avoid disturbance of research occurring outside the limits of this project. Any requirement of these specifications may be waived to further the research goals of the project by written notification from the FAA to the Contractor.

40MR-04 Submittals. Submit the following in accordance with 61MR SUBMITTAL PROCEDURES:

a. SD-01 Preconstruction submittals.

- 1. Construction operations plan.** Contractor shall document the intended general sequence of work activities, general types of anticipated equipment, anticipated utility and service interruptions, and anticipated impact to research or other activities near the work site.
- 2. Project schedule.** Contractor shall prepare and maintain a schedule in MS Project format. Use the Critical Path Method to schedule and control project activities. Include submittals, review periods, all construction activities, inspection, testing,

and closeout activities. Saturdays, Sundays, and Federal holidays are non-work days. Indicate if extended work hours will be requested.

3. **Safety plan.** Contractor shall identify potentially hazardous construction activities and planned mitigation procedures. The plan should include excavation, heavy equipment operation, and minimum Personal Protective Equipment requirements for site access in addition to each major construction activity.

b. SD-03 Product Data.

1. **Instrumentation cut sheets.** Engineer shall provide cut sheets and shop drawings for all instrumentation shown on the plans.

40MR-05 Commencement of work. Work shall not begin until authorization is received from the FAA. The schedule of the availability of work areas shall be confirmed by the FAA. Completion of the work shall be done during standard work hours at the facility of 7:00 AM to 5:00 PM. Requests for extended work hours should be submitted in writing five work days in advance, and may be granted at the discretion of the FAA.

40MR-06 Maintenance of site. Storing any waste material or debris on unstabilized base, subbase, and subgrade materials shall not be done. Staging and stockpile areas shall be maintained in a neat and organized manner, properly drained, and in a manner to prevent contamination of stockpiles and materials.

40MR-07 Items to remain in place. Necessary precautions shall be taken to avoid damage to existing items and instrumentation shall remain in place, to be reused, or to remain the property of the FAA. Do not overload pavements to remain. Provide supports and reinforcement for existing items weakened by excavation, demolition, deconstruction, or removal work. Reinforcement and supports require approval by the FAA prior to performing such work. Prevent contamination of materials to remain with foreign or demolished pavement materials, debris, and refuse. Repair or replace damaged items as directed by and at no additional cost to the FAA.

40MR-08 Dust and debris control. Prevent the spread of dust and debris beyond the project limits. Use of water is permitted, however, do not use water if it results in hazardous or objectionable conditions such as, but not limited to an increase in subgrade moisture content, ice, flooding, or pollution. Water trucks are not permitted inside the test facility. Prevent the accumulation of loose dust, dirt, mud, or debris on haul routes, roadways, staging areas, and parking lots. Provide protective measures to control accumulation and migration of dust and dirt into work areas and office spaces.

40MR-09 Weather protection. Protect materials and equipment from damage by the weather at all times.

40MR-10 Utility service. Utilities must remain in service for the duration of project activities. Protect against damage during demolition and deconstruction operations. Notify the FAA immediately if utility infrastructure is damaged, or if an unmarked utility is located.

40MR-11 Protection of personnel. Conform to the safety requirements in accordance with the NAPTF Health and Safety Plan, Federal, state, and local laws, and rules and regulations concerning construction safety and health standards, including Corps of Engineers manual EM

385-1-1. Comply with the Environmental Protection Agency requirements. The Contractor shall not require or allow any worker to work in surroundings or under conditions that are unsanitary, hazardous, or dangerous to health or safety.

40MR-12 Alteration of work and quantities. The Owner reserves and shall have the right to make such alterations in the work as may be necessary or desirable to complete the work originally intended in an acceptable manner. Unless otherwise specified herein, the Engineer shall be and is hereby authorized to make such alterations in the work as may increase or decrease the originally awarded contract quantities, provided that the aggregate of such alterations does not change the total contract cost or the total cost of any major contract item by more than 25% (total cost being based on the unit prices and estimated quantities in the awarded contract). Alterations that do not exceed the 25% limitation shall not invalidate the contract nor release the surety, and the Contractor agrees to accept payment for such alterations as if the altered work had been a part of the original contract. These alterations that are for work within the general scope of the contract shall be covered by "Change Orders" issued by the Engineer. Change orders for altered work shall include extensions of contract time where, in the Engineer's opinion, such extensions are commensurate with the amount and difficulty of added work.

Should the aggregate amount of altered work exceed the 25% limitation hereinbefore specified, such excess altered work shall be covered by supplemental agreement. If the Owner and the Contractor are unable to agree on a unit adjustment for any contract item that requires a supplemental agreement, the Owner reserves the right to terminate the contract with respect to the item and make other arrangements for its completion.

Supplemental agreements shall be approved by the FAA 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.

40MR-13 Omitted items. The Engineer may, in the Owner's best interest, omit from the work any contract item, except major contract items. Major contract items may be omitted by a supplemental agreement. Such omission of contract items shall not invalidate any other contract provision or requirement.

Should a contract item be omitted 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 omit such item. Payment for work performed shall be in accordance with Section 40MR-20 titled PAYMENT FOR OMITTED ITEMS.

40MR-14 Extra work. Should acceptable completion of the contract require the Contractor to perform an item of work for which no basis of payment has been provided in the original contract or previously issued change orders or supplemental agreements, the same shall be called "Extra Work." Extra Work that is within the general scope of the contract shall be covered by written change order. Change orders for such 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 such 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 as provided in Section 40MR-21 titled PAYMENT FOR EXTRA WORK. 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 40MR-22 titled SUPPLEMENTAL AGREEMENT. Any claim for payment of Extra Work that is not covered by written agreement (change order or supplemental agreement) shall be rejected by the Owner.

40MR-15 Removal of existing structures. All existing structures and instrumentation 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 Engineer shall be notified using the Request for Information process prior to disturbing such structure. The disposition of existing structures so encountered shall be immediately determined by the Engineer in accordance with the provisions of the contract.

Except as provided in the subsection 40MR-16 titled RIGHTS IN AND USE OF MATERIALS FOUND IN THE WORK of this section, 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.

40MR-16 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 either embankment or waste, the Contractor may at his or her 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 his or her own 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 his or her 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.

40MR-17 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 such property Owner.

FAA FURNISHED ITEMS

40MR-18 Materials. Suitable material for construction of the following items will be provided by the FAA at no cost to the Contractor at the locations indicated on the plans. The quantities provided will be sufficient for construction of the test pavement to the lines and grades indicated on the plans. The Contractor is responsible for all other aspects of constructing the items including hauling. Quality control and acceptance testing requirements are not waived for FAA furnished materials.

- Potable water is available from a 2" valve located in the northwest corner of the NAPTF. A hydrant connection is available at the discretion of the Owner through coordination with the FAA Facilities Engineer.
- A stockpile of subgrade material is available near Building 207A.

40MR-19 Equipment. The following equipment may be used at no cost to the contractor to construct the test pavement to the lines and grades indicated on the plans. The equipment will be delivered to the Contractor at the work location. FAA furnished equipment used by the Contractor shall be operated, fueled, and maintained by the Contractor, and will be returned to the FAA in the same condition in which it was delivered to the Contractor.

- CAT PS 300C pneumatic rubber tire roller.
- BOMAG MPH 364 S soil stabilizer.
- SEAMAX MODEL TO730-H-K travel mixer- soil stabilizer.
- GOMACO 450 bridge deck finisher

PAYMENT

40MR-20 Payment for omitted items. As specified in the subsection 40MR-13 titled OMITTED ITEMS, the Engineer shall have the right to omit from the work (order nonperformance) any contract item, except major contract items, in the best interest of the FAA.

Should the Engineer omit 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 omit or non-perform such contract item. Payment will not be made for work on omitted items after the item is omitted from the contract, whether performed or not performed.

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 FAA.

In addition to the reimbursement hereinbefore provided, the Contractor shall be reimbursed for all actual costs incurred for the purpose of performing the omitted 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.

40MR-21 Payment for extra work. Extra work, performed in accordance with the subsection 40MR-14 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.

DEFINITIONS

40MR-22 Supplemental agreement. A written agreement between the Contractor and the Owner covering (1) work that would increase or decrease the total amount of the awarded contract, or any major contract item, by more than 25%, such increased or decreased work being within the scope of the originally awarded contract; or (2) work that is not within the scope of the originally awarded contract.

END OF SECTION 40MR

Section 50MR Control of Work

50MR-01 Roles, responsibilities, and authorities. Responsibility and authority with regard to this project shall be divided as defined in this paragraph, except as indicated in the contract or other sections of these specifications. Reporting and communication shall be organized according to Figure 1, except as indicated in the contract or other sections of these specifications.

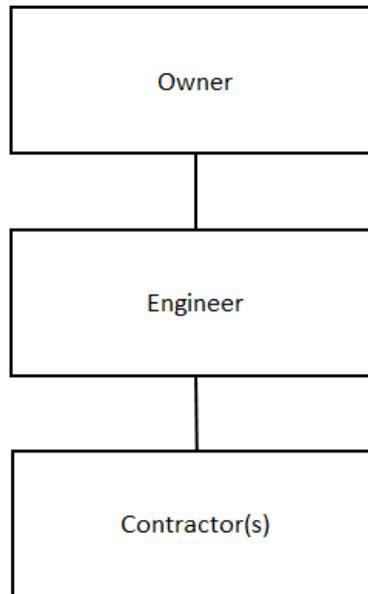


Figure 1. Project Organization Chart

- a. **Contractor.** The contractor is responsible for completion of all aspects of the work in conformance with the plans, specifications, and contract requirements. Subcontractors to the Contractor are not recognized as parties to the contract. All communication with the Engineer must be by the Contractor. The Contractor is solely responsible for the Contractor's schedule, means, methods, techniques, sequences, or procedures of construction or the safety precautions incident thereto.
- b. **Engineer.** The Engineer shall decide any and all questions which may arise as to the quality and acceptability of materials furnished, work performed, and as to the manner of performance and rate of progress of the work. The Engineer shall decide all questions that may arise as to the interpretation of the specifications or plans relating to the work. The Engineer shall determine the amount and quality of the several kinds of work performed and materials furnished which are to be paid for the under contract. The Engineer does not have the authority to accept work that does not conform to FAA specification requirements.
- c. **Owner.** The Owner shall have authority to accept or reject any or all aspects of the work, interpret or otherwise answer questions concerning the plans and specifications, make changes to the plans and specifications, and make payment under the contract. The Owner shall have unfettered access to the site of the work for purposes inspection of the work or other actions necessary under the contract. The owner shall have the authority to suspend work in whole or in part for non-conformance with plans or specifications, or for such

period or periods as the Owner may deem necessary for research purposes, by verbal notification to the Contractor.

50MR-02 Conformity with plans and specifications. 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 within reasonably close conformity with the plans and specifications but that the portion of the work affected will, in his or her opinion, result in a finished product having a level of safety, economy, durability, and workmanship acceptable to the Owner, the Engineer will advise the Owner of his or her determination that the affected work be accepted and remain in place. In this event, the Engineer will document the determination and recommend to the Owner a basis of acceptance that will provide for an adjustment in the contract price for the affected portion of the work. The Engineer's determination and recommended contract price adjustments will be based on sound engineering judgment and such tests or retests of the affected work as are, in the Engineer's opinion, needed. Changes in the contract price shall 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 plans and specifications 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.

For the purpose of this subsection, 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.

For the purpose of this subsection, 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 his or her determinations as to acceptance of 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, plans and specifications.

50MR-03 Coordination of contract, plans, and specifications. The contract, plans, specifications, and all referenced standards cited are essential parts of the contract requirements. A requirement occurring in one 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; contract technical specifications shall govern over contract general provisions, plans, cited standards for materials or testing, and cited advisory circulars (ACs); contract general provisions shall govern over plans, cited standards for materials or testing, and cited ACs; plans shall govern over cited standards for materials or testing and cited

ACs. If any paragraphs contained in the Special Provisions conflict with General Provisions or Technical Specifications, the Special Provisions shall govern.

From time to time, discrepancies within cited testing standards occur due to the timing of the change, edits, and/or replacement of the standards. If the Contractor discovers any apparent discrepancy within standard test methods, the Contractor shall immediately ask the Engineer for an interpretation and decision, and such decision shall be final.

50MR-04 Cooperation of Contractor. The Contractor will be supplied with electronic copies of the plans and specifications in PDF format. The Contractor shall have available on the work at all times one copy each of the plans and specifications. The cost of reproduction shall be borne by the Contractor.

The Contractor shall give constant attention to the work to facilitate the progress thereof, and shall cooperate with the Engineer and his or her inspectors and with other contractors in every way possible. The Contractor shall have a competent superintendent on the work at all times who is fully authorized as his or her agent on the work. The superintendent shall be capable of reading and thoroughly understanding the plans and specifications and shall receive and fulfill instructions from the Engineer or his or her authorized representative.

50MR-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 project, each Contractor shall conduct the work so as not to interfere with or hinder the progress of completion of the work being performed by other Contractors. 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 his or her contract and shall protect and save harmless the 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 his or her work and shall place and dispose of the materials being used so as not to interfere with the operations of the other Contractors within the limits of the same project. The Contractor shall join his or her work with that of the others in an acceptable manner and shall perform it in proper sequence to that of the others.

50MR-06 Construction layout and stakes. The Engineer shall establish horizontal and vertical control only. The Contractor must establish all layout required for the construction of the work. Such stakes and markings as the Engineer may set for either their own or the Contractor's guidance shall be preserved by the Contractor. In case of negligence on the part of the Contractor, or their employees, resulting in the destruction of such stakes or markings, stakes or markings shall be replaced by the Contractor to the satisfaction of the Engineer at no additional cost to the Owner.

The Contractor will be required to furnish all lines, grades and measurements from the control points necessary for the proper execution and control of the work contracted for under these specifications.

The Contractor must give copies of survey notes to the Engineer for each area of construction and for each placement of material as specified to allow the Engineer to make periodic checks for conformance with plan grades, alignments and grade tolerances required by the applicable material specifications. All surveys must be provided to the Engineer prior to commencing work items that will cover or disturb the survey staking as set by the Contractor's surveyor. Survey(s) and notes shall be provided in the following format(s): drawings and plans as AutoCAD dwg (latest version) and equivalent plots as PDF; all other items as PDF. 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 Owner.

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.

The establishment of Survey Control and/or reestablishment of survey control shall be by a State Licensed Land Surveyor.

Controls and stakes disturbed or suspect of having been disturbed shall be checked and/or reset as directed by the Engineer without additional cost to the Owner.

50MR-07 Authority and duties of inspectors. Inspectors shall be 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. Inspectors are not authorized to revoke, alter, or waive any provision of the contract. Inspectors are not authorized to issue instructions contrary to the plans and specifications or to act as foreman for the Contractor.

Inspectors are authorized to notify the Contractor or his or her 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.

50MR-08 Inspection of the work. All materials and each part or detail of the work shall be subject to inspection. 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.

Any work done or materials used without supervision or inspection by an authorized representative of the Owner may be ordered removed and replaced at the Contractor's expense unless the Owner's representative failed to inspect after having been given reasonable notice in writing that the work was to be performed.

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.

50MR-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 the subsection 50MR-02 titled CONFORMITY WITH PLANS AND SPECIFICATIONS of this section.

Unacceptable work, 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 these specifications.

Until the Owner's final written acceptance of the entire completed work, excepting only those portions of the work accepted in accordance with the subsection 50MR-14 titled PARTIAL ACCEPTANCE of Section 50MR, 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 execution or from the non-execution 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 acts of God such as earthquake, tidal wave, tornado, hurricane or other cataclysmic phenomenon of nature, or acts of the public enemy or of government authorities.

If the work is suspended for any cause whatsoever, 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 his or her 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.

No removal work made under provision of this subsection shall be done without lines and grades having been established by the Engineer. Work done contrary to the specifications and 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 under the provisions of this subsection, the Engineer will have authority to cause unacceptable work to be remedied or removed and replaced and unauthorized work to be removed and to deduct the costs incurred by the Owner from any monies due or to become due the Contractor.

50MR-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, research test items, 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 shall be responsible for all damage done by his or her hauling equipment and shall correct such damage at his or her own expense.

50MR-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.

50MR-12 Failure to maintain the work. Should the Contractor at any time fail to maintain the work as provided in the subsection 50MR-12 titled MAINTENANCE DURING CONSTRUCTION of this section, the 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 the exigency that exists.

Should the Contractor fail to respond to the Engineer's notification, the Owner 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 deducted from monies due or to become due the Contractor.

50MR-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 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.

50MR-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 give the Contractor the necessary instructions for correction of same and the Contractor shall immediately comply with and execute such instructions. 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.

50MR-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 his or her 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 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 subsection shall be construed as a waiver of the Contractor's right to dispute final payment based on differences in measurements or computations.

END OF SECTION 50MR

Section 60MR Control of Materials

60MR-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 complete statements to the Engineer as to the origin, composition, and manufacture of all materials to be used in the work. Such statements shall be furnished promptly after execution of the contract but, in all cases, prior to delivery of such materials.

At the Engineer's option, materials may be approved at the source of supply before delivery is stated. 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 is solely responsible for control of quality in accordance with Item C-100MR Contractor Quality Control Program (CQCP). The FAA reserves the right to verify material quality through independent testing and inspection of any material or item as part of the Quality Assurance Program. Provide access to materials and facilities to the Engineer for purposes of sampling and testing. Except as indicated, Quality Assurance Program activities are the responsibility of the Engineer, to be conducted at no additional cost to the Contractor.

60MR-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 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, will be made by and at the expense of the Engineer.

The testing organizations performing on-site quality assurance 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.

The Contractor shall employ a QC testing organization to perform all Contractor required QC tests in accordance with Item C-100 Contractor Quality Control Program (CQCP). All the test data shall be reported to the Engineer after the results are known. A legible, handwritten copy of all test data

shall be given 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.

60MR-03 Submittals

Provide complete and sufficiently detailed submittals as indicated in the technical sections of these Specifications to allow the FAA to determine compliance of the indicated materials and methods with contract requirements. Prepare and submit submittals in accordance with Section 61MR Submittal Procedures.

60MR-04 Plant inspection. The Engineer or their own 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 quality.

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 Engineer has contracted for materials.
- b. The Engineer shall have full entry 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 in a convenient location with respect to the plant.

It is understood and agreed that the Owner 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.

60MR-05 Storage of materials. Materials shall be so stored as 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. Unless otherwise shown on the plans, 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 own entire expense, except as otherwise agreed to (in writing) by the Owner or lessee of the property.

60MR-06 Unacceptable materials. Any material or assembly that does not conform to the requirements of the contract, plans, or specifications 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. The Contractor is responsible for the cost of removal of unacceptable materials, including removal and repair of adjacent or subsequent work.

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.

60MR-07 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 Owner will deduct from any monies due or to become due the Contractor any cost incurred by the Owner in making good such loss due to the Contractor's handling, storage, or use of Owner-furnished materials

END OF SECTION 60MR

Section 61MR Submittal Procedures

61MR-01 Summary. Required submittals are identified in the technical sections. The FAA may request submittals in addition to those specified when deemed necessary to adequately describe the work. Units of weights and measures used on all submittals are to be the same as those used in the contract drawings. Each submittal is to be complete and have sufficient detail to allow ready determination of compliance with contract requirements. An incomplete submittal is grounds for rejection without further review. The Contractor shall review and certify all items prior to submission.

All submittals require FAA approval and are to be approved prior to the acquisition of any material or equipment covered thereby.

61MR-02 Submittal Descriptions (SD). Submittal descriptions define the type of materials expected as part of a submittal. Submittals are identified by Submittal Description (SD) numbers and titles as follows:

- a. **SD-01 Preconstruction Submittals.** Submittals which are required prior to commencement of any on-site work, including demolition, site work, or establishment of staging areas.
- b. **SD-02 Shop Drawings.** Drawings, diagrams and schedules specifically prepared to illustrate some portion of the work.
- c. **SD-03 Product Data.** Catalog cuts, illustrations, schedules, diagrams, performance charts, instructions and brochures illustrating size, physical appearance and other characteristics of materials, systems or equipment for some portion of the work.
- d. **SD-04 Samples.** Fabricated or unfabricated physical examples of materials, equipment or workmanship that illustrate functional and aesthetic characteristics of a material or product and establish standards by which the work can be judged. Field samples and mock-ups constructed on the project site establish standards by which the ensuring work can be judged. Includes assemblies or portions of assemblies which are to be incorporated into the project and those which will be removed at conclusion of the work.
- e. **SD-05 Design Data.** Design calculations, mix designs, analyses or other data pertaining to a part of work.
- f. **SD-06 Test Reports.** Report signed by authorized official of testing laboratory that a material, product or system identical to the material, product or system to be provided has been tested in accordance with specified requirements. Unless specified in another section, testing must have been within three years of date of contract award for the project.
 - 1) Report which includes findings of a test required to be performed by the Contractor on an actual portion of the work or prototype prepared for the project before shipment to job site.
 - 2) Report which includes findings of a test made at the job site or on samples taken from the job site, on a portion of work during or after installation.
 - 3) Investigation reports.
 - 4) Daily logs and checklists.
 - 5) Final acceptance test and operational test procedure.

- g. SD-07 Certificates.** Statements printed on the manufacturer's letterhead and signed by a company officer or Registered Professional employed by the manufacturer of a product, system or material attesting that product, system or material meets specification requirements. Must be dated after award of project contract and clearly name the project. The document purpose is to further promote the orderly progression of a portion of the work by documenting procedures, acceptability of methods or personnel qualifications.
- h. SD-08 Manufacturer's Instructions.** Preprinted material describing installation of a product, system or material, including special notices and material safety data sheets concerning impedances, hazards and safety precautions.
- i. SD-09 Operation and Maintenance Data.** Data that is furnished by the manufacturer, or the system provider, to the equipment operating and maintenance personnel, including manufacturer's help and product line documentation necessary to maintain and install equipment. This data is needed by operating and maintenance personnel for the safe and efficient operation, maintenance and repair of the item.
- j. SD-10 Closeout Submittals.** Documentation to record compliance with technical or administrative requirements or to establish an administrative mechanism.

 - 1) Record drawings
 - 2) As-built drawings
 - 3) Verification statements

61MR-03 Submittals. FAA approval is required for all submittals. Submit the following in accordance with this section:

a. SD-01 Preconstruction Submittals

- 1) **Submittal Register.** Engineer to provide a submittal register in accordance with 61MR-10. No other submittal will be accepted until the Submittal Register is approved by the FAA. A sample register can be found at the end of this document.

FORMAT

61MR-04 Transmittal form. Submit items using NAPTF Transmittal Form. Completely fill out the form and attach it to the submittal as a cover sheet. Submit a transmittal form following normal procedures after physical delivery of SD-04 submittals to the Government.

61MR-05 Quantity of submittals. Provide the following submittal quantities according to the Submittal Description:

- a. SD-02 Shop Drawings.** Provide one half-size (ledger-size, 11x17) hard copy of drawings and one electronic copy of each required SD-02 submittal.
- b. SD-04 Samples.**

 - 1) **Items.** Submit two sample items, or two sets of sample items showing range of variation, of each required item. One approved sample or set of samples will be retained by the FAA and one will be returned to Contractor.
 - 2) **Installations.** Submit one sample installation in the location directed. Include components listed in technical section or as directed.
 - 3) **Liquids.** Submit four 5-gallon samples of non-solid materials, or as indicated in the technical sections.

- 4) **Paving materials.** Submit 200 pounds of material samples for each paving material or constituent, or as indicated in the technical sections.
- c. **All other Submittal Descriptions.** Unless otherwise indicated, provide one electronic copy of each required submittal.

61MR-06 Electronic file format. Provide electronic format submittals as PDF files unless otherwise indicated. Photographs shall be sized minimum 4-megapixel in the JPEG format. Video shall be full 1080p High Definition Video in MP4 format.

61MR-07 Electronic signature. A scanned or cryptographic signature is valid and binding for non-repudiation of documents for purposes of this contract.

61MR-08 Contractor certification. Certify each submittal item as compliant with contract requirements prior to submission.

- a. **Certification authority.** Submittals must be certified by the Contractor Quality Control System Manager, Contractor Project Superintendent, or a company officer.
- b. **Contents of certification.** The certification must identify:
 - The firm name of the Contractor
 - An indication of “Approved” or “Approved with corrections as noted”
 - The signature of the certifying individual
 - The printed name of the certifying individual
 - The title of the certifying individual
 - The date the review and certification by the Contractor was complete

SUBMISSION AND APPROVAL PROCESS

61MR-09 Electronic submission. Upload the electronic documents to the project website provided by the Engineer. Submit the cover sheet for SD-04 Samples submittals after delivery of the samples.

61MR-10 Submittal register. The Engineer will provide an on-line submittal register for submission and tracking of submittals. A draft submittal register identifying the minimum required set of submittals will be provided to the Contractor by the Engineer. The Contractor shall make comments on the register and provide estimated dates of completion prior to submission of the final Submittal Register. The Engineer shall provide a final Submittal Register, including all anticipated submittals, associated submittal descriptions, and anticipated submission dates to the FAA. Upon approval, the Engineer will update the on-line submittal register to reflect the approved submittal register. No other submittal will be accepted until the Submittal Register is approved by the FAA.

61MR-11 Approval process. Submittals will be reviewed for approval within the period specified and only for conformance with project design concepts and compliance with contract documents. Claims for delays due to failure on the part of the Contractor to obtain approval of submittals, including any required resubmittals, in a timely manner will not be considered. Approval of a submittal does not relieve the Contractor of any contract requirements. The Engineer will perform the initial review of each submittal, with the FAA having final approval authority. Submittals will

be returned to the Contractor within 10 business days with one of the following actions and with markings appropriate for action indicated:

A - Approved as submitted. Submittals marked “A” authorize the Contractor to proceed with the work covered.

B - Approved except as noted on drawings. Resubmission not required. Submittals marked “B” authorize the Contractor to proceed with the work covered provided he takes no exception to the corrections.

C - Approved except as noted on the drawings. Refer to attached comments. Resubmission required. Submittals marked “C” authorize the Contractor to proceed with the work covered provided he takes no exception to the corrections. Resubmission is required.

D – Will be returned by separate correspondence. Submittals marked “D” authorize the Contractor to proceed with the work.

E – Disapproved. Refer to attached comments. Submittals marked “E” indicate noncompliance with the contract requirements or design concept, or that submittal is incomplete. Resubmit with appropriate changes. No work shall proceed for this item until resubmittal is approved.

F – Receipt acknowledged. Submittals marked “F” authorize the Contractor to proceed with the work.

G – Other action required. Submittals marked “G” indicate an action is required before the submittal can be approved. The required actions will be specified. Resubmit with appropriate changes. No work shall proceed for this item until resubmittal is approved.

X – Receipt acknowledged, does not comply with contract requirements, as noted. Submittals marked “X” indicate noncompliance with the contract requirements. Resubmit with appropriate changes. No work shall proceed for this item until resubmittal is approved.

61MR-12 Disapproved or rejected submittals. Make corrections required by the Engineer and FAA. If the Contractor considers any correction or notation on the returned submittals to constitute a change to the contract drawings or specifications; notice as required under section 40MR SCOPE OF WORK paragraph EXTRA WORK, is to be given to the Engineer. Approval of a submittal is not considered written agreement for extra work. The Contractor is responsible for the dimensions and design of connection details and construction of work. Failure to point out deviations may result in the Government requiring rejection and removal of such work at the Contractor's expense.

If changes are necessary to submittals, make such revisions and submission of the submittals in accordance with the procedures above. No item of work requiring a submittal change is to be accomplished until the changed submittals are approved.

61MR-13 Approved submittals. The FAA's approval or acceptance of submittals is not to be construed as a complete check, and indicates only that the materials appear to comply with contract requirements. Approval or acceptance will not relieve the Contractor of the responsibility for any error which may exist, as the Contractor under the Contractor Quality Control (CQC) requirements of this contract is responsible for dimensions, the design of adequate connections and details, and the satisfactory construction of all work. After submittals have been approved or accepted by the Contracting Officer, no resubmittal for the purpose of substituting materials or equipment will be considered unless accompanied by an explanation of why a substitution is necessary.

61MR-14 Approved samples. Approval of a sample is only for the characteristics or use named in such approval and is not to be construed to change or modify any contract requirements. Before submitting samples, the Contractor is to assure that the materials or equipment will be available in quantities required in the project. No change or substitution will be permitted after a sample has been approved.

Match the approved samples for materials and equipment incorporated in the work. If requested, approved samples, including those which may be damaged in testing, will be returned to the Contractor, at his expense, upon completion of the contract. Samples not approved will also be returned to the Contractor at its expense, if so requested.

Failure of any materials to pass the specified tests will be sufficient cause for refusal to consider, under this contract, any further samples of the same brand or make of that material. Government reserves the right to disapprove any material or equipment which previously has proved unsatisfactory in service.

Samples of various materials or equipment delivered on the site or in place may be taken by the Contracting Officer for testing. Samples failing to meet contract requirements will automatically void previous approvals. Contractor to replace such materials or equipment to meet contract requirements.

Approval of the Contractor's samples by the Contracting Officer does not relieve the Contractor of his responsibilities under the contract.

61MR-15 Scheduling. Schedule and submit concurrently submittals covering component items forming a system or items that are interrelated. Include certifications to be submitted with the pertinent drawings at the same time. No delay damages or time extensions will be allowed for time lost in late submittals. An additional 10 business days shall be allowed and shown on the register for review and approval of submittals.

- a. **Delays.** Coordinate scheduling, sequencing, preparing and processing of submittals with performance of work so that work will not be delayed by submittal processing. Allow for potential resubmittal of requirements. The normal submittal review period available to the Government is 10 business days.
- b. **Submittals not applicable to work.** Submittals called for by the contract documents will be listed on the register. If a submittal is called for but does not pertain to the contract work, the Contractor is to include the submittal in the register and annotate it "N/A" with a brief explanation. Approval by the Contracting Officer does not relieve the Contractor

of supplying submittals required by the contract documents but which have been omitted from the register or marked "N/A."

- c. **Procurement.** Carefully control procurement operations to ensure that each individual submittal is made on or before the Contractor scheduled submittal date shown on the approved "Submittal Register."

61MR-16 Variations. Except as explicitly requested in the project documents, variations will not be considered due to the research-related nature of the work.

61MR-17 Request for information (RFI). Submit requests for information or clarification of project documents through the project website. Requests for information will be processed and approved through normal submittal approval processes, except that response time to an RFI may exceed the normal submittal review period depending on the complexity and potential cost or schedule impact. Requests for Information shall contain at minimum:

- A description of the required information
- A reference to the pertinent portion of the contract documents
- A description of cost impacts
- A recommended answer or solution
- A description of the impact to schedule, including the effect on the critical path

Submittal Number	Specification Number	Specification Title	Submittal Title	Type	FA/FIO	Date Required	Date Submitted	Remarks
SUB-001	40MR	Scope of Work	Construction operations plan	SD-01	FA			
SUB-002	40MR	Scope of Work	Project schedule	SD-01	FA			
SUB-003	40MR	Scope of Work	Safety plan	SD-01	FA			
SUB-004	40MR	Scope of Work	Instrumentation cut sheets	SD-03	FA			
SUB-005	61MR	Submittal Procedures	Submittal register	SD-01	FA			This document
SUB-006	C-100MR	Contractor Quality Control	Contractor's Quality Control Plan	SD-01	FA			
SUB-007	C-100MR	Contractor Quality Control	Inspection records	SD-06	FA			
SUB-008	C-100MR	Contractor Quality Control	Field test	SD-06	FA			
SUB-009	C-100MR	Contractor Quality Control	Factory tests	SD-06	FA			
SUB-010	C-100MR	Contractor Quality Control	Verification Statement/closeout submittals	SD-11	FA			
SUB-011	M-102MR	Demolition and Removal	Demolition Plan	SD-01	FA			
SUB-012	M-102MR	Demolition and Removal	Documentation of existing conditions	SD-01	FA			
SUB-013	M-102MR	Demolition and Removal	Grade test results	SD-06	FA			
SUB-014	P-152MR	Subgrade	CBR test results	SD-06	FA			
SUB-015	P-152MR	Subgrade	Smoothness test results	SD-06	FA			
SUB-016	P-152MR	Subgrade	Grade test results	SD-06	FA			
SUB-017	P-152MR	Subgrade	Survey of as-built surface	SD-06	FA			
SUB-018	P-154MR	Subbase Course	Separation fabric product information	SD-03	FA			
SUB-019	P-154MR	Subbase Course	Construction equipment list	SD-03	FA			
SUB-020	P-154MR	Subbase Course	Gradation	SD-06	FA			
SUB-021	P-154MR	Subbase Course	Moisture-Density relationship	SD-06	FA			
SUB-022	P-154MR	Subbase Course	Compaction results	SD-06	FA			
SUB-023	P-154MR	Subbase Course	Smoothness test results	SD-06	FA			
SUB-024	P-154MR	Subbase Course	Grade test results	SD-06	FA			
SUB-025	P-154MR	Subbase Course	Thickness test results	SD-06	FA			
SUB-026	P-154MR	Subbase Course	Survey of as-built surface	SD-06	FA			
SUB-027	P-159MR	Geogrid	Laydown plan	SD-02	FA			
SUB-028	P-159MR	Geogrid	Geogrid product information	SD-03	FA			
SUB-029	P-159MR	Geogrid	Geogrid test reports	SD-06	FA			
SUB-030	P-159MR	Geogrid	Certificate of Compliance	SD-07	FA			
SUB-031	P-209MR	Crushed Aggregate Base Course	Construction equipment list	SD-03	FA			
SUB-032	P-209MR	Crushed Aggregate Base Course	Coarse aggregate material tests	SD-06	FA			
SUB-033	P-209MR	Crushed Aggregate Base Course	Fine aggregate material tests	SD-06	FA			
SUB-034	P-209MR	Crushed Aggregate Base Course	Gradation	SD-06	FA			
SUB-035	P-209MR	Crushed Aggregate Base Course	Moisture-Density relationship	SD-06	FA			
SUB-036	P-209MR	Crushed Aggregate Base Course	Compaction results	SD-06	FA			
SUB-037	P-209MR	Crushed Aggregate Base Course	Smoothness test results	SD-06	FA			
SUB-038	P-209MR	Crushed Aggregate Base Course	Grade test results	SD-06	FA			
SUB-039	P-209MR	Crushed Aggregate Base Course	Thickness test results	SD-06	FA			
SUB-040	P-209MR	Crushed Aggregate Base Course	Survey of as-built surface	SD-06	FA			
SUB-041	P-307MR	Cement Treated Permeable Base Course	Proposed techniques	SD-02	FA			
SUB-042	P-307MR	Cement Treated Permeable Base Course	Coarse aggregate source and physical properties	SD-03	FA			
SUB-043	P-307MR	Cement Treated Permeable Base Course	Fine aggregate source and physical properties	SD-03	FA			
SUB-044	P-307MR	Cement Treated Permeable Base Course	Cement source and physical properties	SD-03	FA			
SUB-045	P-307MR	Cement Treated Permeable Base Course	Admixtures source and physical properties	SD-03	FA			
SUB-046	P-307MR	Cement Treated Permeable Base Course	Curing materials source and physical properties	SD-03	FA			
SUB-047	P-307MR	Cement Treated Permeable Base Course	Construction equipment list	SD-03	FA			
SUB-048	P-307MR	Cement Treated Permeable Base Course	Mix design	SD-05	FA			
SUB-049	P-307MR	Cement Treated Permeable Base Course	Gradation (pre-construction)	SD-06	FA			
SUB-050	P-307MR	Cement Treated Permeable Base Course	Gradation (in-place)	SD-06	FA			
SUB-051	P-307MR	Cement Treated Permeable Base Course	Compressive strength test results (7 day)	SD-06	FA			
SUB-052	P-307MR	Cement Treated Permeable Base Course	Smoothness test results	SD-06	FA			
SUB-053	P-307MR	Cement Treated Permeable Base Course	Grade test results	SD-06	FA			
SUB-054	P-307MR	Cement Treated Permeable Base Course	Coefficient of permeability test results	SD-06	FA			
SUB-055	P-307MR	Cement Treated Permeable Base Course	Survey of as-built surface	SD-06	FA			
SUB-056	P-307MR	Cement Treated Permeable Base Course	Laboratory accreditation certificates	SD-07	FA			
SUB-057	P-401MR	Hot Mix Asphalt (HMA) Pavements	Laydown plan	SD-02	FA			
SUB-058	P-401MR	Hot Mix Asphalt (HMA) Pavements	Aggregates	SD-04	FA			
SUB-059	P-401MR	Hot Mix Asphalt (HMA) Pavements	Asphalt cement binder	SD-04	FA			Two binder types required
SUB-060	P-401MR	Hot Mix Asphalt (HMA) Pavements	Asphalt concrete	SD-04	FA			
SUB-061	P-401MR	Hot Mix Asphalt (HMA) Pavements	Job mix formula (JMF)	SD-05	FA			Two JMFs required (one for each binder type)
SUB-062	P-401MR	Hot Mix Asphalt (HMA) Pavements	Coarse aggregate material tests	SD-06	FA			

Submittal Number	Specification Number	Specification Title	Submittal Title	Type	FA/FIO	Date Required	Date Submitted	Remarks
SUB-063	P-401MR	Hot Mix Asphalt (HMA) Pavements	Fine aggregate material tests	SD-06	FA			
SUB-064	P-401MR	Hot Mix Asphalt (HMA) Pavements	Mineral filler material tests	SD-06	FA			
SUB-065	P-401MR	Hot Mix Asphalt (HMA) Pavements	Asphalt binder material tests	SD-06	FA			
SUB-066	P-401MR	Hot Mix Asphalt (HMA) Pavements	Additives/anti-strip material tests	SD-06	FA			
SUB-067	P-401MR	Hot Mix Asphalt (HMA) Pavements	Process control chart	SD-06	FA			
SUB-068	P-401MR	Hot Mix Asphalt (HMA) Pavements	Smoothness test results	SD-06	FA			
SUB-069	P-401MR	Hot Mix Asphalt (HMA) Pavements	Grade test results	SD-06	FA			
SUB-070	P-401MR	Hot Mix Asphalt (HMA) Pavements	Survey of as-built surface	SD-06	FA			
SUB-071	P-401MR	Hot Mix Asphalt (HMA) Pavements	Density/air voids test results	SD-06	FA			
SUB-072	P-401MR	Hot Mix Asphalt (HMA) Pavements	Laboratory accreditation certificates	SD-07	FA			
SUB-073	P-403MR	Hot Mix Asphalt (HMA) Pavements Base Course	Placement plan	SD-02	FA			
SUB-074	P-403MR	Hot Mix Asphalt (HMA) Pavements Base Course	Aggregates	SD-04	FA			
SUB-075	P-403MR	Hot Mix Asphalt (HMA) Pavements Base Course	Asphalt cement binder	SD-04	FA			Two binder types required
SUB-076	P-403MR	Hot Mix Asphalt (HMA) Pavements Base Course	Asphalt concrete	SD-04	FA			
SUB-077	P-403MR	Hot Mix Asphalt (HMA) Pavements Base Course	Job mix formula (JMF)	SD-05	FA			Two JMFs required (one for each binder type)
SUB-078	P-403MR	Hot Mix Asphalt (HMA) Pavements Base Course	Coarse aggregate material tests	SD-06	FA			
SUB-079	P-403MR	Hot Mix Asphalt (HMA) Pavements Base Course	Fine aggregate material tests	SD-06	FA			
SUB-080	P-403MR	Hot Mix Asphalt (HMA) Pavements Base Course	Mineral filler material tests	SD-06	FA			
SUB-081	P-403MR	Hot Mix Asphalt (HMA) Pavements Base Course	Asphalt binder material tests	SD-06	FA			
SUB-082	P-403MR	Hot Mix Asphalt (HMA) Pavements Base Course	Additives/anti-strip material tests	SD-06	FA			
SUB-083	P-403MR	Hot Mix Asphalt (HMA) Pavements Base Course	Process control chart	SD-06	FA			
SUB-084	P-403MR	Hot Mix Asphalt (HMA) Pavements Base Course	Smoothness test results	SD-06	FA			
SUB-085	P-403MR	Hot Mix Asphalt (HMA) Pavements Base Course	Grade test results	SD-06	FA			
SUB-086	P-403MR	Hot Mix Asphalt (HMA) Pavements Base Course	Survey of as-built surface	SD-06	FA			
SUB-087	P-403MR	Hot Mix Asphalt (HMA) Pavements Base Course	Density/air voids test results	SD-06	FA			
SUB-088	P-403MR	Hot Mix Asphalt (HMA) Pavements Base Course	Laboratory accreditation certificates	SD-07	FA			
SUB-089	P-603MR	Emulsified Asphalt Tack Coat	Emulsified asphalt	SD-04	FA			
SUB-090	P-603MR	Emulsified Asphalt Tack Coat	Certificate of Analysis	SD-07	FA			
SUB-091	P-603MR	Emulsified Asphalt Tack Coat	Certificate of Calibration	SD-07	FA			
SUB-092	P-620MR	Pavement Marking	Manufacturer's product information	SD-03	FA			
SUB-093	P-620MR	Pavement Marking	List of construction equipment	SD-03	FA			

END OF SECTION 61MR

Item C-100MR Contractor Quality Control Program (CQCP)

100MR-1 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 accepted by the Engineer. No partial payment will be made for materials subject to specific quality control (QC) requirements until the CQCP has been reviewed.

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.

Paving projects over \$500,000 shall have a Quality Control (QC)/Quality Assurance (QA) workshop with the Engineer, Contractor, subcontractors, testing laboratories, and Owner's representative prior to start of construction. The QC/QA workshop will be facilitated by the Contractor. The contractor shall coordinate with the Owner and the 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. Establishing the overall QC culture.

100MR-2 Submittals. FAA approval is required for all submittals. Submit the following in accordance with section 61MR SUBMITTAL PROCEDURES:

a. SD-01 Preconstruction Submittals

- 1) **Contractor's Quality Control Plan.** Contractor shall document the Contractor's Quality Control Program in sufficient detail to demonstrate compliance with the quality control requirements of the project specifications.

b. SD-06 Test Reports

- 1) **Inspection Records.** Contractor shall provide copies of all inspection records for each item of work.
- 2) **Field Tests.** Contractor shall provide copies of all field test records for each item of work.
- 3) **Factory Tests.** Contractor shall provide copies of all factory test records for each item of work.

c. SD-11 Closeout Submittals

- 1) **Verification Statement.** Contractor shall provide a certified statement for each item of work stating that the appropriate quality control procedures were conducted and that the item of work conforms to the project plans and specifications.

100MR-3 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, 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 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 items:

- a.** QC organization
- b.** Project progress schedule
- c.** Submittals schedule
- d.** Inspection requirements
- e.** QC testing plan
- f.** Documentation of QC activities and distribution of QC reports
- g.** Requirements for corrective action when QC and/or QA acceptance criteria are not met
- h.** For pavement projects, address all elements applicable to the project that affect the quality of the pavement including, but not limited to, the following:
 - Mix design
 - Aggregate grading
 - Quality of materials

- Stockpile management
- Proportioning
- Mixing and transportation
- Placing and finishing
- Joints
- Dowel and tie-bar placement, and alignment
- Compaction and/or consolidation
- Surface smoothness
- Flexural or Compressive Strength
- Finishing and Curing
- Laydown plan
- Equipment
- Temperature Management Plan

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

100MR-4 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 of paragraphs 100MR-03a and 100MR-03b. 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) shall be a full-time employee of the Contractor, or a consultant engaged by the Contractor. The CQCPA shall have a minimum of five (5) years of experience in airport and/or highway construction and shall have had prior QC experience on a project of comparable size and scope as the contract.

Additional qualifications for the CQCPA shall include at least one of the following requirements:

- 1) Professional Engineer with one (1) year of airport paving experience.
- 2) Engineer-in-training with two (2) years of airport paving experience.
- 3) An individual with three (3) years of highway and/or airport paving experience, with a Bachelor of Science Degree in Civil Engineering, Civil Engineering Technology or Construction.
- 4) Construction materials technician certified at Level III by the National Institute for

Certification in Engineering Technologies (NICET).

- 5) Highway materials technician certified at Level III by NICET.
- 6) Highway construction technician certified at Level III by NICET.
- 7) A NICET certified engineering technician in Civil Engineering Technology with five (5) years of highway and/or airport paving experience.

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 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 qualifications in the appropriate field equivalent to NICET Level II or higher construction materials technician or highway construction technician and shall have a 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 subsection 100MR-06.
 - 2) Performance of all QC tests as required by the technical specifications and subsection 100MR-07.
 - 3) Performance of density tests for the Engineer when required by the technical specifications. Certification at an equivalent level of qualification and experience by a state or nationally recognized organization will be acceptable in lieu of NICET certification.
- 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.

100MR-5 Project progress schedule. The Contractor shall submit a coordinated construction schedule for all work activities. The 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 in the contract. As a minimum, it shall provide information on the sequence of work activities, milestone dates, and activity duration.

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.

100MR-6 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 subsection 100MR-08.

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

100MR-7 Contractor QC testing facility.

- a. For projects that include Item P-401 and Item P-403, the Contractor shall ensure facilities, including all necessary equipment, materials, and current reference standards, are provided that meet requirements in the following paragraphs of ASTM D3666, Standard Specification for Minimum Requirements for Agencies Testing and Inspecting Road and Paving Materials:
 - 8.1.3 Equipment Calibration and Checks;
 - 8.1.9 Equipment Calibration, Standardization, and Check Records;
 - 8.1.12 Test Methods and Procedures

100MR-8 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., P-401)
- b. Item description (e.g., Hot 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)

The QC testing plan shall contain a statistically-based procedure of random sampling for acquiring test samples in accordance with ASTM D3665. The Engineer shall be provided the opportunity to witness QC sampling and testing.

All QC test results shall be documented by the Contractor as required by subsection 100MR-09.

100MR-9 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 Engineer daily. The records shall cover all work placed subsequent to the previously furnished records and shall be verified and signed by the CQCPA.

Specific 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:
 - Technical specification item number and description
 - Compliance with approved submittals
 - Proper storage of materials and equipment
 - Proper operation of all equipment
 - Adherence to plans and technical specifications
 - Summary of Results of QC tests and any necessary corrective actions
 - Safety inspection
 - Photographs

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 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:

- Technical specification item number and description
- Test designation
- Location
- Date of test
- Control requirements
- Test results
- Causes for rejection
- Recommended remedial actions
- 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. The daily test reports shall be signed by the responsible QC technician and the CQCPA.

100MR-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.

100MR-11 Surveillance by the Engineer. All items of material and equipment shall be subject to inspection by the 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 surveillance by the Engineer at the site for the same purpose.

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

100MR-12 Noncompliance.

- a. The Engineer will notify the Contractor of any noncompliance with any of the foregoing requirements. The Contractor shall, after receipt of such notice, immediately take corrective action. Any notice, when delivered by the Engineer or their own authorized representative to the Contractor or their own authorized representative at the site of the work, shall be considered sufficient notice.
- b. In cases where QC activities do not comply with either the CQCP or the contract

provisions, or where the Contractor fails to properly operate and maintain an effective CQCP, as determined by the Engineer, the Engineer may:

- 1) Order the Contractor to replace ineffective or unqualified QC personnel or subcontractors.
- 2) Order the Contractor to stop operations until appropriate corrective actions are taken.

100MR-13 Basis of measurement and payment. “Contractor Quality Control Program (CQCP)” will be paid as a lump sum with the following schedule of partial payments:

- a. With first pay request, 25% with approval of CQCP and completion of the Quality Control (QC)/Quality Assurance (QA) workshop.
- 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 20%.
- d. When 75% or more of the original contract is earned, an additional 20%.
- e. After final inspection and acceptance of project as required by 90-11, the final 10%.

100MR-14 Payment will be made under:

Item C-100MR Contractor Quality Control Program (CQCP)

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.

National Institute for Certification in Engineering Technologies (NICET)

ASTM International (ASTM)

ASTM C1077	Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation
ASTM D3665	Standard Practice for Random Sampling of Construction Materials
ASTM D3666	Standard Specification for Minimum Requirements for Agencies Testing and Inspecting Road and Paving Materials

END OF SECTION C-100MR

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

110-1 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 Table 1. 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 Owner'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.

110-2 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 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 values within a lot
 x_1, x_2, \dots, x_n = Individual subplot values
 n = Number of sublots

- 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 values in the set
 d_1, d_2, \dots, d_n = Deviations of the individual subplot values x_1, x_2, \dots from the average value \bar{X}
 that is: $d_1 = (x_1 - \bar{X}), d_2 = (x_2 - \bar{X}) \dots d_n = (x_n - \bar{X})$
 n = Number of sublots

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

$$Q_L = (\bar{X} - L) / S_n$$

Where: L = specification lower tolerance limit

Estimate the percentage of material within limits (PWL) by entering Table 1 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:

$$Q_L = (\bar{X} - L) / S_n$$

and

$$Q_U = (U - \bar{X}) / S_n$$

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 Table 1 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 P-401, Lot A.

A. PWL Determination for Mat Density.

1. Density of four 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 Table 1 with $Q_L = 1.44$ and $n = 4$.
 PWL = 98

B. PWL Determination for Air Voids.

1. Air Voids of four 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 Table 1 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 Table 1 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 P-401, Lot A.

A. Outlier Determination for Mat Density.

1. Density of four 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 1.435 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 1. Table for Estimating Percent of Lot Within Limits (PWL)

Percent Within Limits (PL and PU)	Positive Values of Q (Q _L and Q _U)							
	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

Percent Within Limits (PL and PU)	Positive Values of Q (Q _L and Q _U)							
	n=3	n=4	n=5	n=6	n=7	n=8	n=9	n=10
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
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

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 E178 Standard Practice for Dealing with Outlying Observations

END OF SECTION C-110

Item M-102MR Demolition and Removal

DESCRIPTION

102MR-1.1 Project description. The work covered by this section consists of the demolition and removal of test pavement items at the National Airport Pavement Test Facility (NAPTF) as identified on the plans and removal of resulting rubbish and debris. Materials to be removed may include bituminous pavement, granular sublayers, subgrade materials, specialized or unique paving materials, and appurtenances such as instrumentation. Dispose of all removed pavement materials to the area designated by the project documents, or dispose of them at a legally approved disposal site. The test pavement items are located inside a building and in close proximity to specialized facilities and equipment.

102MR-1.2 Special research requirements. Demolition and removal work at the NAPTF is conducted to support research activities and is subject to unique requirements. Demolition items are subject to intense testing. Remove items in the sequence indicated in project documents. Complete the removal of each item before commencing removal of any underlying item unless otherwise indicated in the project plans. Furnish demolished items to NAPTF personnel for sampling and testing as indicated in project documents. Cease demolition activities for the duration of testing at times indicated in the project documents. Expect a work stoppage of 1 to 3 days, or as indicated in project documents, after demolition of each item is complete to allow adequate time for the FAA to obtain samples and run tests. Coordinate demolition activities with the NAPTF to avoid disturbance of research occurring outside the limits of this project.

102MR-1.3 Submittals. Submit the following in accordance with Section 61MR Submittal Procedures:

a. SD-01 Preconstruction Submittals

- 1) **Demolition plan.** Contractor shall prepare and submit a demolition plan describing methods and equipment to be used for each operation and the sequence of operations. Identify any anticipated effects on research activities or other construction activities, including utility outages.
- 2) **Documentation of existing conditions.** Contractor shall record existing conditions of items and facilities adjacent to the work area, in and around the haul route, and in and around any staging areas. Photographs sized 4 inches or 4-megapixel JPEG format digital photographs will be acceptable as a record of existing conditions. Include in the record the location and extent of existing cracks and other damage and a description of surface conditions that exist prior to before starting work.

b. SD-06 Test Results

- 1) **Grade test results.** Engineer shall provide certified test reports that material complies with the requirements of Paragraph 102MR-2.2.

GENERAL REQUIREMENTS

102MR-2.1 Commencement of work. Do not begin demolition until authorization is received from the FAA. The schedule of the availability of work areas shall be confirmed by the FAA. Complete work during standard work hours at the facility of 7:00 AM to 5:00 PM.

102MR-2.2 Tolerances. Remove items and materials in the locations indicated on project plans.

- a. Remove materials to a depth or elevation of 0.05 feet of the indicated elevation or as specified in the project plans.
- b. Sawcuts at the extents of removal shall be within 1/2 inch of the locations indicated or as specified in the project plans. Sawcuts shall be straight and true, not varying more than 1/4 inch in 10 feet.
- c. The pavement thicknesses and dimensions shown on the plans are approximate. Determine the exact thickness and extent of the existing pavement identified for removal, and each layer thereof, in order to prevent damage to underlying materials during the demolition process.

102MR-2.3 Maintenance of site. Do not store rubbish or debris on unstabilized base, subbase, and subgrade materials. Maintain staging and stockpile areas in a neat and organized manner, properly drained, and in a manner to prevent contamination of stockpiles and materials.

102MR-2.4 Items to remain in place. Take necessary precautions to avoid damage to existing items and instrumentation to remain in place, to be reused, or to remain the property of the FAA. Do not overload pavements to remain. Provide supports and reinforcement for existing items weakened by demolition, deconstruction, or removal work. Reinforcement and supports require approval by the FAA prior to performing such work. Pavements to be removed that are adjacent to structures shall be double saw cut adjacent to the structures in a manner to avoid damage to the structure. Prevent contamination of materials to remain with foreign or demolished pavement materials, debris, and refuse. Repair or replace damaged items as directed by and at no additional cost to the FAA.

102MR-2.5 Dust and debris control. Prevent the spread of dust and debris beyond the project limits. Use of water is permitted, however, do not use water if it results in hazardous or objectionable conditions such as, but not limited to ice, flooding, or pollution. Water trucks are not permitted inside the test facility. Prevent the accumulation of loose dust, dirt, mud, or debris on roadways and parking lots. Provide protective measures to control accumulation and migration of dust and dirt into work areas and office spaces.

102MR-2.6 Weather protection. Protect materials and equipment from damage by the weather at all times.

102MR-2.7 Utility service. Utilities must remain in service for the duration of project activities. Protect against damage during demolition and deconstruction operations.

102MR-2.8 Protection of personnel. Conform to the safety requirements in accordance with Federal, state, and local laws, rules and regulations concerning construction safety and health standards. Comply with the Environmental Protection Agency requirements. The Contractor shall

not require or allow any worker to work in surroundings or under conditions that are unsanitary, hazardous, or dangerous to health or safety.

MATERIALS AND EQUIPMENT

102MR-3.1 Temporary materials. Do not contaminate or damage items to remain, test items, or items outside the project limits with temporary construction support materials. Completely remove all temporary fill, supports, guards, forms, ramps, and other appurtenances prior to completion of the project.

102MR-3.2 Equipment. Concrete saws, core drills, pneumatic hammers, pneumatic chisels, cutting torches, backhoes, loaders, cranes, milling machines, or similar tools and equipment may be used. No equipment required to perform any portion of the work shall be considered or classified as special equipment. All equipment must be approved by the FAA prior to commencement of work.

CONSTRUCTION METHODS

102MR-4.1 Construction limits. Do not disturb items beyond the limits of demolition indicated in the project documents. Precision demolition methods such as hand work are required within 2 feet of facilities and items to remain in order to prevent damage. Pavements to be removed shall be double saw cut at the demolition limits in such a manner to avoid damage to any pavements identified on the plans as to remain. Prevent undermining of adjacent pavements at the demolition limits.

102MR-4.2 Surface course removal. Remove surface course materials to the depth indicated on the plans. Provide a surface free from loose material, debris, and significant defects. Do not score, mar, or otherwise damage underlying layers or sensors. Do not contaminate underlying layers with surface course materials or debris.

102MR-4.3 Granular material removal. Remove granular materials to the depth indicated on the plans. Do not score, mar, or otherwise damage underlying layers or sensors, unless directed by the Engineer. Provide a surface free from loose material, debris, and significant defects. Do not contaminate underlying layers with granular materials or debris. Heavy equipment and trucks are not permitted on exposed underlying layers at any time. Completely expose the granular material within the limits of demolition prior to commencing demolition.

102MR-4.4 Subgrade removal. Remove subgrade materials to the depth indicated on the plans. Do not damage existing sensors to remain. Provide a surface free from loose material, debris, wet material, foreign material, and significant defects. Do not contaminate materials to remain. Completely expose the subgrade within the limits of demolition prior to commencing demolition.

102MR-4.5 Clean-up and disposal. The clean-up operation shall include vacuum sweeping as necessary and shall leave the pavement surface free of loose dust, dirt, mud, and debris. Sawing equipment for cutting of pavements shall be equipped with vacuum pickup and pumps capable of pumping to container or tanker storage. The storage tanks shall be emptied at least daily or as often

as necessary to prevent overflow of the slurry. Slurry generated from this operation shall be disposed of off-site at a legally approved and recognized disposal site.

DISPOSAL OF MATERIALS

102MR-5.1 Title to materials. Except for salvaged items specified in the Plans, and for materials or equipment scheduled for salvage, all materials and equipment removed and not reused, recycled, or salvaged, shall become the property of the Contractor and shall be removed from FAA property. The Contractor shall coordinate with the FAA for potential recycling opportunities prior to removal from the base. Material samples are to be provided during demolition to FAA personnel to determine the material suitability. Title to materials resulting from demolition and deconstruction, and materials and equipment to be removed, is vested in the Contractor upon removal of the material from the project site. The FAA will not be responsible for the condition or loss of, or damage to, such property after contract award. Showing for sale or selling materials and equipment on site is prohibited.

102MR-5.2 Salvaged materials. Pressure cells and sensor plates shall be salvaged as denoted in the plans. HMA millings, base, and subbase material may also be salvaged at the discretion of the FAA in accordance with 102MR-5.1.

METHOD OF MEASUREMENT

102MR-6.1 Measurement shall consist of measuring the number of square yards of concrete pavement, bituminous pavement, or lean concrete base course, or the number of cubic yards of subbase and subgrade removal at the specified depth, all measured in their original existing position, or as determined from the neat lines as shown on the plans.

BASIS OF PAYMENT

102MR-7.1 The quantity of full depth pavement removal measured as provided above, shall be at the Contract lump sum price for pavement layers and subgrade removed, which price and payment shall constitute full compensation for all cutting, sawing, breaking, removal, hauling, and disposal of materials, clean-up, and for labor, equipment, tools, and any incidentals necessary to complete this item of work as specified herein or as specified on the Plans.

Payment will be made under:

Item M-102MR	Demolition Lump Sum
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END OF SECTION M-102MR

Item P-152MR Subgrade

DESCRIPTION

152MR-1.1 This item shall consist of a prepared subgrade consisting of soil that provides the specified design California Bearing Ratio (CBR) values for test items constructed on low strength subgrades. The subgrade shall be prepared in the excavated bed of the NAPTF or Building 207A, Subgrade Processing building, in accordance with these specifications and shall conform to the dimensions and cross section(s) shown on the Plans.

152MR-1.2 Materials. The subgrade soil for constructing the low strength subgrade shall be obtained by the Contractor from existing stockpiles located in the 207 yard, as directed by the Engineer. The USCS soil classification of the test bed and stockpiled subgrade material is CH, fat clay. The soil shall be processed to uniform moisture content and placed (or replaced) in the test bed. The conditioned material will be placed within the test bed and processed, as necessary to obtain the target CBR as indicated in the construction drawings.

152MR-1.3 Submittals. Submit the following in accordance with Section 61MR Submittal Procedures:

a. SD-06 Test Results

- 1) **CBR test results.** Engineer shall provide certified test report that the in-situ CBR determined by ASTM D4429 is in accordance with Paragraph 152MR-2.4.
- 2) **Smoothness test results.** Engineer shall provide certified test reports that material complies with the requirements of Paragraph 152MR-2.5.
- 3) **Grade test results.** Engineer shall provide certified test reports that material complies with the requirements of Paragraph 152MR-2.6.
- 4) **Survey.** Engineer shall provide survey of as-built surface after acceptance.

CONSTRUCTION METHODS

152MR-2.1 Subgrade Processing. New subgrade materials from the stockpile shall be hauled and processed in Building 207A. The material shall be spread in layers and processed to reduce lumps, reduce clay balls, and provide uniform moisture content. The quantity of subgrade material shall be enough to construct one (1) lift of material as required by the construction plans. Material that is too wet shall be dried and re-processed until the target moisture content range for transporting to the NAPTF is achieved. The Contractor will be required, as necessary, to supply fans to aid the drying process. The moisture content of the material prepared in the Building 207A should be slightly wet of the target moisture content before transporting the material to the NAPTF test bed to compensate for drying during transporting, spreading, and in place processing. Seasonal weather conditions may have a substantial impact on the effectiveness of processing the clay to the desired results which may affect the schedule. Deviation to subgrade processing described herein is permitted as approved by Engineer.

Subgrade processing shall be suspended by the Engineer at any time when satisfactory results cannot be obtained due to unsatisfactory conditions in the Building 207A. The Contractor shall protect the processed subgrade with an appropriate cover, as necessary.

Processed subgrade material must be covered any time there is a risk of unwanted moisture loss. The Contractor will be responsible for covering and uncovering the material when necessary during construction activities and material processing. The Contractor will be responsible for furnishing and installing a minimum 6 mil poly sheet product, for protection of the subgrade material. The sheeting must be installed in a manner to minimize moisture loss in the material.

152MR-2.2 Preparation of Existing Test Bed. Pavement and subgrade removal from the existing test bed shall be in accordance with Item M-102MR Demolition and Removal. The Contractor shall ensure that the subbase/subgrade interface is clean and free from contamination. In the event that this interface is not clean and free from contamination at the elevation shown in the plans, the Contractor shall excavate deeper than intended until a suitable surface is obtained. The bottom of the excavation shall be checked and accepted by the Engineer before placing and spreading operations are started. If the material within the existing test bed does not meet the design CBR requirements, the Contractor will be responsible to dry or wet the material as necessary. If corrective action is required to meet the design CBR, the existing material shall be processed to a minimum depth of 8-inches. Adequate time must be provided to the Engineer to provide the moisture content and CBR of the existing test bed for Contractor reference and planning purposes.

Material that is too dry will be watered using the FAA furnished Bridge Deck Finisher (BDF), and processed to obtain uniform moisture. Watering with hoses or the use of a water truck is not permitted. Once the target moisture content is achieved the material will be re-compacted and tested for acceptance by the Engineer.

152MR-2.3 Placement and Compaction. The subgrade materials shall be placed in successive layers of 6 to 8-inches in compacted depth for the full width of the cross section, unless otherwise approved by the Engineer. The FAA CAT PS300C pneumatic tire roller must be used to achieve maximum compaction. The number of passes to achieve maximum compaction will be determined in the field by the Engineer. At the completion of each layer, adequate time must be provided to conduct appropriate material acceptance and characterization tests. A summary of the acceptance testing requirements can be found in 152MR-2.4 and 152MR-2.5.

Hauling operations and other traffic will be controlled in such a manner as to prevent damage to compacted subgrade material. Traffic that is allowed on the compacted subgrade will be distributed evenly over the entire width of the compacted subgrade.

The Contractor will be responsible to supply equipment to properly compact the material lift and eliminate air voids within the material layer. The compacted material layer shall be free of ruts and suitable for material testing.

Each layer of subgrade material is subject to the acceptance criteria. All material layers must be accepted by the Engineer prior to placing and spreading subsequent layers. The Contractor shall be responsible for protecting the individual lift prior to acceptance tests.

The Contractor will be responsible for furnishing a minimum 6 mil poly sheet product, for protection of the subgrade material. The sheeting must be installed in a manner to prevent moisture loss of the entire material surface within the test bed.

152MR-2.4 Acceptance Testing for CBR. Acceptance measurements will be made on each layer of completed subgrade by the Engineer. The in-place field CBR shall be determined in accordance with ASTM D4429 at a rate of not less than one location per test item.

The location within each experiment section for CBR testing will be determined at random by the Engineer. At each location, a total of three (3) CBR penetrations will be conducted and the average of the three (3) penetrations will be considered an individual CBR test. The three (3) CBR penetrations will be located as follows: 1) random station and offset; 2) same offset, down station 1 ft.; 3) same offset, up station 1 ft. A subgrade layer within a given experiment section shall be considered acceptable when the CBR test meets the following criteria at the determined location:

Low Strength Subgrade (CBR 5)

- a. The difference between the highest and lowest of the three (3) CBR penetration values at a given location cannot exceed 1.5. If the value is greater than 1.5, the subgrade layer will not be acceptable for that experiment section.
- b. The average of the three (3) CBR penetrations shall not exceed ± 0.5 of the target CBR.

Any test item not meeting the CBR acceptance criteria shall be reworked in place by wetting or drying, and compacted until the material layer is accepted by the Engineer.

152MR-2.5 Acceptance Testing for Smoothness. The final surface shall be free from roller marks. The final finished surface shall not vary more than 1/2 inch when evaluated with a 12 foot straightedge. The lot size shall consist of the entire length and width placed for each material. Smoothness measurements shall be made at 15 foot intervals and as determined by the Engineer. In the longitudinal direction, a smoothness reading shall be made at the following offsets: -25ft, -10ft, 10ft, and 25ft. In the transverse direction, smoothness readings shall be made continuously across the full width of the testing area (the outer 3ft may be excluded from testing). However, transverse smoothness readings shall not be made across designed grade changes. Any deviation in excess of these amounts shall be corrected by loosening, adding, or removing materials; reshaping; and recompacting. The area will be considered accepted if less than 15% of the testing area is considered deficient.

152MR-2.6 Acceptance Testing for Grade. The surface of the top layer in the testing area shall show no deviations in excess of 0.05 feet in the vertical direction from the target elevation when surveyed in a 5 foot by 5 foot grid, or equivalent method. Correct deviations exceeding this amount by removing material and replacing with new material, or by reworking existing material and compacting it to meet the specifications.

152MR-2.7 Finishing and Protection of Subgrade. Accepted subgrade material must be covered any time there is a risk of unwanted moisture loss. The Contractor will be responsible for protecting the material from damage and moisture loss during construction activities.

When the final lift has been placed and compacted, the top of the subgrade shall be fine-graded to meet the design grade. Meeting the final grade by placement of thin layers (less than 6") of subgrade material is not acceptable. In order to minimize the risk of missing the design grade after compaction, the final lift shall be slightly over built. The Contractor shall over build the final layer and trim the subgrade material to meet the design elevation. NOTE: The overlying material must be approved by the Engineer for use, and scheduled for placement prior to finish grading the subgrade material.

152MR-2.8 Hauling of Subgrade Materials. All hauling will be considered a necessary and incidental part of the work. Its cost shall be considered by the Contractor and included 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.

Upon acceptance of the final layer of subgrade material the Contractor shall be responsible for hauling the excess subgrade material from the NAPTF and 207A building. The material shall be properly placed in the subgrade stockpile. Any costs or equipment necessary to complete this work shall be included in the cost of the test bed.

METHOD OF MEASUREMENT

152MR-3.1 Subgrade shall be measured in-place, completed, and accepted for:

- a. Subgrade fill from stockpile -- per cubic yard
- b. Reclaimed material from in-situ subgrade -- per cubic yard

For payment specified by the cubic yard (cubic meter), measurement for all subgrade materials shall be computed by the average end area method. The end area is that bound by the original ground line established by field cross-sections and the final theoretical pay line established by excavation cross-sections shown on the plans, subject to verification by the Engineer. After completion of all excavation operations and prior to the placing of base or subbase material, the final excavation shall be verified by the Engineer by means of field cross-sections taken randomly at intervals not exceeding 500 linear feet (150 m).

BASIS OF PAYMENT

152MR-4.1 Payment will be made under:

- | | |
|------------------|--|
| Item P-152MR-4.1 | The Contract unit price for fill from stockpile - per cubic yard (cubic meter) |
| Item P-152MR-4.2 | The contract unit price for in-situ subgrade - per cubic yard (cubic meter) |

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 D4429

Standard Test Methods for CBR (California Bearing Ratio) of Soils
in Place

END OF SECTION P-152MR

Item P-154MR Subbase Course

DESCRIPTION

154MR-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 shown on the plans.

154MR-1.2 Submittals. Submit the following in accordance with 61MR SUBMITTAL PROCEDURES:

a. SD-03 Product Data.

- 1) **Separation fabric.** Contractor shall provide manufacturer's product information as per Paragraph 154MR-2.2.
- 2) **Construction equipment list.** Contractor shall provide the list of proposed equipment to be used in the performance of construction work, including descriptive data, shall be approved by the Engineer prior to use on the project.

b. SD-06 Test Reports.

- 1) **Gradation.** Contractor shall provide certified test reports that material gradation complies with the requirements of Paragraph 154MR-2.1. Indicate the target final gradation and band tolerances.
- 2) **Moisture-density relationship.** Engineer shall provide certified test reports identifying the maximum dry density, optimum moisture content, target dry density, and target moisture of the material.
- 3) **Compaction results.** Engineer shall provide certified test report that the material complies with the requirements of Paragraph 154MR-3.6.
- 4) **Smoothness tests results.** Engineer shall provide certified test reports that material complies with the requirements of Paragraph 154MR-3.7.
- 5) **Grade test results.** Engineer shall provide certified test reports that material complies with the requirements of Paragraph 154MR-3.8.
- 6) **Thickness test results.** Engineer shall provide certified test reports that material complies with the requirements of Paragraph 154MR-3.9
- 7) **Survey.** Engineer shall provide survey of as-built surface after acceptance.

MATERIALS

154MR-2.1 Materials. The subbase material shall consist of hard durable particles or fragments of granular aggregates. This mixture must be uniform and shall comply with the requirements of these specifications as to gradation, soil constants, and shall be capable of being compacted into a dense and stable subbase. The material shall be free from vegetative matter, lumps or excessive amounts of clay, and other objectionable or foreign substances.

Start Revision 2, 3/13/2019 and Revision 5, 8/28/2019

Gradation Requirements

Sieve designation	Percentage by weight passing sieves	Contractor's Final Gradation	Job Control Grading Band Tolerances for Contractor's Final Gradation Percent
3 inch (75 mm)	100		0
No. 10 (2.00 mm)	20-100		±10
No. 40 (425 µm)	5-60		±5
No. 200 (75 µm)	0- 15		±5

End Revision 2, 3/13/2019 and Revision 5, 8/28/2019

The portion of the material passing the No. 40 (425 µm) sieve shall have a liquid limit of not more than 25 and a plasticity index of not more than six (6) when tested in accordance with ASTM D4318.

154MR-2.2 Separation Fabric. Separation Fabric shall be Class 2 per AASHTO M288-17, 0.02 sec-1 permittivity per ASTM D4491, 0.60 mm max average roll value per ASTM D4751.

154MR-2.3 Geogrid. Geogrid shall conform to the specifications provided in P-159MR for a Class B geogrid.

154MR-2.4 Sampling and testing. Material used on the project shall be sampled per ASTM D75 and tested per ASTM C136 and ASTM C117. The Contractor shall supply results to the Engineer prior to the start of construction. During placement, the Engineer will collect samples at least once per day and furnish the results of those tests.

CONSTRUCTION METHODS

154MR-3.1 General. The subbase course shall be placed where designated on the plans or as directed by the 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 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.

154MR-3.2 Preparing underlying course. Prior to constructing the subbase course, clean the underlying course or subgrade of all foreign substances. The surface of the underlying course or

subgrade shall meet specified compaction and surface tolerances in accordance with Item P-152MR. Correct ruts, or soft yielding spots, in the underlying courses and subgrade areas having inadequate compaction and deviations of the surface from the specified requirements by loosening and removing soft or unsatisfactory material and by adding approved material, reshaping to line and grade, and recompacting to specified density requirements. For cohesionless underlying courses or subgrades containing sands or gravels, as defined in ASTM D2487, the surface shall be stabilized prior to placement of the overlying course. Accomplish stabilization by mixing the overlying course material into the underlying course, and compacting by approved methods. The finished underlying course shall not be disturbed by traffic or other operations and shall be maintained in a satisfactory condition until the overlying course is placed. The course shall be checked and accepted by the Engineer before placing and spreading operations are started.

154MR-3.3 Materials acceptance. When the subbase material is in a uniform and satisfactory condition at approximately the required moisture content, the approved material may be moved directly to the subgrade for placing. The material may be obtained from gravel pits, stockpiles, or may be produced from a crushing and screening plant with proper blending. The materials from these sources shall meet the requirements for gradation, quality, and consistency. The intent of the specifications is to secure materials that will not require further mixing. The target moisture content of the material shall be determined in the laboratory as the maximum moisture content where draindown is not observed during ASTM D1557 testing. Any minor deficiency or excess in moisture content may be corrected by surface sprinkling or by aeration. Some mixing or aeration may be required prior to rolling to obtain the required moisture content. Blading or dragging, if necessary, shall be performed to obtain a smooth uniform surface true to line and grade.

154MR-3.4 Plant mixing. When materials from several sources will be blended and mixed, the subbase material shall be processed in a mixing plant. The subbase material, together with any blended material, shall be thoroughly mixed with the required amount of water. After the mixing is complete, the material shall be transported to and spread on the underlying course without undue loss of moisture content.

154MR-3.5 Placement. The Contractor shall demonstrate 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.

The subbase course shall be constructed in lifts of not less than 4 inches (100 mm) nor more than 10 inches (254 mm) of compacted thickness.

The subbase material shall be deposited and spread evenly to a uniform thickness and width. The material, as spread, shall be of uniform gradation with no pockets of fine or coarse materials. The subbase, unless otherwise permitted by the Engineer, shall not be spread more than 2,000 square yards (1700 sq m) in advance of the rolling. Any necessary sprinkling shall be kept within this limit. No material shall be placed in snow or on a soft, muddy, or frozen course.

When more than one lift is required, the construction procedure described here shall apply similarly to each lift.

During the placing and spreading, the Contractor shall prevent the incorporation of subgrade, shoulder, or foreign material in the subbase course mixture.

154MR-3.6 Finishing and compacting. After spreading or mixing, the subbase material shall be thoroughly compacted by rolling and sprinkling, when necessary. Sufficient rollers shall be furnished to adequately handle the rate of placing and spreading of the subbase course.

The field density of the compacted material shall be at least 100% of the target dry density of laboratory specimens prepared from samples of the subbase material delivered to the jobsite. The laboratory specimens shall be compacted and tested in accordance with ASTM D1557. The in-place field density shall be determined in accordance with ASTM D6938 using Procedure A, the direct transmission method, and ASTM D6938 shall be used to determine the moisture content of the material. The machine shall be calibrated in accordance with ASTM D6938. The rate of collection shall not less than one test per test item. All test probe depths shall be to the depth equal to the project specification lift thickness or at a depth that does not exceed the lift thickness. The test probe shall not penetrate through the separation fabric or geogrid.

The course shall not be compacted when the underlying course is soft or yielding or when the compaction causes undulation in the subbase. When the compaction results in irregularities that exceed 3/8-inch (9 mm) when tested with a 12-foot (3.7 m) straightedge, the irregular surface shall be loosened and then refilled with the same kind of material as that used in constructing the course and again compacted as required above.

Along places inaccessible to compactors, the subbase material shall be tamped thoroughly with mechanical or hand tampers.

Watering, to meet the target moisture content, shall be added using the FAA Bridge Deck Finisher (BDF). Water shall not be added in such a manner or quantities that free water will reach the underlying layer and cause it to become soft. The Contractor shall be responsible for supplying any equipment or machinery required for the aeration activities. The average moisture content of the material at the start of compaction shall be within $\pm 2\%$ of the target moisture content. All testing shall be done by the Engineer.

Start Revision 1, 1/21/2019

Note: For P-154MR placed directly on top of P-152MR, the first lift of P-154MR shall be placed dry of optimum. The laboratory shall note the moisture content where drain down occurs when tested according to ASTM D1557. The moisture content where drain down is observed shall be the target moisture content for the first lift of P-154MR. For acceptance, the material must be within 2 percentage points of the target moisture content. The material must be rolled until further densification cannot be achieved, as tested with the nuclear density gauge. No further densification is defined as the average density for all tests performed within a paving lane not changed by more than 0.5% in successive readings after a minimum of 3 passes with the roller. In the event that the moisture content is not within 2 percentage points of the target moisture or if the material continues to densify, the material

shall be processed at the Contactor's expense until the above is achieved. All subsequent lifts on top of this first layer of P-154MR must be 100% of the target dry density at the target moisture content.

End Revision 1, 1/21/2019

154MR-3.7 Acceptance Testing for Smoothness. The final surface shall be free from roller marks. The final finished surface shall not vary more than 3/8 inch when evaluated with a 12 foot straightedge. The lot size shall consist of the entire length and width placed for each material in a single day. Smoothness measurements shall be made at 15 foot intervals and as determined by the Engineer. In the longitudinal direction, a smoothness reading shall be made at the following offsets: -25ft, -10ft, 10ft, and 25ft. In the transverse direction, smoothness readings shall be made continuously across the full width of the testing area (the outer 3ft may be excluded from testing). However, transverse smoothness readings shall not be made across designed grade changes. Any deviation in excess of these amounts shall be corrected by loosening, adding, or removing materials; reshaping; and recompacting. The area will be considered accepted if less than 15% of the testing area is considered deficient.

154MR-3.8 Acceptance Testing for Grade. The surface of the top layer in the testing area shall show no deviations in excess of 1/2 inch (13 mm) in the vertical direction from the target elevation when surveyed in a 5 foot by 5 foot grid, or equivalent method. Correct deviations exceeding this amount by removing material and replacing with new material, or by reworking existing material and compacting it to meet the specifications.

154MR-3.9 Thickness control. The completed thickness of the course(s) shall be in accordance with the thickness and grade indicated on the drawings. The completed course shall not be more than 1/2 inch (13 mm) deficient in thickness. Where any of these tolerances are exceeded, correct such areas by scarifying, adding new material of proper gradation or removing material, and compacting, as directed. Where the measured thickness is 1/2 inch (13 mm) or more thicker than shown, the course will be considered as conforming with the specified thickness requirements plus 1/2 inch (13 mm). The average job thickness shall be the average of the job measurements as specified above but within 1/4 inch (6 mm) of the thickness shown. The thickness of the completed subbase course shall be determined by survey.

154MR-3.10 Protection. Work on subbase course shall not be conducted during freezing temperatures nor when the subgrade is wet. When the subbase material contains frozen material or when the underlying course is frozen, the construction shall be stopped. The Contractor shall protect and maintain the subgrade from yielding until the subbase is accepted.

154MR-3.11 Maintenance. The Contractor shall maintain the completed course in a satisfactory condition until accepted by the Engineer.

METHOD OF MEASUREMENT

154MR-4.1 Subbase course shall be measured by the number of cubic yards of subbase course material placed, compacted, and accepted in the completed course. The quantity of subbase course

material shall be measured in final position based upon survey and by means of average end areas on the complete work computed from elevations to the nearest 0.01 foot (3 mm). Subbase materials shall not be included in any other excavation quantities.

154MR-4.2 Separation fabric-Class 2 shall be measured by the number of square yards of materials placed and accepted by the Engineer as complying with the plans and specifications excluding seam overlaps and edge anchoring.

154MR-4.3 Geogrid-Class B shall be measured by the number of square yards of materials placed and accepted by the Engineer as complying with the plans and specifications excluding seam overlaps and edge anchoring.

BASIS OF PAYMENT

154MR-5.1 Payment shall be made at the contract unit price per cubic yard (cubic meter) for subbase course. This price 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 item.

154MR-5.2 Payment shall be made at the contract unit price per square yard for separation fabric-class 2. The price shall be full compensation for furnishing all labor, equipment, material, anchors, and necessary incidentals.

154MR-5.3 Payment shall be made at the contract unit price per square yard for Geogrid-Class B. The price shall be full compensation for furnishing all labor, equipment, material, anchors, and necessary incidentals.

Payment will be made under:

- Item P-154MR-5.1 Subbase Course - cubic yard
- Item P-154MR-5.2 Separation Fabric per square yard
- Item P-154MR-5.3 Geogrid per square yard

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 C117 Standard Test Method for Materials Finer than 75- μ m (No. 200) Sieve in Mineral Aggregates by Washing
- ASTM C136 Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates ASTM D75 Standard Practice for Sampling Aggregates

ASTM D1557	Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft ³ (2,700 kN-m/m ³))
ASTM D2487	Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D4759	Practice for Determining the Specification Conformance of Geosynthetics
ASTM D4318	Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D6938	Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
American Association of State Highway and Transportation Officials (AASHTO)	
M 288	Geotextile Specification for Highway Applications

END OF SECTION P-154MR

Item P-159MR Geogrid

DESCRIPTION

159MR-1.1 This item shall consist of placing a Class B geogrid beneath or within an aggregate structure, e.g. granular base or sub-base. The geogrid is intended to provide lateral confinement to aggregate materials, subgrade restraint, and an improved effective bearing capacity.

159MR-1.2 Submittals. Submit the following in accordance with 61MR SUBMITTAL PROCEDURES:

- a. **SD-02 Shop Drawings**
 - 1) **Laydown Plan.** Contractor to provide laydown plan.
- b. **SD-03 Product Data.**
 - 1) **Geogrid.** Contractor to provide manufacturer's product information as per Paragraph 159MR-2.1 for the class of geogrid shown on the plans.
- c. **SD-06 Test Reports.**
 - 1) **Geogrid.** Contractor to provide tests reports indicated in Table 1 for the class of geogrid shown on the plans.
- d. **SD-07 Certificates**
 - 1) **Certificate of Compliance.** Contractor to provide certificate of compliance as per Paragraph 159MR-2.2.

MATERIALS

159MR-2.1 Geogrid. Polymers used in the manufacture of geogrids shall consist of long-chain synthetic polymers, composed of at least 95 percent by weight of polyolefins (polyethylene or polypropylene), polyesters, or polyamides formed into a stable network of regular apertures. Geogrids used for subgrade stabilization shall conform to the property requirements of a Class B geogrid as shown in Table 1. Unless otherwise noted, all mechanical property values in these specifications represent minimum average roll values (MARV).

Non-quality control and quality assurance (QC/QA) property testing, e.g. durability and UV, shall be performed at least once for each manufacturer's geogrids, or upon a change in formulation, or alteration in geometrical properties or reduction in mechanical properties. This non-QC/QA property testing shall be performed by an independent laboratory certified for the associated testing, with the testing report submitted upon request by the Specifier. This testing may be performed on the lightest geogrid within the same 'style', i.e. each product within the 'style' has the same aperture shape, the same rib pitch consistency, the same manufacturing method and formulation, and applied to heavier(or more dense) products of the same manufacturing methods, formulations and geometric properties.

Table 1					
Geogrid Survivability Property Requirements ^{1,2,3,4}					
For Subgrade Stabilization Applications					
Property	Test Method	Units	Geogrid Class ⁶		
			CLASS A ⁶	CLASS B ⁶	CLASS C ⁶
Ultimate Tensile Strength ⁵	ASTM D6637, Method B	lb/ft (kN/m)	3500 ⁷ (51.1 ⁷)	2500 ⁷ (36.5 ⁷)	1500 ⁷ (21.9 ⁷)
Tensile Strength at 2% Strain ⁵	ASTM D6637, Method B	lb/ft (kN/m)	550 ⁸ (8.0 ⁸)	400 ⁸ (5.8 ⁸)	250 ⁸ (3.6 ⁸)
Junction Strength ⁵	ASTM D7737, Method A	lb (N)	45 ⁸ (200 ⁸)	35 ⁸ (156 ⁸)	25 ⁸ (111 ⁸)
Percent Open Area ⁹	Direct Measure	%	70	70	70
Ultraviolet Stability ⁹ (Retained Strength)	ASTM D 4355	%	70% after 500 hours of exposure		
1. The values in Table 1 are applicable for common non-proprietary roadway geogrids and are based on geogrid survivability considerations. Other geogrids, such as those possessing unique features, may be specified according to their descriptive index and performance properties and evaluated and considered for allowance as alternatives to the products meeting the classes listed in Table 1. Allowance as an alternative should be based on documented field experience or an independent laboratory evaluation that reasonably simulates anticipated field conditions.					
2. Acceptance of geogrid material shall be based on ASTM D 4759.					
3. MARV certifications shall be based upon QC sampling in accordance with ASTM D 4354, Table 1. Typical value certifications shall be based upon either QC sampling in accordance with ASTM D 4354, Table 1 or independent laboratory testing performed within the previous 12 months.					
4. The values within this table are descriptive in nature and are meant for quality control and/or quality assurance purposes only.					
5. MARV value.					
6. Class A is the default geogrid selection for severe survivability conditions and Class B is the default geogrid selection for moderate survivability conditions. The engineer may specify a Class C geogrid for light survivability conditions, based on one or more of the following: <ul style="list-style-type: none"> a. The Engineer has found the class of geogrid to have sufficient survivability based on field experience. b. The Engineer has found the class of geogrid to have sufficient survivability based on laboratory testing and visual inspection of a geogrid sample removed from a field test section constructed under anticipated field conditions. 					
7. Tensile Strength values shown are for the sum of the ultimate machine direction (MD) and the ultimate cross machine direction (CMD) strengths for all types of geogrids.					
8. 2% Tensile Strength values shown are for the minimum principle direction (i.e. either machine direction (MD) or cross machine direction (CMD)) for all types of geogrids.					
9. Typical Value.					

159MR-2.2 Certification. A Certificate of Compliance shall accompany each shipment and be submitted to the Engineer prior to installation. The certificate shall include the name of the geogrid manufacturer, chemical composition, product description, lot number(s) for the project-delivered

product, signature of the manufacturer's representative, and, if requested, quality control test results for the lot number(s) of the project-delivered product.

The Manufacturer is responsible for establishing and maintaining a quality control program to assure compliance with the requirements of the specification. Documentation describing the quality control program shall be made available upon request.

The Manufacturer's certificate shall state that the furnished geogrid meets MARV, Minimum, Maximum, or Typical (UV and Percent Open Area) requirements of the manufacturer's specification as evaluated under the supplier's quality control program. A person having legal authority to bind the manufacturer shall attest to the certificate.

Any misrepresentation or mislabeling of materials shall be reason to reject those geogrid material.

159MR-2.3 Identification, packaging, and storage. Geogrid labeling, shipment, and storage shall conform to ASTM D4873. The geogrid shall be shipped in rolls. Each roll shall include a durable, gummed label, or equivalent, either clearly readable on the roll packaging, on the outer wrap when no packaging is required, or on the inside of the core. Roll identification should include, at minimum, the name of the manufacturer or supplier, product or style number, and the unique roll number. Identification should also include the width and length of the geogrid roll. Any other unique characteristics should be clearly identified. For rolls with no identification on the inside of the core, once the roll is unwrapped or samples taken, labels on the outer wrap or the roll packaging should be removed and placed inside the roll for traceability. All designations should be readable for clear identification.

Each geogrid roll shall be packaged or manufactured in such a manner to ensure it is protected from damage during handling and storage, including the ends of the rolls, damage due to shipment, water, sunlight and contaminants.

During storage, geogrid rolls shall be elevated off of the ground, adequately protected from site construction damage including extended ultraviolet exposure, chemicals corrosive to synthetic polymers; flames (including welding sparks), temperatures exceeding 160°F (71°C), and other environmental condition that may damage the performance of the geogrid.

Following placement, the geogrid can be exposed to environmental exposure for a maximum of 30 days during installation or site preparation to minimize damage potential.

CONSTRUCTION METHODS

159MR-3.1 General. Prepare the site, clear, grub and excavate to the designed geogrid elevation. Remove unsuitable materials such as topsoil and vegetation from the site. Grade and compact the installation area using the appropriate compaction equipment.

The geogrid will be rolled out and laid smooth over the prepared subgrade, making sure to pull out wrinkles. In certain conditions, based on material type or environmental factors, pins or anchors may be needed to hold geogrid in place before fill placement. Overlap of rolls in adjacent and end-to-end alignment is outlined in Table 2. Overlaps will be shingled in the direction of aggregate fill

placement. This will avoid layer separation of overlaps and retain the integrity of geogrid coverage. Geogrid can be cut using a sharp knife, shears or hand held saw. Care should be used to not damage portions of the geogrid intended for use. Construction traffic and equipment shall not operate over exposed geogrid, unless otherwise approved by the Manufacturer.

Table 2 – Overlap Requirements

Soil CBR	Minimum Overlap
$CBR \leq 0.5$	3 ft.
$0.5 \leq CBR \leq 2$	2 - 3 ft.
$2 \leq CBR \leq 4$	1 - 2 ft.
$4 \leq CBR$	1 ft.

Aggregate fill placement shall follow the installation instructions provided by the Engineer. A minimum aggregate thickness, based on subgrade strength, shall be specified before construction equipment is allowed to operate over the stabilized section to minimize geogrid and/or subgrade damage.

Standard compaction methods shall be used over placed aggregate fill. The Engineer shall specify special compaction instructions based on site specific conditions.

MATERIAL ACCEPTANCE

159MR-4.1 Acceptance sampling and testing. All geogrids shall be subject to sampling and testing to verify conformance with this specification. Sampling shall be in accordance with the most current ASTM D4354. In the absence of purchaser's testing, verification may be based upon the manufacturer's certifications specific to Manufacturer's Quality Assurance (MQA) Testing. The smaller of either a truckload or a lot size shall be considered to be the shipment quantity subject to testing.

Testing shall be performed in accordance with the methods referenced in this specification. The number of test specimens per sample is specified by each test method. Geogrid acceptance shall be based upon conformance with ASTM D4759.

METHOD OF MEASUREMENT

159MR-5.1 Geogrid. The quantity of geogrid will be determined by measurement of the number of square yards of geogrid actually constructed and accepted by the Engineer as complying with the plans and specifications.

BASIS OF PAYMENT

159MR-6.1 Geogrid. Payment shall be made at the contract price per square yard for geogrid. This price shall be full compensation for furnishing geogrid; and for all labor, equipment, tools, and incidentals necessary to complete the item.

Item P-159MR-6.1 Payment will be made for geogrid - per square yard

REFERENCES

ASTM D276	Test Method for Identification of Fibers in Textiles
ASTM D7748	Standard Test Method for Flexural Rigidity of Geogrids, Geotextiles and Related Products
ASTM D4354	Practice for Sampling of Geosynthetics for Testing
ASTM D1603	Standard Test Method for Carbon Black Content in Olefin Plastics
ASTM D5322	Standard Practice for Immersion Procedures for Evaluating the chemical Resistance of Geosynthetics to Liquids
ASTM D5818	Evaluation of Installation Damage of Geosynthetics
ASTM D4355	Test Method for Deterioration of Geotextiles from Exposure to Ultraviolet Light and Water (Xenon-Arc Type Apparatus)
ASTM D4354	Practice for Sampling of Geosynthetics for Testing
ASTM D4759	Practice for Determining the Specification Conformance of Geosynthetics
ASTM D4873	Guide for Identification, Storage, and Handling of Geotextiles
ASTM D6637	Standard Test Method for Determining Tensile Properties of Geogrids by the Single or Multi-Rib Tensile Method
ASTM D7737	Standard Test Method for Individual Geogrid Junction Strength

END OF SECTION P-159MR

Item P-209MR Crushed Aggregate Base Course

DESCRIPTION

209MR-1.1 This item consists of a base course composed of crushed aggregate base constructed on a prepared course in accordance with these specifications and in conformity to the dimensions and typical cross-sections shown on the plans.

209MR-1.2 Submittals. Submit the following in accordance with 61MR SUBMITTAL PROCEDURES:

a. SD-03 Product data

1. Construction equipment list. Contractor shall provide the Engineer the list of proposed equipment to be used in the performance of construction work, including descriptive data for approval.

b. SD-06 Test Reports.

1. Coarse aggregate material tests. Contractor shall provide certified test reports that the coarse aggregate portion complies with the requirements of Paragraph 209MR-2.1 and Table 1.

2. Fine aggregate material tests. Contractor shall provide certified test reports that the coarse aggregate portion complies with the requirements of Paragraph 209MR-2.1 and Table 1.

3. Gradation. Contractor shall provide certified test reports that material gradation complies with the requirements of Paragraph 209MR-2.2 and Table 2. Indicate the target final gradation and band tolerances.

4. Moisture-density relationship. Engineer shall provide certified test reports identifying the maximum dry density and optimum moisture content of the material. Engineer also to provide the target dry density and target moisture content of the material for the first lift of compaction.

5. Compaction results. Contractor shall provide certified test reports that material complies with the requirements of Paragraph 209MR-3.5 and 209MR3.6.

6. Smoothness tests results. Certified test reports shall be provided that material complies with the requirements of Paragraph 209MR-3.7.

7. Grade test results. Certified test reports shall be provided that material complies with the requirements of Paragraph 209MR-3.8.

8. Thickness test results. Certified test reports shall be provided that material complies with the requirements of Paragraph 209MR-3.9

9. Survey. Provide survey of as-built surface after acceptance

MATERIALS

209MR-2.1 Crushed aggregate base. Crushed aggregate shall consist of clean, sound, durable particles of crushed stone, crushed gravel 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 (4.75 mm) sieve shall consist of fines from the coarse aggregate crushing operation. The fine aggregate shall be produced by crushing stone, gravel, that meet the coarse aggregate requirements for wear and soundness. Aggregate base material requirements are listed in the following table.

Crushed Aggregate Base Material Requirements		
Coarse Aggregate Portion (retained on the No. 4 (4.75 mm) sieve)		
Material Test	Requirement	Standard
Resistance to Degradation	Loss: 45% maximum	ASTM C131
Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate	Loss after 5 cycles: 12% maximum using Sodium sulfate - or - 18% maximum using magnesium sulfate	ASTM C88
Percentage of Fractured Particles	Minimum 90% by weight of particles with at least two fractured faces and 100% with at least one fractured face ¹	ASTM D5821
Flat Particles, Elongated Particles, or Flat and Elongated Particles	10% maximum, by weight, of flat, elongated, or flat and elongated particles ²	ASTM D4791
Fine Aggregate Portion (Passing the No. 40 (425µm) sieve)		
Liquid limit	Less than or equal to 25	ASTM D4318
Plasticity Index	Not more than five (5)	ASTM D4318

¹ The area of each face shall be equal to at least 75% of the smallest mid-sectional area of the piece. When two fractured faces are contiguous, the angle between the planes of fractures shall be at least 30 degrees to count as two fractured faces.

² A flat particle is one having a ratio of width to thickness greater than five (5); an elongated particle is one having a ratio of length to width greater than five (5).

209MR-2.2 Gradation requirements. The gradation of the aggregate base material shall meet the requirements of the gradation given in the following table when tested per ASTM C117 and ASTM C136. The gradation shall be well graded from coarse to fine as defined by ASTM D2487 and shall not vary from the lower limit on one sieve to the high limit on an adjacent sieve or vice versa.

Requirements for Gradation of Aggregate Base

Sieve Size	Design Range Percentage by Weight	Contractor's Final Gradation	Job Control Grading Band Tolerances for Contractor's Final Gradation Percent
2 inch (50 mm)	100		0
1-1/2 inch (37.5 mm)	95-100		±5
1 inch (25.0 mm)	70-95		±8
3/4 inch (19.0 mm)	55-85		±8
No. 4 (4.75 mm)	30-60		±8
No. 40 (425 µm) ¹	10-30		±5
No. 200 (75 µm)	0-8		±3

¹ The fraction of material passing the No. 200 (75 µm) sieve shall not exceed two-thirds the fraction passing the No. 40 (425 µm) sieve.

209MR-2.3 Sampling and Testing.

- a. **Aggregate base materials.** Samples shall be taken by the Contractor for initial aggregate base requirements and gradation. Material shall meet the requirements in paragraph 209MR-2.1. 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 aggregate base samples per lot in the presence of the Engineer to check the final gradation. Sampling shall be per ASTM D75. Material shall meet the requirements in paragraph 209MR-2.2. 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 sampling points and intervals designated by the Engineer.

209MR-2.4 Separation fabric. Not used.**CONSTRUCTION METHODS**

209MR-3.1 Control strip. Prior to construction, the Contractor shall place a quantity of P-209MR according to the aggregate blend at a location to be determined by the Contractor. 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 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.

209MR-3.2 Preparing underlying subgrade and/or subbase. The underlying subgrade and/or subbase shall be checked and accepted by the Engineer before base course placing and spreading operations begin. Any ruts or soft, yielding areas due to hauling or any other cause shall be corrected before the base course is placed.

209MR-3.3 Production. The aggregate shall be uniformly blended and, when at a satisfactory moisture content per paragraph 209MR-3.5, the approved material may be transported directly to the placement.

209MR-3.4 Placing. The aggregate base material shall be placed on the prepared underlying subgrade and/or subbase and compacted in layers to the thickness shown on the plans. Work shall progress without interruption. The material shall be deposited and spread in lanes in a uniform layer without segregation to such loose depth that, when compacted, the layer shall have the specified thickness. The aggregate base course shall be constructed in layers of uniform thickness of not less than 4 inches (100 mm) nor more than 8 inches (200 mm) of compacted thickness. The aggregate as spread shall be of uniform grading with no pockets of fine or coarse materials. The aggregate, unless otherwise permitted by the Engineer, shall not be spread more than 2,000 square yards (1700 sq m) in advance of the rolling. Any necessary sprinkling shall be kept within these limits. Care shall be taken to prevent cutting into the underlying layer during spreading. No

material shall be placed in snow or on a soft, muddy, or frozen course. The aggregate base material shall be spread by a paving machine, spreader boxes, or other approved devices. This equipment shall have positive thickness controls that spread the aggregate in the required amount to avoid or minimize the need for hand manipulation. Dumping from vehicles that require re-handling shall not be permitted. Hauling over the uncompacted base course shall not be permitted.

When more than one layer is required, the construction procedure described herein shall apply similarly to each layer.

Note: for P-209MR placed directly on top of P-152MR, the first lift of P-209MR shall be placed using methods approved by the Engineer for protection of subgrade.

209MR-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 field density of the compacted material shall be at least 100% of the maximum density of laboratory specimens prepared from samples of the subbase material delivered to the jobsite. The laboratory specimens shall be compacted and tested in accordance with ASTM D1557. The in-place field density shall be determined in accordance with ASTM D6938 using Procedure A, the direct transmission method, and ASTM D6938 shall be used to determine the moisture content of the material. The machine shall be calibrated in accordance with ASTM D6938. The average moisture content of the material during placing operations shall be within ± 2 percentage points of the optimum moisture content as determined by ASTM D1557. The rate of collection shall be a minimum of 1 test per test item, or 4 tests per day's production, whichever is more stringent. All readings shall be taken at the maximum depth that does not exceed the lift thickness. Reference ASTM D698 or ASTM D1557 if the material has greater than 30% retained on the 3/4-inch (19.0 mm) sieve.

Note: for P-209MR placed directly on top of P-152MR, the first lift of P-209MR shall be placed dry of optimum. The laboratory shall note the moisture content where drain down occurs when tested according to ASTM D1557. The moisture content where drain down is observed shall be the target moisture content for the first lift of P-209MR.

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For acceptance, the material must be within 2 percentage points of the target moisture content. The material must be rolled until further densification cannot be achieved, as tested with the nuclear density gauge. No further densification is defined as the average density for all tests performed within a paving lane not changed by more than 0.5% in successive readings after a minimum of 3 passes with the roller. In the event that the moisture content is not within 2 percentage points of the target moisture or if the material continues to densify, the material shall be processed at the Contactor's expense until the above is achieved.

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All subsequent lifts on top of this first layer of P-209MR must be 100% of the maximum density at the optimum moisture content.

209MR-3.6 Acceptance sampling and testing for density. Aggregate base course shall be accepted for density on a lot basis. A lot will consist of the lesser of one day's production, one lift, or 2,400 square yards (2000 sq m). A subplot shall be considered a test item. The Engineer shall perform all density tests.

The rate of collection shall be a minimum of 1 per test section, or 4 per day's production, whichever is more stringent. All readings shall be taken at the maximum depth that does not exceed the lift thickness. Sampling locations will be determined by the Engineer on a random basis per ASTM D3665.

Each lot will be accepted for density when the field density is at least 100% of the maximum density of laboratory specimens. The specimens shall be compacted and tested per ASTM 1557. The in-place field density shall be determined per ASTM D6938 using Procedure A, the direct transmission method, and ASTM D6938 shall be used to determine the moisture content of the material. The machine shall be calibrated in accordance with ASTM D6938. If the specified density is not attained, the subplot shall be reworked and/or recompacted and two additional random tests made at the Contractor's expense. Retesting of a failing subplot without additional scarification and/or compaction of the material is prohibited. This procedure shall be followed until the specified density is reached.

209MR-3.7 Acceptance Testing for Smoothness. After the course has been compacted, the surface shall be tested for smoothness. Any portion lacking the required smoothness shall be scarified to a depth of at least 3 inches (76 mm), reshaped and recompacted until the required smoothness is obtained and approved by the Engineer. Any deviation in surface tolerances shall be corrected by the Contractor at the Contractor's expense. The smoothness requirements specified here apply only to the top layer when base course is constructed in more than one layer.

The final surface shall be free from roller marks. The final finished surface shall not vary more than 3/8 inch when evaluated with a 12 foot straightedge. The lot size shall consist of the entire length and width placed for each material. In the longitudinal direction, a smoothness reading shall be made along the centerline of each pull of material along the entire length of material. In the transverse direction, smoothness readings shall be made continuously across the full width of the testing area at 15 foot intervals and as determined by the Engineer (the outer 3ft may be excluded from testing). However, transverse smoothness readings shall not be made across designed grade changes. The area will be considered accepted if less than 15% of the testing area is considered deficient.

209MR-3.8 Acceptance Testing for Grade. The surface of the top layer in the testing area shall be within $\pm 1/4$ inch in the vertical direction from the target elevation when surveyed in a 5 foot by 5 foot grid, or equivalent method. Any portion failing in accuracy of grade shall be scarified to a depth of at least 3 inches (76 mm), reshaped and recompacted to grade until the required smoothness and accuracy are obtained and approved by the Engineer. Any deviation in surface tolerances shall be corrected by the Contractor at the Contractor's expense.

209MR-3.9 Thickness control. The thickness of the base course shall be within $\pm 1/4$ inch of the specified thickness as determined by survey or LiDAR scanning. Survey shall be required before and after placement of the base. The survey interval should be specified based on the size of the project. Where the thickness is deficient by more than 1/2-inch (13 mm), the Contractor shall correct such areas at no additional cost by scarifying to a depth of at least 3 inches (76 mm), adding new material of proper gradation, and the material shall be blended and recompact to grade.

209MR-3.10 Weather limitations. Perform construction when the atmospheric temperature is above 35°F (2°C). When the temperature falls below 35°F (2°C), protect all completed areas by approved methods against detrimental effects of freezing. Correct completed areas damaged by freezing or other weather conditions to meet specified requirements. When the aggregates contain frozen materials or when the underlying course is frozen or wet, the construction shall be stopped. Hauling equipment may be routed over completed portions of the base course, provided no damage results. Equipment shall be routed over the full width of the base course to avoid rutting or uneven compaction. The Engineer will stop all hauling over completed or partially completed base course when, in the Engineer's opinion, such hauling is causing damage. Any damage to the base course shall be repaired by the Contractor at the Contractor's expense. The Engineer may also recommend a prime-coat to prevent moisture evaporation in case the finished P-209MR base course will be overlaid by a surface layer after a prolonged period of time.

209MR-3.11 Maintenance. The base course shall be maintained in a condition that will meet all specification requirements until the work is accepted. The surface shall be kept clean and free from foreign material at all times. Maintenance shall include immediate repairs to any defects and shall be repeated as often as necessary to keep the area intact. Any base course that is not paved over prior to the onset of winter shall be retested to verify that it still complies with the requirements of this specification. Any area of base course that is damaged shall be reworked or replaced as necessary to comply with this specification. Equipment used in the construction of an adjoining section may be routed over completed sections of base course, provided that no damage results and provided that equipment is routed over the full width of the completed base course

METHOD OF MEASUREMENT

209MR-4.1 The quantity of crushed aggregate base course will be determined by measurement of the number of cubic yards of material actually constructed and accepted by the Engineer as complying with the plans and specifications. Base materials shall not be included in any other excavation quantities.

BASIS OF PAYMENT

209MR-5.1 Payment shall be made at the contract unit price per cubic yard for crushed aggregate base course. This price 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 item.

Payment will be made under:

Item P-209MR-5.1 Crushed Aggregate Base Course - per cubic yard (cubic meter)

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 C29	Standard Test Method for Bulk Density (“Unit Weight”) and Voids in Aggregate
ASTM C88	Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C117	Standard Test Method for Materials Finer than 75- μm (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C131	Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C136	Standard Test Method for Sieve or Screen Analysis of Fine and Coarse Aggregates
ASTM D75	Standard Practice for Sampling Aggregates
ASTM D1557	Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft ³ (2700 kN-m/m ³))
ASTM D2419	Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate
ASTM D3665	Standard Practice for Random Sampling of Construction Materials
ASTM D2487	Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D4318	Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D4718	Standard Practice for Correction of Unit Weight and Water Content for Soils Containing Oversize Particles
ASTM D4791	Standard Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate
ASTM D5821	Standard Test Method for Determining the Percentage of Fractured Particles in Coarse Aggregate

ASTM D6938 Standard Test Method for In-Place Density and Water Content of
Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

END OF SECTION P-209MR

Item P-307MR Cement Treated Permeable Base Course (CTPB)

DESCRIPTION

307MR-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 prepared subgrade or subbase course in accordance with these specifications and shall conform to the lines, grades, thickness, and typical cross sections shown in the plans.

307MR-1.2 Submittals. At least 30 days prior to the placement of the CTPB, the Contractor shall submit certified test reports to the Engineer for those materials proposed for use during construction, as well as the mix design information for the material. The certification 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 be in accordance with Section 61MR Submittal Procedures and include the following:

a. SD-02 Shop Drawings

- 1) **Proposed techniques.** Contractor shall provide a placement plan including the sequence of paving, forming and placing methods, consolidation methods, finishing methods, and curing methods.

b. SD-03 Product Data

- 1) **Coarse aggregate.** Contractor shall provide the coarse aggregate source and physical properties as per Paragraph 307MR-2.1.
- 2) **Fine aggregate.** Contractor shall provide the fine aggregate source and physical properties as per Paragraph 307MR-2.1.
- 3) **Cement.** Contractor shall provide the cement source and physical properties as per Paragraph 307MR-2.3.
- 4) **Admixtures.** Contractor shall provide the admixtures source and physical properties as per Paragraph 307MR-2.5.
- 5) **Curing materials.** Contractor shall provide the curing materials source and physical properties as per Paragraph 307MR-2.6.
- 6) **Construction equipment list.** Contractor shall provide to the Engineer the list of proposed equipment to be used in the performance of construction work, including descriptive data for approval.

c. SD-05 Design Data

- 1) **Mix design.** Contractor shall provide the mix design containing the information identified in Paragraph 307MR-3.1. Mix design documentation must be complete, containing all items identified.

d. SD-06 Test Reports

- 1) **Gradation (Pre-Construction).** Contractor shall provide the mix design gradation as per Paragraph 307MR-2.2a.

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~~2) **Gradation (In-Place).** Engineer shall provide in-place gradation results as per Paragraph 307MR-2.2b.~~

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- 3) **Compressive strength.** Engineer shall provide certified test reports that material complies with the requirements of Paragraph 307MR-3.1 and 307MR-5.2.
 - 4) **Smoothness test results.** Engineer shall provide certified test reports that material complies with the requirements of Paragraph 307MR-5.3.
 - 5) **Grade test results.** Engineer shall provide certified test reports that material complies with the requirements of Paragraph 307MR-5.4.
 - 6) **Thickness test results.** Certified test reports shall be provided that material complies with the requirements of Paragraph 209MR-5.5.
 - 7) **Coefficient of permeability.** Engineer shall provide certified test reports that material complies with the requirements of Paragraph 307MR-3.1 and 307MR-5.6.
 - 8) **Survey.** Engineer shall provide a survey of the as-built surface after acceptance.
- e. **SD-07 Certificates**
- 1) **Testing Laboratory Accreditation.** Contractor shall provide documentation that laboratories used for quality control and for acceptance testing are accredited in accordance with the requirements of this specification and Item C-100MR.

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.

MATERIALS

Start Revision 3, 6/20/2019

307MR-2.1 Aggregate. Coarse aggregate shall be crushed gravel or crushed stone and shall meet the gradation requirements of ASTM C33 Size 67 **or Size 57**. Fine aggregate shall consist of natural sand or manufactured sand meeting the requirements of ASTM C33. The aggregate shall meet the material requirements in the table below.

End Revision 3, 6/20/2019

Start Revision 4, 7/2/2019

Aggregate Material Requirements

Coarse Aggregate Portion (retained on the No. 4 (4.75 mm) sieve)		
Material Test	Requirement	Standard
Resistance to Degradation	Loss: 40% maximum	ASTM C131
Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate	Loss after 5 cycles: 10% maximum using Sodium sulfate - or - 15% maximum using magnesium sulfate	ASTM C88
Flat Particles, Elongated Particles, or Flat and Elongated Particles ¹	10% maximum, by weight, for fraction retained on the ½ inch (12.5mm) sieve and 10% maximum, by weight, for the fraction passing the 1/2-inch (12.5 mm) sieve	ASTM D4791
Clay lumps and friable particles	Less than or equal to 3 percent	ASTM C142
Fine Aggregate Portion (Passing the No. 40 (425µm) sieve)		
Clay lumps and friable particles	Less than or equal to 3 percent	ASTM C142
Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate	Loss after 5 cycles: 10% maximum using Sodium sulfate - or - 15% maximum using magnesium sulfate	ASTM C88

¹ A flat particle is one having a ratio of width to thickness greater than **five (5)**; an elongated particle is one having a ratio of length to width greater than **five (5)**.

End Revision 4, 7/2/2019

307MR-2.2 Sampling and testing.

- a. **Aggregate base materials.** The Contractor shall take samples of the aggregate base in accordance with ASTM D75 to verify initial aggregate base requirements and gradation. Material shall meet the requirements in paragraphs 307MR-2.1. This sampling and testing will be the basis for approval of the aggregate base quality requirements.

Start Revision 4, 7/2/2019

~~b. Gradation requirements. The Engineer shall take at least one belt cut per day to check the final gradation. Sampling shall be per ASTM D75. Material shall meet the requirements in paragraph 307MR-2.1. The samples shall be taken from the in-place, un-compacted material at sampling points and intervals designated by the Engineer.~~

End Revision 4, 7/2/2019

307MR-2.3 Cement. Cement shall conform to the requirements of ASTM C150, Type I or II; ASTM C595, Type IP, IL, or IS.

The Contractor shall furnish vendor's certified test reports for cement shipped to the project.

307MR-2.4 Water. Water used in mixing or curing shall be from potable water sources. Other sources shall be tested in accordance with ASTM C1602 prior to use.

307MR-2.5 Admixtures. The use of any material to be added to the mixture shall be approved by the Engineer.

307MR-2.6 Curing Material. Curing materials shall conform to one of the following specifications:

- White burlap-polyethylene sheeting for curing concrete shall conform to the requirements of ASTM C171.
- Waterproof paper for curing concrete shall conform to the requirements of ASTM C171.

307-2.7 Separation Geotextile. Not used.

COMPOSITION OF MIXTURE

307MR-3.1 Mix design. The Mix Design shall be composed of a mixture of aggregate, cement, and water meeting the following requirements:

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Mix Design Requirements

Material or Test	Requirements	Standard	
7-day Compressive strength, psi (kPa)	Between minimum 400 psi (2758 kPa) and maximum 800 psi (5516 kPa)	ASTM C31 and ASTM C39	Cylinders in accordance with ASTM C31 and test per ASTM C39
Coefficient of permeability (ft/day)	Between 500 to 1500 ft/day (150 to 450 m/day)	AASHTO T215	

Water-Cement Ratio	Approx. 0.36		Cement content shall be adequate to hold the material together and meet strength requirements.
Coarse aggregate	Size #67 or Size #57	ASTM C33	
Fine aggregate	Approximately 300 to 400 pounds per cubic yard (178 to 237 kg/m ³)		As necessary to meet stability while maintaining permeability

End Revision 3, 6/20/2019 and Revision 4, 7/2/2019

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 7 day compressive strength test results and the results of the permeability tests. Data shall be provided to the Engineer for 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.

CONSTRUCTION METHODS

307MR-4.1 Control strip. Prior to construction, the Contractor shall place a quantity of CTPB according to the mix design at a location to be determined by the Contractor. 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. During placement of the CTPB test section, an additional "control strip" will be placed for field permeability testing, as to not introduce excess water into the test section.

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 to three passes of a self-propelled, steel-wheel static roller with weight between 5 and 12 tons (4.5 to 10.9 metric 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 and shows no evidence of crushing; the surface is firm, unyielding and stable under construction traffic; and the layer meets the field permeability per paragraph 307MR-3.1.

307MR-4.2 Weather limitations. The CTPB material shall not be mixed or placed while the air temperature is below 40°F (4°C) or when conditions indicate that the temperature may fall below 35°F (2°C) 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.

307MR-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 Engineer prior to the start of construction operations.

307MR-4.4 Preparation of the underlying course. The underlying course shall be checked and accepted by the 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.

307MR-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 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 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.

307MR-4.6 Hauling. The CTPB mixture shall be transported from the plant to the job site in ready mix trucks, 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.

307MR-4.7 Placing. The CTPB material shall be placed using an asphalt paver. The CTPB shall be installed in a single 8 inch (200 mm) lift. The paver shall be capable of placing a uniform, full-depth layer of material across the full width of the base in one pass.

A secondary “control strip” shall be placed on the same day of placement for field permeability testing to limit the amount of water that is added to the test section.

307MR-4.8 Finishing. Shape the finished surface of the lean concrete base layer to the specified lines, grades, and cross-section.

307MR-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(s) can be determined and corrections are made.

Alternative compaction using a large asphalt paving machine with dual tamping bars may be used in lieu of the rolling.

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

307MR-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, thoroughly moistened with water prior to place the new material.

307MR-4.11 Curing. The completed drainage layer shall be moist cured for a period of seven days in accordance with paragraph 307MR-2.6.

307MR-4.12 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 thirty (30) calendar days after placement of the drainage layer. The CTPB shall not be opened to traffic until specimens made in accordance with ASTM C31 and tested in accordance with ASTM C39 show that a 7-day compressive strength of 500 psi (35.2 kg/square cm) has been achieved.

MATERIAL ACCEPTANCE

307MR-5.1 Sampling and testing. All acceptance sampling and testing necessary to determine conformance with the requirements specified in this section will be performed by the Engineer for

each day of production. Sampling locations will be determined by the Engineer on a random basis per ASTM D3665. The Contractor shall bear the cost of providing curing facilities for the strength specimens.

307MR-5.2 Acceptance Testing for Compressive Strength. One sample of CTPB will be taken for compressive strength for each day of production in accordance with ASTM C172. From the sample, three test cylinders will be made and cured per ASTM C31 and the 7-day compressive strength of each cylinder determined per ASTM C39. The compressive strength will be computed by averaging the three 7-day compressive strengths. The Contractor shall provide for the initial curing of cylinders in accordance with ASTM C31 during the 24 hours after molding.

307MR-5.3 Acceptance Testing for Smoothness. The Engineer shall perform smoothness checks daily. Any area not meeting smoothness and grade shall be corrected by the Contractor at the Contractor's expense.

The finished surface shall not vary more than $\pm 3/8$ -inch (9 mm) when tested with a 12-foot (3.7-m) straightedge applied parallel with and at right angles to the centerline. The lot size shall consist of the entire length and width placed for each material. In the longitudinal direction, a smoothness reading shall be made along the centerline of each pull of material along the entire length of material. In the transverse direction, smoothness readings shall be made continuously across the full width of the testing area at 15 foot intervals and as determined by the Engineer (the outer 3ft may be excluded from testing). However, transverse smoothness readings shall not be made across designed grade changes. The Contractor shall correct any high spots more than $3/8$ inch (9 mm) in 12-foot (3.7-m) with a grinding machine or remove and replace the material at the Contractor's expense. The area will be considered accepted if less than 15% of the testing area is considered deficient.

307MR-5.4 Acceptance Testing for Grade. The Engineer shall perform grade checks daily. Any area not meeting grade shall be corrected by the Contractor at the Contractor's expense. The surface of the top layer in the testing area shall show no deviations in excess of $1/2$ inch (13 mm) in the vertical direction from the target elevation when surveyed in a 5 foot by 5 foot grid, or equivalent method. When the surface is more than $1/2$ inch (13 mm) above the grade shown in the plans, the surface shall be corrected at the Contractor's expense to an elevation that falls within a tolerance of $1/4$ inch (6 mm).

307MR-5.5 Thickness Control. The thickness of the section shall be determined based on the before and after elevations of the finished surface. Prior to the first day of placement, the Engineer shall scan the surface using a LiDAR scanner.

Start Revision 4, 7/2/2019

After placement, the Engineer shall survey the final surface in a 5 foot by 5 foot grid using rod and level.

End Revision 4, 7/2/2019

The difference in these two elevations shall not be more than 1/2 inch (12 mm) less than the thickness specified on the plans.

307MR-5.6 Acceptance Testing for Field Permeability. One test shall be limited to the control strips performed by the Engineer. The test location will be determined on a random basis in accordance with ASTM D3665. The permeability of the base will be determined in accordance with ASTM C1701.

METHOD OF MEASUREMENT

307MR-6.1 Measurement. The quantity of CTPB to be paid for shall be the number of square yards of material placed, and accepted in the completed base course.

BASIS OF PAYMENT

307MR-7.1 Payment. Payment will be made at the contract unit price per square yard for CTPB as measured by Engineer. This price shall be full compensation for furnishing all materials, for all preparation, mixing, placing, compacting, and curing; and for all labor, equipment, tools, and incidentals necessary to complete the item.

Payment will be made under:

Item P-307MR	Cement treated permeable base course (CTPB) - per square yard.
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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 C31	Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C33	Standard Specification for Concrete Aggregates
ASTM C39	Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C94	Standard Specification for Ready-Mixed Concrete
ASTM C150	Standard Specification for Portland Cement
ASTM C172	Standard Practice for Sampling Freshly Mixed Concrete
ASTM C174	Standard Test Method for Measuring Thickness of Concrete Elements Using Drilled Concrete Cores

ASTM C309	Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C595	Standard Specification for Blended Hydraulic Cements
ASTM C1077	Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation
ASTM D3665	Standard Practice for Random Sampling of Construction Materials

END OF SECTION P-307MR

Item P-401MR Hot Mix Asphalt (HMA) Pavements

DESCRIPTION

401MR-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 in accordance with these specifications and shall conform to the lines, grades, thicknesses, and typical cross-sections shown on the plans. 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.

401MR-1.2 Submittals. Submit the following in accordance with Section 61MR Submittal Procedures

a. SD-02 Shop Drawings

- 1) **Laydown plan.** Contractor shall provide laydown plan as per Paragraph 401MR-4.12.

b. SD-04 Samples

- 1) **Aggregates.** Contractor shall provide aggregate samples for each type and source.
- 2) **Asphalt cement binder.** Contractor shall provide asphalt cement binder samples for each type and source.
- 3) **Asphalt concrete.** Contractor shall provide asphalt concrete samples for each type and source during each day of placement.

c. SD-05 Design data

- 1) **Job mix formula.** Contractor shall provide job mix formula containing the information identified in Paragraph 401MR3.3. Job mix formula documentation must be complete, containing all items identified. Note: Two P-401MR mixes will be used, so two JMFs must be submitted and approved.

d. SD-06 Test reports

- 1) **Coarse aggregate.** Contractor shall supply certified test reports showing selected aggregate(s) meet the requirements of Paragraph 401MR-2.1a in accordance with Paragraph 401MR-2.4.
- 2) **Fine aggregate.** Contractor shall supply certified test reports showing selected aggregate(s) meet the requirements of Paragraph 401MR-2.1b in accordance with Paragraph 401MR-2.4.
- 3) **Mineral filler.** Contractor shall supply certified test reports showing selected mineral filler(s) meet the requirements of Paragraph 401MR-2.2 in accordance with Paragraph 401MR-2.4.
- 4) **Asphalt.** Contractor shall supply certified test reports showing the selected asphalt binder meets the requirement of Paragraph 401MR-2.3 in accordance with Paragraph 401MR-2.4.
- 5) **Additive/anti-strip agent.** Contractor shall supply certified test reports for material used in Paragraph 401MR-2.5
- 6) **Process control charts.** Contractor shall provide charts that comply with

Paragraph 401MR-5.5.

- 7) **Smoothness test results.** Engineer shall provide certified test reports that material complies with the requirements of Paragraph 401MR-5.3g
 - 8) **Grade test results.** Engineer shall provide certified test reports that material complies with the requirements of Paragraph 401MR-5.3h
 - 9) **Survey.** Engineer shall provide survey of as-built surface after acceptance.
 - 10) **Density/air void test results.** Engineer shall provide certified test reports for the mat and joints that material complies with the requirements of Paragraph 401MR-6.1c-d
- e. **SD-07 Certificates**
- 1) **Testing laboratory accreditation.** Contractor and Engineer shall provide documentation that laboratories used for quality control and for acceptance testing are accredited in accordance with the requirements of this specification and Item C-100MR.

ASPHALT BINDER MATERIALS

401MR-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. The portion retained on the No. 4 (4.75 mm) sieve is coarse aggregate. The portion retained on the No. 200 (75 μ m) sieve is fine aggregate. The portion passing the No. 200 (75 μ m) sieve is mineral filler.

- a. **Coarse aggregate.** Coarse aggregate shall consist of 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. Coarse aggregate material requirements are given in the table below.

Coarse Aggregate Material Requirements (Portion retained on the No. 4 (4.75 mm) sieve)		
Material Test	Requirement	Standard
Resistance to Degradation	Loss: 40% maximum	ASTM C131
Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate	Loss after 5 cycles: 12% maximum using Sodium sulfate - or - 18% maximum using magnesium sulfate	ASTM C88
Clay lumps and friable particles	0.3% maximum	ASTM C142
Percentage of Fractured Particles	For pavements designed for aircraft gross weights of 60,000 pounds (27200 kg) or more: Minimum 75% by weight of particles with at least two fractured faces and 85% with at least one fractured face ¹	ASTM D5821
Flat, Elongated, or Flat and Elongated Particles	10% maximum, by weight, of flat, elongated, or flat and elongated particles at 5:1 ²	ASTM D4791

¹ The area of each face shall be equal to at least 75% of the smallest mid-sectional area of the piece. When two fractured faces are contiguous, the angle between the planes of fractures shall be at least 30 degrees to count as two fractured faces.

² A flat particle is one having a ratio of width to thickness greater than five (5); an elongated particle is one having a ratio of length to width greater than five (5).

b. Fine aggregate. Fine aggregate shall consist of clean, sound, tough, durable, angular shaped particles produced by crushing stone, slag, or gravel that meets the requirements for wear and soundness specified for fine aggregate material requirements. The aggregate particles shall be free from coatings of clay, silt, or other objectionable matter. Natural (non-manufactured) sand may be used to obtain the gradation of the fine aggregate blend or to improve the workability of the mix. The fine aggregate shall not contain more than 15% natural sand by weight of total aggregates. Fine aggregate material requirements are listed in the table below.

Fine Aggregate Material Requirements (Portion retained on the No. 200 (75 µm))		
Liquid limit	25 maximum	ASTM D4318
Plasticity Index	3 maximum	ASTM D4318
Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate	Loss after 5 cycles: 10% maximum using Sodium sulfate - or - 15% maximum using magnesium sulfate	ASTM C88
Clay lumps and friable particles	0.3% maximum	ASTM C142
Sand equivalent	45 minimum	ASTM D2419
Natural Sand	0% to 15% maximum by weight of total aggregate	ASTM D1073

c. Sampling. ASTM D75 shall be used in sampling coarse and fine aggregate, and ASTM C183 shall be used in sampling mineral filler.

401MR-2.2 Mineral filler. When mineral filler is added as a separate ingredient it shall meet the requirements of ASTM D242.

401MR-2.3 Asphalt binder. Asphalt binder shall conform to ASTM D6373 Performance Grade (PG) 64-22 and/or 76-22 for the asphalt mix shown on the plans. A certificate of compliance from the manufacturer shall be included with the mix design submittal.

The supplier’s certified test report with test data indicating grade certification for the asphalt binder shall be provided to the Engineer for each load at the time of delivery to the mix plant. A certified test report with test data indicating grade certification for the asphalt binder shall also be provided to the Engineer for any modification of the asphalt binder after delivery to the mix plant and before use in the HMA.

401MR-2.4 Preliminary material acceptance. Prior to delivery of materials to the job site, the Contractor shall submit certified test reports to the Engineer for the following materials:

- a. Coarse Aggregate**
 - 1) Percent of wear

- 2) Soundness
 - 3) Clay lumps and friable particles
 - 4) Percent fractured faces
 - 5) Flat and elongated particles
- b. Fine Aggregate**
- 1) Liquid limit and Plasticity index
 - 2) Soundness
 - 3) Clay lumps and friable particles
 - 4) Percent natural sand
 - 5) Sand equivalent
- c. Mineral Filler**
- d. Asphalt binder.** Test results for asphalt binder shall include temperature/viscosity charts for mixing and compaction temperatures. The certifications shall show the appropriate ASTM tests for each material, the test results, and a statement that the material meets the specification requirement. The Engineer may request samples for testing, prior to and during production, to verify the quality of the materials and to ensure conformance with the applicable specifications

401MR-2.5 Anti-stripping agent. Any anti-stripping agent or additive (anti-strip) shall be heat stable and shall not change the asphalt binder grade beyond specifications. Anti-strip shall be an approved material of the New Jersey Department of Transportation.

COMPOSITION

401MR-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).

401MR-3.2 Job mix formula (JMF) laboratory. The laboratory used to develop the JMF shall possess a current certificate of accreditation, listing D3666 from a national accrediting authority and all test methods required for developing the JMF, and listed on the accrediting authority's website.

A copy of the laboratory's current accreditation and accredited test methods shall be submitted to the Engineer prior to start of construction.

401MR-3.3 Job mix formula (JMF). No asphalt mix for payment shall be produced until a JMF has been approved in writing by the Engineer. The JMF shall be prepared by an accredited laboratory that meets the requirements of paragraph 401MR-3.2. The asphalt 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 ASTM D6925.

The Engineer may request samples 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 30 days prior to the start of paving operations. The JMF shall be developed with aggregates currently being produced.

The submitted JMF shall be dated, and stamped or sealed by the responsible professional Engineer of the laboratory and shall include the following items as a minimum:

- a. Manufacturer's Certificate of Analysis (COA) for the asphalt binder used in the JMF in accordance with paragraph 401MR-2.3. Certificate of asphalt performance grade is with modifier already added, if used and must indicate compliance with ASTM D6373. For plant modified asphalt binder, certified test report indicating grade certification of modified asphalt binder.
- b. Manufacturer's Certificate of Analysis (COA) for the anti-stripping agent if used in the JMF in accordance with paragraph 401MR-2.4.
- c. Certified material test reports for the coarse and fine aggregate and mineral filler in accordance with paragraphs 401MR-2.1 and 401MR-2.2. Certified reports must include all tests required; reporting each test, test method, test result, and requirement specified (criteria).
- d. Percent passing each sieve size for total combined gradation, individual gradation of all aggregate stockpiles and percent by weight of each stockpile used in the job mix formula.
- e. Specific Gravity and absorption of each coarse and fine aggregate.
- f. Percent natural sand.
- g. Percent of asphalt.
- h. Number of gyrations
- i. Laboratory mixing temperature.
- j. Laboratory compaction temperature.
- k. Supplier-recommended field mixing and compaction temperatures.
- l. Plot of the combined gradation on a 0.45 power gradation curve.
- m. Graphical plots of air voids, voids in the mineral aggregate, and unit weight versus asphalt content.
- n. Tensile Strength Ratio (TSR).
- o. Type and amount of Anti-strip agent when used.
- p. Asphalt Pavement Analyzer (APA) results.
- q. Date the JMF was developed. Mix designs that are not dated shall not be accepted.
- r. The Contractor shall submit to the Engineer the results of verification testing indicating conformance with the JMF requirements specified in Tables 1 and 2.

When the project requires asphalt mixtures, a separate JMF and the results of JMF verification testing shall be submitted for each mix.

The JMF for each mixture shall be in effect until a modification is approved in writing by the Engineer. Should a change in sources of materials be made, a new JMF must be submitted and approved by the Engineer 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 Engineer's approval of the new or modified JMF, including a new control strip when required by the engineer, will be borne by the Contractor.

Table 1. HMA Design Criteria

Test Property	Value	Test Method
Number of blows/gyrations	75	
Air voids (%)	3.5	ASTM D3203
Percent voids in mineral aggregate (VMA), minimum	See Table 2	ASTM D6995
TSR	not less than 80 at a saturation of 70-80% ¹	ASTM D4867
Asphalt Pavement Analyzer (APA)	10 mm @ 4000 passes at 250 psi	AASHTO T340

¹ An anti-stripping agent shall be added to the asphalt mixture, as necessary.

² AASHTO T340 at 100 psi hose pressure at 64°C test temperature may be used in the interim prior to publication of the next update. If this method is used the required Value shall be LESS THAN 5 mm @ 8000 passes

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 ASTM C136 and ASTM C117.

The gradations in Table 2 represent 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 sieve to the high limit on the adjacent sieve, or vice versa.

Table 2. Aggregate – HMA Pavements

Sieve Size	Percentage by Weight Passing Sieve
1 inch (25.0 mm)	100
3/4 inch (19.0 mm)	90-100
1/2 inch (12.5 mm)	68-88
3/8 inch (9.5 mm)	60-82
No. 4 (4.75 mm)	45-67
No. 8 (2.36 mm)	32-54
No. 16 (1.18 mm)	22-44
No. 30 (600 µm)	15-35
No. 50 (300 µm)	9-25
No. 100 (150 µm)	6-18
No. 200 (75 µm)	3-6
Voids in Mineral Aggregate (VMA)	14
Asphalt Percent:	
Stone or gravel	4.5-7.0
Minimum Construction Lift Thickness	3 inch

The aggregate gradations shown are 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.

401MR-3.4 Reclaimed asphalt pavement (RAP). RAP shall not be used.

401MR-3.5 Control section. Prior to full production, the Contractor shall prepare and place a quantity of asphalt according to the JMF at a location to be determined by the Contractor. The control section shall not be located within the test areas of NAPTF or NAPMRC at the FAA William J. Hughes Technical Center. Contractor will not be allowed to place the control section until the contractor quality control program (CQCP), showing conformance with the requirements of paragraph 401- 5.1, has been approved, in writing, by the Engineer.

The control section shall be placed in two lanes at same width to be used in production, with a longitudinal wedge joint, and shall be of the same depth specified for the construction of the course which it represents. The cold joint must be cut back using the same procedure that will be used during production in accordance with paragraph 401-4.13. However, a cold joint for this control section is an exposed construction joint at least four (4) hours old or whose mat has cooled to less than 160°F (71°C). The underlying grade or pavement structure upon which the control section is to be constructed shall be the same as the remainder of the course represented by the control section. The equipment used in construction of the control section shall be the same type, configuration and weight to be used on the project.

The control section shall be evaluated for acceptance as a single lot in accordance with the acceptance criteria in paragraph 401-6.2. The control section shall be divided into equal sublots. As a minimum, the control section shall consist of three (3) sublots.

The control section shall be considered acceptable if (1) mat density, air voids, and joint density are 90% or more within limits specified in paragraphs 401-6.2b and 401-6.2c, (2) gradation and asphalt content are within the action limits specified in paragraph 401-3.3, and (3) the voids in the mineral aggregate are within the limits of Table 2. APA test results shall be reported to the Engineer.

If the initial control section should prove to be unacceptable, it shall be removed. Necessary adjustments to the JMF, plant operation, placing procedures, and/or rolling procedures shall be made and a second control section shall then be placed. Additional control sections, as required, shall be constructed and evaluated for conformance to the specifications. Any control sections that are not acceptable shall be removed at the Contractor's expense. Full production shall not begin until an acceptable control section has been constructed and accepted in writing by the Engineer. Once an acceptable control section has been placed, payment for the acceptable control section that meets specification requirements shall be made in accordance with paragraph 401-8.1.

Job mix control testing shall be performed by the Contractor at the start of plant production and in conjunction with the calibration of the plant for the JMF. Any changes to the JMF shall be in accordance with paragraph 401-3.3.

CONSTRUCTION METHODS

401MR-4.1 Weather limitations. The asphalt shall not be placed upon a wet surface or when the surface temperature of the underlying course is less than specified in Table 4. The temperature requirements may be waived by the Engineer, if requested; however, all other requirements including compaction shall be met.

Table 3. Surface Temperature Limitations of Underlying Course

Mat Thickness	Base Temperature (Minimum)	
	°F	°C
3 inches (7.5 cm) or greater	40	4
Greater than 2 inches (50 mm) but less than 3 inches (7.5 cm)	45	7

401MR-4.2 Asphalt plant. Plants used for the preparation of asphalt shall conform to the requirements of American Association of State Highway and Transportation Officials (AASHTO) M156 including the following items.

- a. **Inspection of plant.** The Engineer, or Engineer's authorized representative, 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.
- b. **Storage bins and surge bins.** The asphalt stored in storage and surge bins shall meet the same requirements as asphalt loaded directly into trucks and may be permitted under the following conditions:
 - 1) Stored in non-insulated bins for a period of time not to exceed three (3) hours.
 - 2) Stored in insulated bins for a period of time not to exceed eight (8) hours.

If the Engineer determines that there is an excessive amount of heat loss, segregation, or oxidation of the asphalt due to temporary storage, no temporary storage will be allowed.

401MR-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.

401MR-4.4 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.

401MR-4.4.1 Material transfer vehicle (MTV). MTVs are required. Material transfer vehicles used to transfer the material from the hauling equipment to the paver, shall use a self-propelled, material transfer vehicle 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 Material Transfer Vehicle will have remixing and storage capability to prevent physical and thermal segregation.

401MR-4.5 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. The asphalt paver shall be equipped with a control system capable of automatically maintaining the specified screed grade and elevation.

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.

401MR-4.6 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, capable 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.

401MR-4.7 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 Engineer upon request at any time during construction. No separate payment will be made for supplying the density gauge and technician.

401MR-4.8 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 (160°C) when added to the aggregate. The temperature of modified asphalt binder shall be no more than 350°F (175°C) when added to the aggregate.

401MR-4.9 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 (175°C) 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.

401MR-4.10 Preparation of Asphalt. 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 ASTM D2489, 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%.

401MR-4.11 Preparation of the underlying surface. Immediately before placing the asphalt, the underlying course shall be cleaned of all dust and debris.

A tack coat shall be applied in accordance with Item P-603MR to all vertical and horizontal surfaces prior to placement of each lift of asphalt. In addition, all wedge joints shall be tacked.

401MR-4.12 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.). All joints shall be constructed using wedge joints. 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.

Contractor shall survey each lift of asphalt surface course and certify to Engineer that every lot of each lift meets the grade tolerances of paragraph 401MR-6.2e before the next lift can be placed.

Edges of existing asphalt pavement abutting the new work shall be saw cut and carefully removed as shown on the drawings and coated with asphalt tack coat before new material is placed against it.

The speed of the paver shall be regulated to eliminate pulling and tearing of the asphalt mat. The longitudinal joint in one course shall offset the longitudinal joint in the course immediately below by at least 1 foot (30 cm); however, the joint in the surface top course shall be at the centerline of crowned pavements. Transverse joints in one course shall be offset by at least 10 feet (3 m) from transverse joints in the previous course. Transverse joints in adjacent lanes shall be offset a minimum of 10 feet (3 m). 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.

Areas of segregation in the surface course, as determined by the 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 in paragraph 401MR-3.3, Table 2 for the

approved mix design. The area to be removed and replaced shall be a minimum width of the paver and a minimum of 10 feet (3 m) long.

The Engineer may at any time, reject and require the Contractor to dispose of any batch of asphalt 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 Engineer, and if it can be demonstrated in the laboratory, in the presence of the Engineer, that such material was erroneously rejected, payment will be made for the material at the contract unit price.

401MR-4.13 Compaction of asphalt. After placing, the asphalt shall be thoroughly and uniformly compacted by self-propelled rollers. The surface shall be compacted as soon as possible when the asphalt has attained sufficient stability so that the rolling does not cause undue displacement, cracking or shoving. The sequence of rolling operations and the type of rollers used shall be at the discretion of the Contractor. The speed of the roller shall, at all times, be sufficiently slow to avoid displacement of the hot mixture and be effective in compaction. Any displacement occurring as a result of reversing the direction of the roller, or from any other cause, shall be corrected at once.

Sufficient rollers shall be furnished to handle the output of the plant. Rolling shall continue until the surface is of uniform texture, true to grade and cross-section, and the required field density is obtained. To prevent adhesion of the asphalt to the roller, the wheels shall be equipped with a scraper and kept properly moistened but excessive water will not be permitted.

In areas not accessible to the roller, the mixture shall be thoroughly compacted with approved power 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.

401MR-4.14 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 be wedge joints. 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 (80°C); or are irregular, damaged, uncompacted or otherwise defective shall be cut back with a cutting wheel or pavement saw a maximum of 3 inches

(75 mm) 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 or other product approved by the Engineer 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.

401MR-4.15 Saw-cut grooving. Saw-cut grooving is not required.

401MR-4.16 Diamond grinding. When required, diamond grinding shall be accomplished by sawing with saw blades impregnated with industrial diamond abrasive. The saw blades shall be assembled in a cutting head mounted on a machine designed specifically for diamond grinding that will produce the required texture and smoothness level without damage to the pavement. The saw blades shall be 1/8-inch (3-mm) wide and there shall be a minimum of 55 to 60 blades per 12 inches (300 mm) of cutting head width; the actual number of blades will be determined by the Contractor and depend on the hardness of the aggregate. Each machine shall be capable of cutting a path at least 3 feet (0.9 m) wide. Equipment that causes ravel, aggregate fractures, spalls or disturbance to the pavement will not be permitted. The surface of the ground pavement shall have a texture consisting of grooves between 0.090 and 0.130 inches (2 and 3.5 mm) wide. The peaks and ridges shall be approximately 1/32 inch (1 mm) higher than the bottom of the grooves. The pavement shall be left in a clean condition. The removal of all of the slurry resulting from the grinding operation shall be continuous. Control the grinding operation so the residue from the operation does not flow across other lanes of pavement. The Contractor shall apply a surface treatment per P-608 to all areas that have been subject to grinding.

401MR-4.17 Smoothness Equipment.

- Profilograph shall meet ASTM E1274
- Rolling Inclinometer shall meet ASTM E2133
- Inertial Profiler shall meet ASTM E950

CONTRACTOR QUALITY CONTROL (CQC)

401MR-5.1 General. The Contractor shall develop a Contractor Quality Control Program (CQCP) in accordance with Item C-100MR. No partial payment will be made for materials without an approved CQCP.

401MR-5.2 Contractor quality control (QC) facilities. The Contractor shall provide or contract for testing facilities in accordance with Item C-100. 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.

401MR-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 tests shall be performed per lot in accordance with ASTM D6307 or ASTM D2172 for determination of asphalt content. When using ASTM D6307, 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 lot 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 ASTM D5444, ASTM C136, and ASTM C117.
- c. Moisture content of aggregate.** The moisture content of aggregate used for production shall be determined a minimum of once per lot in accordance with ASTM C566.
- d. Moisture content of asphalt.** The moisture content shall be determined once per lot in accordance with AASHTO T329 or ASTM D1461.
- e. Temperatures.** Temperatures shall be checked, at least four 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. Smoothness for Contractor Quality Control.** The Contractor shall perform smoothness testing on each subplot to verify that the construction processes are producing pavement that meets the following guidelines. If the smoothness criteria is not met, appropriate changes and corrections to the construction process shall be made by the contractor before construction continues

Smoothness shall be tested in both the transverse and longitudinal direction of each lot to identify areas that may be prone to ponding of water which could lead to hydroplaning of aircraft. The final surface shall be free from roller marks. After the final rolling, but not later than 24 hours after placement, the surface of each lot shall be tested in both longitudinal and transverse directions for smoothness. The contractor has the option of using either a 12-foot (3.7 m) straightedge and/or a rolling inclinometer meeting the requirements of ASTM E2133. Testing shall be continuous across all joints. Straight-edge testing shall start with one-half the length of the straightedge at the edge of pavement section being tested and then moved ahead one-half the length of the straightedge for each successive measurement. The amount of surface irregularity shall be determined by placing the freestanding (unleveled) straightedge on the pavement surface and allowing it to rest upon the two highest spots covered by its length, and measuring the maximum gap between the straightedge and the pavement surface in the area between these two high points. The contractor may choose to evaluate daily lot compliance with the 1/4-inch straightedge requirement using a rolling inclinometer (i.e., SurPRO). If the rolling inclinometer is used, the acquired data can be read into the FAA profile program, ProFAA, using the

straightedge simulation function to assess the compliance with 1/4-inch variance with a 12-foot straightedge. If the contractor opts to use a rolling inclinometer, the device shall be operated in accordance with ASTM E2133.

The final finished surface course of the pavement shall not vary more than 1/4 inch (6 mm) transversely. Smoothness readings will not be made across grade changes or cross slope transitions. Deviations on final surface course in either the transverse or longitudinal direction that will trap water > 1/4 inch (6 mm) will be corrected with diamond grinding per paragraph 401MR-4.16 or by removing and replacing the surface course to full depth. Grinding will be tapered in all directions to provide smooth transitions to areas not requiring grinding. All areas in which diamond grinding has been performed will be subject to the final pavement thickness tolerances specified in paragraph 401MR-6.2d. Areas that have been ground will be sealed with a surface treatment in accordance with Item P-608. To avoid the surface treatment creating any conflict with runway or taxiway markings, it may be necessary to seal a larger area.

- 1) **Transverse measurements.** Transverse measurements will be taken for each lot placed. Transverse measurements will be taken perpendicular to the pavement centerline each 15 feet (4.5 m) or more often as determined by the Engineer. The joint between lots shall be tested separately to facilitate smoothness between lots.
- 2) **Longitudinal measurements.** Longitudinal measurements will be taken for each lot placed. Longitudinal tests will be parallel to the centerline of paving; at the center of paving lanes when widths of paving lanes are less than 20 feet (6 m); and at the third points of paving lanes when widths of paving lanes are 20 ft (6 m) or greater.

If the contractor's machines and/or methods produce significant areas that need corrective actions, production must be stopped until corrective measures can be implemented.

- h. Grade.** Grade will be evaluated prior to the first day of placement and then as a minimum, prior to placement of the surface lift and after the placement of the surface lift to allow adjustments to paving operations if measurements do not meet specification requirements.

The Engineer shall evaluate the finished layer on a 5 foot by 5 foot grid using a LiDAR scanner for final grade acceptance. The final finished surface of the pavement of the completed project shall not vary from the grade line elevations and cross-sections shown on the plans by more than 1/2 inch vertically or 0.1 feet laterally.

Grinding shall be in accordance with paragraph 401MR-4.16. High points may be ground off provided the course thickness after grinding is not more than 1/2 inch (12 mm) less than the thickness specified on the plans.

- i. Monitoring.** The Engineer reserves the right to monitor any or all of the above testing.

401MR-5.4 Sampling. When directed by the 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.

401MR-5.5 Control charts. The Contractor shall maintain linear control charts both for individual measurements and range (that is, difference between highest and lowest measurements) for aggregate gradation, asphalt content, and VMA. The VMA for each subplot will be calculated and monitored by the QC laboratory.

Control charts shall be posted in a location satisfactory to the Engineer and shall be kept current. 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 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 suspend production or acceptance of the material.

- a. Individual measurements.** Control charts for individual measurements shall be established to maintain process control within tolerance for aggregate gradation, asphalt content, and VMA. The control charts shall use the job mix formula target values as indicators of central tendency for the following test parameters with associated Action and Suspension Limits:

Control Chart Limits for Individual Measurements		
Sieve	Action Limit	Suspension Limit
3/4 inch (19.0 mm)	±6%	±9%
1/2 inch (12.5 mm)	±6%	±9%
3/8 inch (9.5 mm)	±6%	±9%
No. 4 (4.75 mm)	±6%	±9%
No. 16 (1.18 mm)	±5%	±7.5%
No. 50 (300 μm)	±3%	±4.5%
No. 200 (75 μm)	±2%	±3%
Asphalt Content	±0.45%	±0.70%
VMA	-1.00%	-1.50%

- b. Range.** Control charts for range shall be established to control process variability for the test parameters and Suspension Limits listed below. The range shall be computed for each lot as the difference between the two test results for each control parameter. The Suspension Limits specified below are based on a sample size of $n = 2$. Should the Contractor elect to perform more than two tests per lot, the Suspension Limits shall be adjusted by multiplying the Suspension Limit by 1.18 for $n = 3$ and by 1.27 for $n = 4$.

Control Chart Limits Based on Range	
Sieve	Suspension Limit
1/2 inch (12.5 mm)	11%
3/8 inch (9.5 mm)	11%
No. 4 (4.75 mm)	11%
No. 16 (1.18 mm)	9%
No. 50 (300 μ m)	6%
No. 200 (75 μ m)	3.5%
Asphalt Content	0.8%

c. **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) One point falls outside the Suspension Limit line for individual measurements or range; or
- 2) Two points in a row fall outside the Action Limit line for individual measurements.

401MR-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 C-100MR.

MATERIAL ACCEPTANCE

401MR-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 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 shall be accredited in accordance with ASTM D3666. The QA 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.

b. **Lot size.**

- 1) **Standard lot.** A standard lot will be equal to one day's production. Each test item will be considered a subplot within the lot. The rate of testing performed shall be 1 test for each subplot, or 4 test for each day's production, whichever is more stringent, unless otherwise noted within the specification.

c. **Asphalt air voids.** Plant-produced asphalt will be tested for air voids on a lot basis. Sampling will be from material deposited into trucks at the plant or from trucks at the job site. Samples will be taken in accordance with ASTM D979.

- 1) **Sampling.** Each lot will consist of equal sublots. Sufficient asphalt for preparation of test specimens for all testing will be sampled by the Engineer on a random basis, in accordance with the procedures contained in ASTM D3665. Samples will be taken 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 stabilize to compaction temperature. The compaction temperature of the specimens will be as specified in the JMF.

- 2) **Testing.** Air voids will be determined by the Engineer in accordance with ASTM D3203.

The bulk specific gravity of each test specimen will be measured by the Engineer in accordance with ASTM D2726 using the procedure for thoroughly dry (laboratory-prepared dried specimens), or ASTM D1188, whichever is applicable, for use in computing air voids.

For air voids and pavement density, the theoretical maximum density (TMD) of the mixture will be measured one time for each subplot in accordance with ASTM D2041.

- 3) **Acceptance.** Acceptance of plant-produced material for air voids will be determined by the Engineer in accordance with the requirements of paragraph 401MR-6.3 and Table 4.
- d. **In-place asphalt mat and joint density.** Asphalt placed in the field will be tested for mat and joint density on a lot basis. The lot size will be the same as that indicated in paragraph 401MR-6.1b. The average in-place mat and joint densities are expressed as a percentage of the average theoretical maximum density (TMD) for the lot.

- 1) **Sampling.** Samples will be neatly cut with a diamond core drill bit. Samples will be taken in accordance with ASTM D979. The minimum diameter of the sample will be 5 inches (125 mm). Samples that are clearly defective, as a result of sampling, will be discarded and another sample taken. The Contractor shall furnish all tools, labor, and materials for cutting samples, cleaning, and filling the cored pavement. Cored pavement shall be cleaned and core holes shall be filled in a manner acceptable to the Engineer within one day after sampling. Laitance produced by the coring operation shall be removed immediately.

The top most lift of asphalt shall be completely bonded to the underlying layer. If any of the cores reveal that the surface is not bonded to the layer immediately below the surface, then additional cores shall be taken as directed by the Engineer in accordance with this paragraph to determine the extent of any delamination. All delaminated areas shall be completely removed by milling to the limits and depth and replaced as directed by the Engineer at no additional cost.

- 2) **Mat density.** The lot and subplot size will be the same as that indicated in paragraph 401MR-6.1b. One core of finished, compacted asphalt shall be taken from each subplot. Core locations will be determined by the Engineer on a random basis in accordance with procedures contained in ASTM D3665. Cores for mat density shall not be taken closer than one foot (30 cm) from a transverse or longitudinal joint. The minimum core diameter for density determination shall be 5 inches (125 mm).
- 3) **Joint density.** Longitudinal joints include joints internal to the lot and joints created when paving adjacent to previously placed lots. Core locations will be determined by the Engineer on a random basis in accordance with procedures contained in ASTM D3665, one joint core per subplot for all sublots that contain longitudinal joints. All cores for joint density shall be taken centered on the joint. The minimum core diameter for joint density determination shall be 5 inches (125 mm).

- 4) **Testing.** Samples will be taken in accordance with ASTM D979. The bulk specific gravity of each cored sample will be measured by the Engineer in accordance with ASTM D2726. The percent compaction (density) of each sample will be determined by dividing the bulk specific gravity of each subplot sample by the average TMD for the lot, as determined in paragraph 401MR-6.1c2. The average TMD used to determine the joint density at joints formed between different lots will be the lowest of the average TMD values from the two adjacent lots.
- 5) **Acceptance.** Acceptance of field placed asphalt for mat density will be determined by the Engineer in accordance with the requirements of paragraph 401MR-6.2b. Acceptance for joint density will be determined by the Engineer in accordance with the requirements of paragraph 401MR-6.2c.

401MR-6.2 Acceptance criteria.

- a. **General.** Acceptance will be based on the following characteristics of the asphalt and completed pavement as well as the implementation of the Contractor Quality Control Program (CQCP) and test results:
 - 1) Air voids
 - 2) Mat density
 - 3) Joint density
 - 4) Thickness
 - 5) Grade
- b. **Air Voids and Mat density.** Acceptance of each lot of plant produced material for mat density and air voids 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. Acceptance and payment will be determined in accordance with paragraph 401MR-8.1.

The only exception will be the first lift of asphalt concrete which has sensors embedded in it, the FAA will not require its removal if the density criteria is not met. The FAA reserves the right to reduced payment up to 50% of the Contract price for the asphalt concrete if the PWL is below 55.

- 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 and until the reason for poor compaction has been determined. If the PWL is less than 71%, the pay factor for the lot used to complete the joint will be reduced by five (5) percentage points. This lot pay factor reduction will be incorporated and evaluated in accordance with paragraph 401MR-8.1.
- d. **Thickness.** Thickness of each lift of surface course will be evaluated by the Engineer for compliance to the requirements shown on the plans. Measurements of thickness will be made by the Engineer using the cores extracted for each subplot for density measurement. The maximum allowable deficiency at any point will not be more than 1/4 inch (6 mm) 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.

- e. **Grade.** Grade shall be evaluated prior to the first day of placement and then as a minimum, prior to placement of the surface lift and after the placement of the surface lift to allow adjustments to paving operations if measurements do not meet specification requirements.

The Engineer shall evaluate the finished layer on a 5 foot by 5 foot grid using rod and level, or equivalent, for final grade acceptance. The final finished surface of the pavement of the completed project shall not vary from the gradeline elevations and cross-sections shown on the plans by more than 1/2 inch (12 mm) vertically or 0.1 feet (30 mm) laterally. The documentation, stamped and signed by a licensed surveyor, shall be provided by the Engineer to the Contractor.

Grinding shall be in accordance with paragraph 401MR-4.16. High points may be ground off provided the course thickness after grinding is not more than 1/2 inch (12 mm) less than the thickness specified on the plans.

401MR-6.3 Percentage of material within specification limits (PWL). The PWL will be determined in accordance with procedures specified in Item C-110. The specification tolerance limits (L) for lower and (U) for upper are contained in Table 4.

Table 4. Acceptance Limits for Air Voids and Density

Test Property	Pavements Specification Tolerance Limits	
	L	U
Air Voids Total Mix (%)	2	5
Surface Course Mat Density (%)	92.8	-
Base Course Mat Density (%)	91.8	-
Joint density (%)	90.5	--

- 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. The criteria in Table 4 is based on production processes which have a variability with the following standard deviations: Surface Course Mat Density (%), 1.20; Base Course Mat Density (%), 1.55; Joint Density (%), 1.8.

The Contractor should note that (1) 90 PWL is achieved when consistently producing a surface course with an average mat density of at least 94% with 1.20% or less variability, (2) 90 PWL is achieved when consistently producing a base course with an average mat density of at least 93.5% with 1.8% or less variability, and (3) 90 PWL is achieved when consistently producing joints with an average joint density of at least 91% with 1.8% or less variability.

401MR-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 Engineer. A retest will consist of all the sampling and testing

procedures contained in paragraphs 401MR- 6.1d and 401MR-6.2b. Only one resampling per lot will be permitted.

- 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 in accordance with Table 6.
- c. Outliers.** Check for outliers in accordance with ASTM E178, at a significance level of 5%.

METHOD OF MEASUREMENT

401MR-7.1 Measurement. Asphalt shall be measured by the number of tons of asphalt used in the accepted work. Batch weights or truck scale weights will be used to determine the basis for the tonnage.

BASIS OF PAYMENT

401MR-8.1 Payment. Payment for a lot of asphalt meeting all acceptance criteria as specified in paragraph 401MR-6.2 shall be made based on results of tests for mat density and air voids. Payment for acceptable lots shall be adjusted according to paragraph 401MR-8.1a for mat density and air voids, subject to the limitation that:

- a.** The total project payment for plant mix asphalt pavement shall not exceed 100 percent of the product of the contract unit price and the total number of tons of asphalt used in the accepted work (See Note 1 of Table 5).
- b.** The price 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.
- c. Basis of adjusted payment.** The pay factor for each individual lot shall be calculated in accordance with Table 5. 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 payment limitation specified in paragraph 401MR-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%.

Table. 5 Price adjustment schedule

Percentage of material within specification limits (PWL)	Lot pay factor (percent of contract unit price)
90 – 100	100
75-89	0.5 PWL + 55
55-74	1.4 PWL - 12
Below 55	Reject ¹

¹ The lot shall be removed and replaced. However, the Engineer may decide to allow the rejected lot to remain. In that case, if the Engineer and Contractor agree in writing that the lot shall not be removed, it shall be paid for at 50% of the contract unit price and the total project payment shall be reduced by the amount withheld for the rejected lot.

401MR-8.1.1 Payment.

Payment will be made under:

Item P-401MR-8.1.1 Hot Mix Asphalt Surface Course - per ton

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 C29	Standard Test Method for Bulk Density (“Unit Weight”) and Voids in Aggregate
ASTM C88	Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C117	Standard Test Method for Materials Finer than 75- μ m (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C127	Standard Test Method for Density, Relative Density (Specific Gravity) and Absorption of Coarse Aggregate
ASTM C131	Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C136	Standard Test Method for Sieve or Screen Analysis of Fine and Coarse Aggregates
ASTM C142	Standard Test Method for Clay Lumps and Friable Particles in Aggregates
ASTM C183	Standard Practice for Sampling and the Amount of Testing of Hydraulic Cement

ASTM C566	Standard Test Method for Total Evaporable Moisture Content of Aggregate by Drying
ASTM D75	Standard Practice for Sampling Aggregates
ASTM D242	Standard Specification for Mineral Filler for Bituminous Paving Mixtures
ASTM D946	Standard Specification for Penetration-Graded Asphalt Cement for Use in Pavement Construction
ASTM D979	Standard Practice for Sampling Asphalt Paving Mixtures
ASTM D1073	Standard Specification for Fine Aggregate for Asphalt Paving Mixtures
ASTM D1188	Standard Test Method for Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Coated Samples
ASTM D2172	Standard Test Method for Quantitative Extraction of Bitumen from Asphalt Paving Mixtures
ASTM D1461	Standard Test Method for Moisture or Volatile Distillates in Asphalt Paving Mixtures
ASTM D2041	Standard Test Method for Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures
ASTM D2419	Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate
ASTM D2489	Standard Practice for Estimating Degree of Particle Coating of Bituminous-Aggregate Mixtures
ASTM D2726	Standard Test Method for Bulk Specific Gravity and Density of Non-Absorptive Compacted Bituminous Mixtures
ASTM D2950	Standard Test Method for Density of Bituminous Concrete in Place by Nuclear Methods
ASTM D3203	Standard Test Method for Percent Air Voids in Compacted Dense and Open Bituminous Paving Mixtures
ASTM D3381	Standard Specification for Viscosity-Graded Asphalt Cement for Use in Pavement Construction
ASTM D3665	Standard Practice for Random Sampling of Construction Materials
ASTM D3666	Standard Specification for Minimum Requirements for Agencies Testing and Inspecting Road and Paving Materials

ASTM D4318	Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D4552	Standard Practice for Classifying Hot-Mix Recycling Agents
ASTM D4791	Standard Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate
ASTM D4867	Standard Test Method for Effect of Moisture on Asphalt Concrete Paving Mixtures
ASTM D5444	Standard Test Method for Mechanical Size Analysis of Extracted Aggregate
ASTM D5821	Standard Test Method for Determining the Percentage of Fractured Particles in Coarse Aggregate
ASTM D6084	Standard Test Method for Elastic Recovery of Bituminous Materials by Ductilometer
ASTM D6307	Standard Test Method for Asphalt Content of Hot Mix Asphalt by Ignition Method
ASTM D6373	Standard Specification for Performance Graded Asphalt Binder
ASTM D6752	Standard Test Method for Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Automatic Vacuum Sealing Method
ASTM D6925	Standard Test Method for Preparation and Determination of the Relative Density of Hot Mix Asphalt (HMA) Specimens by Means of the SuperPave Gyrotory Compactor.
ASTM D6995	Standard Test Method for Determining Field VMA based on the Maximum Specific Gravity of the Mix (Gmm)
ASTM E11	Standard Specification for Woven Wire Test Sieve Cloth and Test Sieves
ASTM E178	Standard Practice for Dealing with Outlying Observations
ASTM E2133	Standard Test Method for Using a Rolling Inclinometer to Measure Longitudinal and Transverse Profiles of a Traveled Surface
American Association of State Highway and Transportation Officials (AASHTO)	
AASHTO M156	Standard Specification for Requirements for Mixing Plants for Hot-Mixed, Hot-Laid Bituminous Paving Mixtures.
AASHTO T329	Standard Method of Test for Moisture Content of Hot Mix Asphalt (HMA) by Oven Method

AASHTO T 340 Standard Method of Test for Determining the Rutting Susceptibility of Hot Mix Asphalt (APA) Using the Asphalt Pavement Analyzer (APA)

Asphalt Institute (AI)

Asphalt Institute Handbook MS-26, Asphalt Binder

Asphalt Institute MS-2 Mix Design Manual, 7th Edition

AI State Binder Specification Database

FAA Orders

5300.1 Modifications to Agency Airport Design, Construction, and Equipment Standards

END OF SECTION P-401MR

Item P-403MR Hot Mix Asphalt (HMA) Pavements Base Course

DESCRIPTION

403MR-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 in accordance with these specifications and shall conform to the lines, grades, thicknesses, and typical cross-sections shown on the plans. 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.

403MR-1.2 Submittals. Submit the following in accordance with Section 61MR Submittal Procedures

a. SD-02 Shop drawings

- 1) **Laydown plan.** Contractor shall provide laydown plan as per Paragraph 403MR-4.12.

b. SD-04 Samples

- 1) **Aggregates.** Contractor shall provide aggregate samples for each type and source.
- 2) **Asphalt cement binder.** Contractor shall provide asphalt cement binder samples for each type and source.
- 3) **Asphalt concrete.** Contractor shall provide asphalt concrete samples for each type and source during each day of placement.

c. SD-05 Design data

- 1) **Job mix formula (JMF).** Contractor shall provide JMF containing the information identified in Paragraph 403MR3.3. JMF documentation must be complete, containing all items identified.

d. SD-06 Test reports

- 1) **Coarse aggregate.** Contractor shall supply certified test reports showing selected aggregate(s) meet the requirements of Paragraph 403MR-2.1a in accordance with Paragraph 403MR-2.4.
- 2) **Fine aggregate.** Contractor shall supply certified test reports showing selected aggregate(s) meet the requirements of Paragraph 403MR-2.1b in accordance with Paragraph 403MR-2.4.
- 3) **Mineral filler.** Contractor shall supply certified test reports showing selected mineral filler(s) meet the requirements of Paragraph 403MR-2.2 in accordance with Paragraph 403MR-2.4.
- 4) **Asphalt.** Contractor shall supply certified test reports showing the selected asphalt binder meets the requirement of Paragraph 403MR-2.3 in accordance with Paragraph 403MR-2.4.
- 5) **Additive/anti-strip agent.** Contractor shall supply certified test reports for material used in Paragraph 403MR-2.5
- 6) **Process control charts.** Contractor shall provide charts that comply with Paragraph 403MR-5.5.

- 7) **Smoothness test results.** Engineer shall provide certified test reports that material complies with the requirements of Paragraph 403MR-5.3g
 - 8) **Grade test results.** Engineer shall provide certified test reports that material complies with the requirements of Paragraph 403MR-5.3h
 - 9) **Survey.** Engineer shall provide survey of as-built surface after acceptance.
 - 10) **Density/air void test results.** Engineer shall provide certified test reports for the mat and joints that material complies with the requirements of Paragraph 403MR-6.1c-d
- e. **SD-07 Certificates**
- 1) **Testing laboratory accreditation.** Contractor and Engineer shall provide documentation that laboratories used for quality control and for acceptance testing are accredited in accordance with the requirements of this specification and Item C-100MR.

MATERIALS

403MR-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. The portion retained on the No. 4 (4.75 mm) sieve is coarse aggregate. The portion passing the No. 4 (4.75 mm) sieve and retained on the No. 200 (75 μ m) sieve is fine aggregate, and the portion passing the No. 200 (75 μ m) sieve is mineral filler consisting of a non-plastic material meeting the requirements of ASTM D242.

- a. **Coarse aggregate.** Coarse aggregate shall consist of 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. Coarse aggregate material requirements are given in the table below.

Coarse Aggregate Material Requirements (Portion retained on the No. 4 (4.75 mm) sieve)		
Material Test	Requirement	Standard
Resistance to Degradation	Loss: 40% maximum for surface, asphalt binder, and leveling course Loss: 50% maximum for base course	ASTM C131
Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate	Loss after 5 cycles: 12% maximum using Sodium sulfate - or - 18% maximum using magnesium sulfate	ASTM C88
Clay lumps and friable particles	0.3% maximum	ASTM C142
Percentage of Fractured Particles	For pavements designed for aircraft gross weights of 60,000 pounds (27200 kg) or more: Minimum 75% by weight of particles with at least two fractured faces and 85% with at least one fractured face ¹	ASTM D5821

Flat, Elongated, or Flat and Elongated Particles	10% maximum, by weight, of flat, elongated, or flat and elongated particles at 5:1 ²	ASTM D4791
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¹ The area of each face shall be equal to at least 75% of the smallest mid-sectional area of the piece. When two fractured faces are contiguous, the angle between the planes of fractures shall be at least 30 degrees to count as two fractured faces.

² A flat particle is one having a ratio of width to thickness greater than five (5); an elongated particle is one having a ratio of length to width greater than five (5).

- b. Fine aggregate.** Fine aggregate shall consist of clean, sound, tough, durable, angular shaped particles produced by crushing stone, slag, or gravel that meets the requirements for wear and soundness specified for coarse aggregate. The aggregate particles shall be free from coatings of clay, silt, or other objectionable matter. Natural (non-manufactured) sand may be used to obtain the gradation of the aggregate blend or to improve the workability of the mix. The fine aggregate shall not contain more than 15% natural sand by weight of total aggregates.

Fine Aggregate Material Requirements (Portion retained on the No. 200 (75 µm))		
Liquid limit	25 maximum	ASTM D4318
Plasticity Index	3 maximum	ASTM D4318
Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate	Loss after 5 cycles: 10% maximum using Sodium sulfate - or - 15% maximum using magnesium sulfate	ASTM C88
Clay lumps and friable particles	0.3% maximum	ASTM C142
Sand equivalent	45 minimum	ASTM D2419
Natural Sand	0% to 15% maximum by weight of total aggregate	ASTM D1073

- c. Sampling.** ASTM D75 shall be used in sampling coarse and fine aggregate, and ASTM C183 shall be used in sampling mineral filler.

403MR-2.2 Mineral filler. When mineral filler is added as a separate ingredient it shall meet the requirements of ASTM D242.

403MR-2.3 Asphalt binder. Asphalt binder shall conform to ASTM D6373 Performance Grade (PG) 76-22. A certificate of compliance from the manufacturer shall be included with the mix design submittal.

The supplier's certified test report with test data indicating grade certification for the asphalt binder shall be provided to the Engineer for each load at the time of delivery to the mix plant. A certified test report with test data indicating grade certification for the asphalt binder shall also be provided to the Engineer for any modification of the asphalt binder after delivery to the mix plant and before use in the asphalt.

403MR-2.4 Preliminary material acceptance. Prior to delivery of materials to the job site, the Contractor shall submit certified test reports to the Engineer for the following materials:

a. Coarse aggregate:

- 1) Percent of wear
- 2) Soundness
- 3) Clay lumps and friable particles
- 4) Percent fractured faces
- 5) Flat and elongated particles

b. Fine aggregate:

- 1) Liquid limit and Plasticity index
- 2) Soundness
- 3) Clay lumps and friable particles
- 4) Sand equivalent
- 5) Percent natural sand

c. Mineral filler.**d. Asphalt binder.** Asphalt binder supplier certified test report must be provided with the following information:

- Test results for the appropriate ASTM tests in accordance with paragraph 403MR-2.3 for each PG asphalt binder supplied and a statement that the material meets the specification.
- Temperature/viscosity charts
- Recommended laboratory mixing, and compaction temperatures
- Recommended temperatures for plant mixing
- Recommended temperatures for field compaction The Engineer may request samples for testing, prior to and during production, to verify the quality of the materials and to ensure conformance with the applicable specifications.

403MR-2.5 Anti-stripping agent. Any anti-stripping agent or additive (anti-strip) shall be heat stable and shall not change the asphalt binder grade beyond specifications. Anti-strip shall be an approved material of the New Jersey Department of Transportation.

COMPOSITION

403MR-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).

403MR-3.2 Job mix formula (JMF) laboratory. The laboratory used to develop the JMF shall possess a current certificate of accreditation, listing D3666 from a national accrediting authority and all test methods required for developing the JMF, and listed on the accrediting authority's website. A copy of the laboratory's current accreditation and accredited test methods shall be submitted to the Engineer prior to start of construction.

403MR-3.3 Job mix formula (JMF). No asphalt mix for payment shall be produced until a JMF has been approved in writing by the Engineer. The JMF shall be prepared by an accredited laboratory that meets the requirements of paragraph 403MR-3.2. The asphalt shall be designed using procedures contained in Asphalt Institute MS-2 Mix Design Manual, 7th Edition. Samples

shall be prepared at various asphalt contents and compacted using the gyratory compactor in accordance with ASTM D6925.

The Engineer may request samples 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 30 days prior to the start of paving operations. The JMF shall be developed within the same construction season using aggregates currently being produced.

The submitted JMF shall be stamped or sealed by the responsible professional Engineer of the laboratory and shall include the following items as a minimum:

- a. Percent passing each sieve size for total combined gradation, individual gradation of all aggregate stockpiles and percent by weight of each stockpile used in the JMF.
- b. Specific Gravity and absorption of each aggregate.
- c. Percent natural sand.
- d. Percent fractured faces.
- e. Percent by weight of flat particles, elongated particles, and flat and elongated particles (and criteria).
- f. Percent of asphalt.
- g. Asphalt binder performance, grade, and type of modifier if used.
 - Certificate of compliance from the manufacturer indicating compliance with ASTM D6373.
 - For plant modified asphalt binder, certified test report indicating grade certification of modified asphalt binder.
- h. Number of gyrations.
- i. Laboratory mixing temperature.
- j. Laboratory compaction temperature.
- k. Supplier recommended mixing and compaction temperatures.
- l. Plot of the combined gradation on the 0.45 power gradation curve.
- m. Graphical plots of air voids, voids in the mineral aggregate, and unit weight versus asphalt content.
- n. Tensile Strength Ratio (TSR).
- o. Type and amount of Anti-strip agent when used.
- p. Date the JMF was developed. Mix designs that are not dated or which are from a prior construction season shall not be accepted.

The Contractor shall submit to the Engineer the results of verification testing of three (3) asphalt samples prepared at the optimum asphalt content. The average of the results of this testing shall indicate conformance with the JMF requirements specified in Tables 1 and 2.

When the project requires asphalt mixtures, a separate JMF and the results of JMF verification testing shall be submitted for each mix.

The JMF for each mixture shall be in effect until a modification is approved in writing by the Engineer. Should a change in sources of materials be made, a new JMF must be submitted and approved by the Engineer 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 Engineer's approval of the new or modified JMF, including a new control strip when required by the engineer, will be borne by the Contractor.

Table 1. Asphalt Design Criteria

Test Property	Value	Test Method
Number of blows/gyrations	75	
Air voids (%)	3.5	ASTM D3203
Percent voids in mineral aggregate (VMA), minimum	See Table 2	ASTM D6995
TSR	not less than 80 at a saturation of 70-80% ¹	ASTM D4867
Asphalt Pavement Analyzer (APA)	10 mm @ 4000 passes at 250 psi	AASHTO T340

¹ An anti-stripping agent shall be added to the asphalt, as necessary, to produce a TSR of not less than 75.

² AASHTO T340 at 100 psi hose pressure at 64°C test temperature may be used in the interim prior to publication of the next update. If this method is used the required Value shall be LESS THAN 5 mm @ 8000 passes

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 ASTM C136 and ASTM C117.

The gradations in Table 2 represent 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 sieve to the high limit on the adjacent sieve, or vice versa.

Table 2. Aggregate – Asphalt Pavements

Sieve Size	Percentage by Weight Passing Sieve
1 inch (25.0 mm)	100
3/4 inch (19.0 mm)	90-100
1/2 inch (12.5 mm)	68-88
3/8 inch (9.5 mm)	60-82
No. 4 (4.75 mm)	45-67
No. 8 (2.36 mm)	32-54
No. 16 (1.18 mm)	22-44
No. 30 (600 µm)	15-35
No. 50 (300 µm)	9-25
No. 100 (150 µm)	6-18
No. 200 (75 µm)	3-6
Voids in Mineral Aggregate (VMA)	14
Asphalt Percent:	
Stone or gravel	4.5-7.0
Minimum Construction Lift Thickness	3 inch

The aggregate gradations shown are 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.

403MR-3.4 Reclaimed asphalt pavement (RAP). RAP shall not be used.

403MR-3.5 Control section. Prior to full production, the Contractor shall prepare and place a quantity of asphalt according to the JMF at a location to be determined by the Contractor. The control section shall not be located within the test areas of NAPTF or NAPMRC at the FAA William J. Hughes Technical Center. Contractor will not be allowed to place the control section until the CQCP, showing conformance with the requirements of paragraph 403-5.1, has been approved, in writing, by the Engineer.

The control section shall be placed in two lanes at same width to be used in production with a longitudinal wedge joint, and shall be of the same depth specified for the construction of the course which it represents. The cold joint must be cut back using the same procedure that will be used during production in accordance with 403-4.12. However, a cold joint for this control section is an exposed construction joint at least four (4) hours old or whose mat has cooled to less than 160°F (71°C). The underlying grade or pavement structure upon which the control section is to be constructed shall be the same as the remainder of the course represented by the control section. The equipment used in construction of the control section shall be the same type, configuration and weight to be used on the project.

The control section shall be evaluated for acceptance as a single lot in accordance with the acceptance criteria in paragraph 403-6.1 and 403-6.2. The control section shall be divided into equal sublots. As a minimum, the control section shall consist of three (3) sublots.

The control section shall be considered acceptable if the average mat density of the control section cores is greater than or equal to 96% and the average joint density of the control section cores is greater than or equal to 94%.

If the initial control section should prove to be unacceptable, it shall be removed and the necessary adjustments to the JMF, plant operation, placing procedures, and/or rolling procedures shall be made. A second control section shall then be placed. If the second control section also does not meet specification requirements, it shall be removed at the Contractor's expense. Additional control sections, as required, shall be constructed and evaluated for conformance to the specifications. Any additional sections that are not acceptable shall be removed at the Contractor's expense. Full production shall not begin until an acceptable control section has been constructed and accepted in writing by the Engineer. Once an acceptable control section has been placed, payment for the test section that meets specification requirements shall be made in accordance with paragraph 403-8.1.

Job mix control testing shall be performed by the Contractor at the start of plant production and in conjunction with the calibration of the plant for the JMF. If the aggregates produced by the plant do not satisfy the gradation requirements or produce a mix that meets the JMF, it will be necessary

to reevaluate and redesign the mix using plant-produced aggregates. Specimens shall be prepared and the optimum asphalt content determined in the same manner as for the original JMF tests.

CONSTRUCTION METHODS

403MR-4.1 Weather limitations. The asphalt shall not be placed upon a wet surface or when the surface temperature of the underlying course is less than specified in Table 4. The temperature requirements may be waived by the Engineer, if requested; however, all other requirements including compaction shall be met.

Table 4. Surface Temperature Limitations of Underlying Course

Mat Thickness	Base Temperature (Minimum)	
	°F	°C
3 inches (7.5 cm) or greater	40	4
Greater than 2 inches (50 mm) but less than 3 inches (7.5 cm)	45	7

403MR-4.2 Asphalt plant. Plants used for the preparation of asphalt shall conform to the requirements of American Association of State Highway and Transportation Officials (AASHTO) M156 including the following items:

- a. **Inspection of plant.** The Engineer, or Engineer's authorized representative, 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.
- b. **Storage bins and surge bins.** The asphalt stored in storage and surge bins shall meet the same requirements as asphalt loaded directly into trucks and may be permitted under the following conditions:
 - 1) Stored in non-insulated bins for a period of time not to exceed three (3) hours.
 - 2) Stored in insulated storage bins for a period of time not to exceed eight (8) hours.

If the Engineer determines that there is an excessive amount of heat loss, segregation or oxidation of the asphalt due to temporary storage, no temporary storage will be allowed.

403MR-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.

403MR-4.4 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.

403MR-4.4.1 Material transfer vehicle (MTV). MTVs are required. Material transfer Vehicles shall be required due to the improvement in smoothness and decrease in both physical and thermal segregation. To transfer the material from the hauling equipment to the paver, use a self-propelled, material transfer vehicle 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 Material Transfer Vehicle will have remixing and storage capability to prevent physical and thermal segregation.

403MR-4.5 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. The asphalt paver shall be equipped with a control system capable of automatically maintaining the specified screed grade and elevation. If, during construction, it is found that 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 and satisfactory equipment shall be provided by the Contractor.

403MR-4.6 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, capable 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.

403MR-4.7 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 Engineer upon request at any time during construction. No separate payment will be made for supplying the density gauge and technician.

403MR-4.8 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 (160°C) when added to the aggregate. The temperature of modified asphalt binder shall be no more than 350°F (175°C) when added to the aggregate.

403MR-4.9 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 (175°C) 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.

403MR-4.10 Preparation of asphalt. 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 ASTM D2489, 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%.

403MR-4.11 Preparation of the underlying surface. Immediately before placing the asphalt, the underlying course shall be cleaned of all dust and debris.

A tack coat shall be applied in accordance with Item P-603MR to all vertical and horizontal surfaces prior to placement of each lift of asphalt. In addition, tack coat shall be applied to all wedge joints.

403MR-4.12 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 atmospheric temperature.

Contractor shall survey each lift of asphalt surface course and certify to Engineer that every lot of each lift meets the grade tolerances of paragraph 403MR-6.2b(5) before the next lift can be placed.

Edges of existing asphalt pavement abutting the new work shall be saw cut and carefully removed as shown on the drawings and coated with asphalt tack coat before new material is placed against it.

The speed of the paver shall be regulated to eliminate pulling and tearing of the asphalt mat. The longitudinal joint in one course shall offset the longitudinal joint in the course immediately below by at least one foot (30 cm); however, the joint in the surface top course shall be at the centerline

of crowned pavements. Transverse joints in one course shall be offset by at least 10 feet (3 m) from transverse joints in the previous course. Transverse joints in adjacent lanes shall be offset a minimum of 10 feet (3 m).

On areas where irregularities or unavoidable obstacles make the use of mechanical spreading and finishing equipment impractical, the asphalt mixture may be spread and luted by hand tools.

Areas of segregation in the course, as determined by the 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 in paragraph 403MR-3.3, Table 2 for the approved mix design. The area to be removed and replaced shall be a minimum width of the paver and a minimum of 10 feet (3 m) long.

403MR-4.13 Compaction of asphalt. After placing, the asphalt shall be thoroughly and uniformly compacted by power rollers. The surface shall be compacted as soon as possible when the mixture has attained sufficient stability so that the rolling does not cause undue displacement, cracking or shoving. The sequence of rolling operations and the type of rollers used shall be at the discretion of the Contractor. The speed of the roller shall, at all times, be sufficiently slow to avoid displacement of the hot mixture and be effective in compaction. Any displacement occurring as a result of reversing the direction of the roller, or from any other cause, shall be corrected at once.

Sufficient rollers shall be furnished to handle the output of the plant. Rolling shall continue until the surface is of uniform texture, true to grade and cross-section, and the required field density is obtained. To prevent adhesion of the mixture to the roller, the wheels shall be equipped with a scraper and kept properly moistened using a water-soluble asphalt release agent approved by the Engineer.

In areas not accessible to the roller, the mixture shall be thoroughly compacted with approved power driven tampers. Tampers shall weigh not less than 275 pounds (125 kg), have a tamping plate width not less than 15 inches (38 cm), be rated at not less than 4,200 vibrations per minute, and be suitably equipped with a standard tamping plate wetting device.

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.

403MR-4.14 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 be wedge joints. 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 (80°C); or are irregular, damaged, uncompacted or otherwise defective shall be cut back with a cutting wheel or pavement saw a maximum of 3 inches (75 mm) 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. An asphalt tack coat or other product approved by the Engineer 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.

403MR-4.15 Saw-cut grooving. Saw-cut grooving is not required.

403MR-4.16 Diamond grinding. When required, diamond grinding shall be accomplished by sawing with saw blades impregnated with industrial diamond abrasive. The saw blades shall be assembled in a cutting head mounted on a machine designed specifically for diamond grinding that will produce the required texture and smoothness level without damage to the pavement. The saw blades shall be 1/8-inch (3-mm) wide and there shall be a minimum of 55 to 60 blades per 12 inches (300 mm) of cutting head width; the actual number of blades will be determined by the Contractor and depend on the hardness of the aggregate. Each machine shall be capable of cutting a path at least 3 feet (0.9 m) wide. Equipment that causes ravel, aggregate fractures, spalls or disturbance to the pavement will not be permitted. The surface of the ground pavement shall have a texture consisting of grooves between 0.090 and 0.130 inches (2 and 3.5 mm) wide. The peaks and ridges shall be approximately 1/32 inch (1 mm) higher than the bottom of the grooves. The pavement shall be left in a clean condition. The removal of all of the slurry resulting from the grinding operation shall be continuous. Control the grinding operation so the residue from the operation does not flow across other lanes of pavement. The Contractor shall apply a surface treatment per Item P-608 to all areas that have been subject to grinding.

403MR-4.17 Smoothness Equipment.

- Profilograph shall meet ASTM E1274
- Rolling Inclinator shall meet ASTM E2133
- Inertial Profiler shall meet ASTM E950

CONTRACTOR QUALITY CONTROL (CQC)

403MR-5.1 General. The Contractor shall develop a CQCP in accordance with Item C-100MR. No partial payment will be made for materials that are subject to specific QC requirements without an approved CQCP.

403MR-5.2 Contractor quality control (QC) facilities. The Contractor shall provide or contract for testing facilities in accordance with Item C-100. 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.

403MR-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 asphalt content tests shall be performed per lot in accordance with ASTM D6307 or ASTM D2172 if the correction factor in ASTM D6307 is greater than 1.0. The asphalt content for the lot 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 ASTM D5444 and ASTM C136, and ASTM C117.
- c. **Moisture content of aggregate.** The moisture content of aggregate used for production shall be determined a minimum of once per lot in accordance with ASTM C566.
- d. **Moisture content of asphalt.** The moisture content of the asphalt shall be determined once per lot in accordance with ASTM D1461.
- e. **Temperatures.** Temperatures shall be checked, at least four 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. **Smoothness.** The Contractor shall perform smoothness testing on each subplot to verify that the construction processes are producing pavement that meets the following guidelines. If the smoothness criteria is not met, appropriate changes and corrections to the construction process shall be made by the contractor before construction continues.

Smoothness shall be tested in both the transverse and longitudinal direction of each lot to identify areas that may be prone to ponding of water which could lead to hydroplaning of aircraft. The final surface shall be free from roller marks. After the final rolling, but not later than 24 hours after placement, the surface of each lot shall be tested in both longitudinal and transverse directions for smoothness. The contractor has the option of using either a 12-foot (3.7 m) straightedge and/or a rolling inclinometer meeting the requirements of ASTM E2133. Testing shall be continuous across all joints. Straightedge testing shall start with one-half the length of the straightedge at the edge of pavement section being tested and then moved ahead one-half the length of the straightedge for each successive measurement. The amount of surface irregularity shall be determined by placing the freestanding (unleveled) straightedge on the pavement surface and allowing it to rest upon the two highest spots covered by its length, and measuring the maximum gap between the straightedge and the pavement surface in the area between these two high points. The contractor may choose to evaluate daily lot compliance with the 1/4-inch straightedge requirement using a rolling inclinometer. If the rolling inclinometer is used, the acquired data can be read into the FAA profile program, ProFAA, using the straightedge simulation

function to assess the compliance with 1/4-inch variance with a 12-foot straightedge. If the contractor opts to use a rolling inclinometer, the device shall be operated in accordance with ASTM E2133.

The final finished surface course of the pavement shall not vary more than 1/4 inch (6 mm) transversely. Smoothness readings will not be made across grade changes or cross slope transitions. Deviations on final surface course in either the transverse or longitudinal that will trap water > 1/4 inch (6 mm) will be corrected with diamond grinding per paragraph 403MR-4.16 or by removing and replacing the surface course to full depth. Grinding will be tapered in all directions to provide smooth transitions to areas not requiring grinding. All areas in which diamond grinding has been performed will be subject to the final pavement thickness tolerances specified in paragraph 403MR-5.3g. Areas that have been ground will be sealed with a surface treatment in accordance with Item P-608. To avoid the surface treatment creating any conflict with runway or taxiway markings, it may be necessary to seal a larger area.

- 1) **Transverse measurements.** Transverse measurements will be taken for each lot placed. Transverse measurements will be taken perpendicular to the pavement centerline each 15 feet (4.5 m) or more often as determined by the Engineer. The joint between lots shall be tested separately to facilitate smoothness between lots.
- 2) **Longitudinal measurements.** Longitudinal measurements will be taken for each lot placed. Longitudinal tests will be parallel to the centerline of paving; at the center of paving lanes when widths of paving lanes are less than 20 feet (6 m); and at the third points of paving lanes when widths of paving lanes are 20 ft (6 m) or greater.

If the contractor's machines and/or methods are producing significant areas that need corrective actions, then production should be stopped until corrective measures can be implemented. If corrective measures are not implemented and when directed by the Engineer, production shall be stopped until corrective measures can be implemented.

- h. **Grade.** Grade will be evaluated prior to the first day of placement and then as a minimum, prior to placement of the surface lift and after the placement of the surface lift to allow adjustments to paving operations if measurements do not meet specification requirements.

The Engineer shall evaluate the finished layer on a 5 foot by 5 foot grid using a LiDAR scanner for final grade acceptance. The final finished surface of the pavement of the completed project shall not vary from the gradeline elevations and cross-sections shown on the plans by more than 1/2 inch (12 mm) vertically or 0.1 feet (30 mm) laterally. The documentation, stamped and signed by a licensed surveyor, shall be provided by the Engineer to the Contractor.

Grinding shall be in accordance with paragraph 403MR-4.16. High points may be ground off provided the course thickness after grinding is not more than 1/2 inch (12 mm) less than the thickness specified on the plans.

- i. **Monitoring.** The Engineer reserves the right to monitor any or all of the above testing.

403MR-5.4 Sampling. When directed by the 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.

403MR-5.5 Control charts. The Contractor shall maintain linear control charts both for individual measurements and range (i.e., difference between highest and lowest measurements) for aggregate gradation, asphalt content, and VMA. The VMA for each subplot will be calculated and monitored by the QC laboratory.

Control charts shall be posted in a location satisfactory to the Engineer and shall be kept current. 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 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 suspend production or acceptance of the material.

- a. Individual measurements.** Control charts for individual measurements shall be established to maintain process control within tolerance for aggregate gradation, asphalt content, and VMA. The control charts shall use the JMF target values as indicators of central tendency for the following test parameters with associated Action and Suspension Limits:

Control Chart Limits for Individual Measurements		
Sieve	Action Limit	Suspension Limit
3/4 inch (19.0 mm)	±6%	±9%
1/2 inch (12.5 mm)	±6%	±9%
3/8 inch (9.5 mm)	±6%	±9%
No. 4 (4.75 mm)	±6%	±9%
No. 16 (1.18 mm)	±5%	±7.5%
No. 50 (300 μm)	±3%	±4.5%
No. 200 (75 μm)	±2%	±3%
Asphalt Content	±0.45%	±0.70%
VMA	-1.00%	-1.50%

- b. Range.** Control charts for range shall be established to control process variability for the test parameters and Suspension Limits listed below. The range shall be computed for each lot as the difference between the two test results for each control parameter. The Suspension Limits specified below are based on a sample size of $n = 2$. Should the Contractor elect to perform more than two tests per lot, the Suspension Limits shall be adjusted by multiplying the Suspension Limit by 1.18 for $n = 3$ and by 1.27 for $n = 4$.

Control Chart Limits Based on Range	
Sieve	Suspension Limit
1/2 inch (12.5 mm)	11%
3/8 inch (9.5 mm)	11%
No. 4 (4.75 mm)	11%
No. 16 (1.18 mm)	9%
No. 50 (300 μ m)	6%
No. 200 (75 μ m)	3.5%
Asphalt Content	0.8%

- c. **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) One point falls outside the Suspension Limit line for individual measurements or range; or
- 2) Two points in a row fall outside the Action Limit line for individual measurements.

403MR-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 C-100MR.

MATERIAL ACCEPTANCE

403MR-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 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.** Quality assurance testing organizations performing these acceptance tests will be accredited in accordance with ASTM D3666. 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.

b. **Lot Size**

- 1) **Standard lot.** A standard lot will be equal to one day's production. Each unique test item will be considered a subplot within the lot. The rate of testing performed shall be 1 test for each subplot, or 4 tests for each day's production, whichever is more stringent, unless otherwise noted within the specification.

- c. **Asphalt air voids.** Plant-produced asphalt will be tested for air voids on a lot basis. Sampling will be from material deposited into trucks at the plant or from trucks at the job site. Samples will be taken in accordance with ASTM D979.

- 1) **Sampling.** Each lot will consist of equal sublots. Sufficient asphalt for preparation of test specimens for all testing will be sampled by the Engineer on a random basis, in accordance with the procedures contained in ASTM D3665. Samples will be

taken 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 stabilize to compaction temperature. The compaction temperature of the specimens will be as specified in the JMF.

- 2) **Testing.** Air voids will be determined by the Engineer in accordance with ASTM D3203.

The bulk specific gravity of each test specimen will be measured by the Engineer in accordance with ASTM D2726 using the procedure for laboratory-prepared thoroughly dry specimens, or ASTM D1188, whichever is applicable, for use in computing air voids.

For air voids and pavement density, the theoretical maximum specific gravity of the mixture will be measured for each subplot in accordance with ASTM D2041. The value used in the air voids computation for each subplot will be based on the maximum specific gravity measurement performed for the subplot.

- 3) **Acceptance.** Acceptance of plant-produced material for air voids will be determined by the Engineer in accordance with the requirements of paragraph 403MR-6.2b.
- d. In-place asphalt mat and joint density.** Asphalt placed in the field will be tested for mat and joint density on a lot basis. The lot size will be the same as that indicated in paragraph 403MR-6.1b. The average in-place mat and joint densities are expressed as a percentage of the average theoretical maximum density (TMD) for the lot.
- 1) **Mat density.** The lot size will be the same as that indicated in paragraph 403MR-6.1b. One core of finished, compacted asphalt shall be taken by the Contractor from each subplot. Core locations will be determined by the Engineer on a random basis in accordance with procedures contained in ASTM D3665. Cores for mat density shall not be taken closer than one foot (30 cm) from a transverse or longitudinal joint. The minimum core diameter for density determination shall be 5 inches (125 mm).
 - 2) **Joint density.** Longitudinal joints include joints internal to the lot and joints created when paving adjacent to previously placed lots. Core locations will be determined by the Engineer on a random basis in accordance with procedures contained in ASTM D3665, one joint core per subplot for all subplots that contain longitudinal joints. All cores for joint density shall be taken centered on the joint. The minimum core diameter for joint density determination shall be 5 inches (125 mm).
 - 3) **Sampling.** Samples shall be neatly cut with a diamond core drill bit. Samples will be taken in accordance with ASTM D979. The minimum diameter of the sample shall be 5 inches (125 mm). Samples that are defective, as a result of sampling, shall be discarded and another sample taken. The Contractor shall furnish all tools, labor, and materials for cutting samples, cleaning, and filling the cored pavement. Cored pavement shall be cleaned and core holes shall be filled in a manner acceptable to the Engineer and within one day after sampling. Laitance produced by the coring operation shall be removed immediately. The top most lift of asphalt material shall be completely bonded to the underlying layers of asphalt material. If any of the cores reveal that the surface is not bonded to the asphalt layer immediately below the surface, then additional cores shall be taken as directed by

the Engineer in accordance with paragraph 403MR-6.1b to determine the extent of any delamination. The Contractor shall completely remove all delaminated areas by milling to the limits and depth and replaced as directed by the Engineer at no additional cost.

- 4) **Testing.** The bulk specific gravity of each cored sample will be measured by the Engineer in accordance with ASTM D2726. Samples will be taken in accordance with ASTM D979. The percent compaction (density) of each sample will be determined by dividing the bulk specific gravity of each subplot sample by theoretical maximum density (TMD) for the lot, as determined in paragraph 403MR-6.1d(2). The average TMD used to determine the joint density at joints formed between different lots will be the lowest of the TMD values from the two adjacent lots.
- 5) **Acceptance.** Acceptance of field placed asphalt for mat density will be determined by the Engineer in accordance with the requirements of paragraph 403MR-6.2b(3). Acceptance for joint density will be determined by the Engineer in accordance with the requirements of paragraph 403MR-6.2b(3).

403MR-6.2 Acceptance criteria.

- a. **General.** Acceptance will be based on the following characteristics of the asphalt and completed pavement and test results:
 - 1) Air Voids
 - 2) Mat density
 - 3) Joint density
 - 4) Thickness
 - 5) Grade

Air voids will be evaluated for acceptance in accordance with paragraph 403MR-6.1b(2). Mat density will be evaluated for acceptance in accordance with paragraph 403MR-6.2b(2). Joint density will be evaluated for acceptance in accordance with paragraph 403MR-6.2b(3).

Thickness will be evaluated by the Engineer for compliance in accordance with paragraph 403MR- 6.2b(4). Acceptance for grade will be based on the criteria contained in paragraph 403MR-6.2b(5).

The Engineer may at any time reject and require the Contractor to dispose of any batch of asphalt 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 Engineer, and if it can be demonstrated in the laboratory, in the presence of the Engineer, that such material was erroneously rejected, payment will be made for the material at the contract unit price.

- b. **Acceptance criteria.**

- 1) **Air voids.** Acceptance of each lot of plant produced material for air voids will be based upon the average air void from the sublots. If the average air voids of the lot

are equal to or greater than 2% and equal to or less than 5%, then the lot will be acceptable. If the average is below 2% or greater than 5%, the lot shall be removed and replaced at the Contractor's expense.

- 2) **Mat density.** Acceptance of each lot of plant produced material for mat density will be based on the average of all of the densities taken from the sublots. If the average mat density of the lot so established equals or exceeds 96%, the lot will be acceptable. If the average mat density of the lot is below 96%, the lot shall be removed and replaced at the Contractor's expense.
- 3) **Joint density.** Acceptance of each lot of plant produced asphalt for joint density will be based on the average of all of the joint densities taken from the sublots. If the average joint density of the lot so established equals or exceeds 94%, the lot will be acceptable. If the average joint density of the lot is less than 94%, the Contractor shall stop production and evaluate the method of compacting joints. Production may resume once the reason for poor compaction has been determined and appropriate measures have been taken to ensure proper compaction.
- 4) **Thickness.** Thickness of each course will be evaluated by the Engineer for compliance to the requirements shown on the plans. Measurements of thickness will be made by the Engineer using the cores extracted for each subplot for density measurement. The maximum allowable deficiency at any point will not be more than 1/4 inch (6 mm) less than the thickness indicated for the lift. Average thickness of lift, or combined lifts, will not be less than the indicated thickness. Where thickness deficiency exceeds the specified tolerances, 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.
- 5) **Grade.** Grade shall be evaluated prior to the first day of placement and then as a minimum, prior to placement of the surface lift and after the placement of the surface lift to allow adjustments to paving operations if measurements do not meet specification requirements.

The Engineer shall evaluate the finished layer on a 5 foot by 5 foot grid using rod and level, or equivalent, for final grade acceptance. The final finished surface of the pavement of the completed project shall not vary from the gradeline elevations and cross-sections shown on the plans by more than 1/2 inch (12 mm) vertically or 0.1 feet (30 mm) laterally. The documentation, stamped and signed by a licensed surveyor, shall be provided by the Engineer to the Contractor.

Grinding shall be in accordance with paragraph 403MR-4.16. High points may be ground off provided the course thickness after grinding is not more than 1/2 inch (12 mm) less than the thickness specified on the plans.

403MR-6.3 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 Engineer. A retest will consist of all the sampling and testing procedures contained in paragraphs 403MR-6.3. Only one resampling per lot will be permitted.

- 1) A redefined mat density will be calculated for the resampled lot. The number of tests used to calculate the redefined mat density 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 mat density for a resampled lot will be used to evaluate the acceptance of that lot in accordance with paragraph 403MR-6.2.
- c. Outliers.** Check for outliers in accordance with ASTM E178, at a significance level of 5%.

METHOD OF MEASUREMENT

403MR-7.1 Measurement. Plant mix asphalt mix pavement shall be measured by the number of tons of asphalt pavement used in the accepted work. Recorded batch weights or truck scale weights will be used to determine the basis for the tonnage.

BASIS OF PAYMENT

403MR-8.1 Payment. Payment for a lot of asphalt mixture meeting all acceptance criteria as specified in paragraph 403MR-6.2 shall be made at the contract unit price per ton (kg) for asphalt. The price 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.

Payment will be made under:

Item P-403MR-8.1 Hot Mix Asphalt Base Course - per ton

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 C29	Standard Test Method for Bulk Density (“Unit Weight”) and Voids in Aggregate
ASTM C88	Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C117	Standard Test Method for Materials Finer than 75- μ m (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C127	Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate
ASTM C131	Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine

ASTM C136	Standard Test Method for Sieve or Screen Analysis of Fine and Coarse Aggregates
ASTM C142	Standard Test Method for Clay Lumps and Friable Particles in Aggregates
ASTM C183	Standard Practice for Sampling and the Amount of Testing of Hydraulic Cement
ASTM C566	Standard Test Method for Total Evaporable Moisture Content of Aggregate by Drying
ASTM D75	Standard Practice for Sampling Aggregates
ASTM D242	Standard Specification for Mineral Filler for Bituminous Paving Mixtures
ASTM D946	Standard Specification for Penetration-Graded Asphalt Cement for Use in Pavement Construction
ASTM D979	Standard Practice for Sampling Bituminous Paving Mixtures
ASTM D1073	Standard Specification for Fine Aggregate for Bituminous Paving Mixtures
ASTM D1074	Standard Test Method for Compressive Strength of Bituminous Mixtures
ASTM D1461	Standard Test Method for Moisture or Volatile Distillates in Bituminous Paving Mixtures
ASTM D2041	Standard Test Method for Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures
ASTM D2172	Standard Test Method for Quantitative Extraction of Bitumen from Bituminous Paving Mixtures
ASTM D2419	Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate
ASTM D2489	Standard Practice for Estimating Degree of Particle Coating of Bituminous-Aggregate Mixtures
ASTM D2726	Standard Test Method for Bulk Specific Gravity and Density of Non- Absorptive Compacted Bituminous Mixtures
ASTM D2950	Standard Test Method for Density of Bituminous Concrete in Place by Nuclear Methods
ASTM D3203	Standard Test Method for Percent Air Voids in Compacted Dense and Open Bituminous Paving Mixtures

ASTM D3381	Standard Specification for Viscosity-Graded Asphalt Cement for Use in Pavement Construction
ASTM D3665	Standard Practice for Random Sampling of Construction Materials
ASTM D3666	Standard Specification for Minimum Requirements for Agencies Testing and Inspecting Road and Paving Materials
ASTM D4125	Standard Test Methods for Asphalt Content of Bituminous mixtures by the Nuclear Method
ASTM D4318	Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D4552	Standard Practice for Classifying Hot-Mix Recycling Agents
ASTM D4791	Standard Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate
ASTM D4867	Standard Test Method for Effect of Moisture on Asphalt Concrete Paving Mixtures
ASTM D5444	Standard Test Method for Mechanical Size Analysis of Extracted Aggregate
ASTM D5581	Standard Test Method for Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus (6 inch-Diameter Specimen)
ASTM D5821	Standard Test Method for Determining the Percentage of Fractured Particles in Coarse Aggregate
ASTM D6307	Standard Test Method for Asphalt Content of Hot-Mix Asphalt by Ignition Method
ASTM D6373	Standard Specification for Performance Graded Asphalt Binder
ASTM D6752	Standard Test Method for Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Automatic Vacuum Sealing Method
ASTM D6925	Standard Test Method for Preparation and Determination of the Relative Density of Hot Mix Asphalt (HMA) Specimens by Means of the SuperPave Gyrotory Compactor
ASTM D6995	Standard Test Method for Determining Field VMA based on the Maximum Specific Gravity of the Mix (Gmm)
ASTM E11	Standard Specification for Woven Wire Test Sieve Cloth and Test Sieves
ASTM E178	Standard Practice for Dealing with Outlying Observations

ASTM E2133	Standard Test Method for Using a Rolling Inclinometer to Measure Longitudinal and Transverse Profiles of a Traveled Surface
American Association of State Highway and Transportation Officials (AASHTO)	
AASHTO M156	Standard Specification for Requirements for Mixing Plants for Hot-Mixed, Hot-Laid Bituminous Paving Mixtures
AASHTO T329	Standard Method of Test for Moisture Content of Hot Mix Asphalt (HMA) by Oven Method
AASHTO T 340	Standard Method of Test for Determining the Rutting Susceptibility of Hot Mix Asphalt (APA) Using the Asphalt Pavement Analyzer (APA)
Asphalt Institute (AI)	
MS-2	Mix Design Manual, 7th Edition
MS-26	Asphalt Binder Handbook AI State Binder Specification Database
FAA Orders	
5300.1	Modifications to Agency Airport Design, Construction, and Equipment Standards

END OF SECTION P-403MR

Start Revision 1, 1/21/2019

Item P-603MR Bituminous Tack Coat

DESCRIPTION

603MR-1.1 This item shall consist of preparing and treating a bituminous surface with bituminous material in accordance with these specifications and in reasonably close conformity to the lines shown on the plans.

603MR-1.2 Submittals. Submit the following in accordance with Section 61MR Submittal Procedures

a. SD-03 Product Data

- 1) **Bituminous Tack Coat.** Contractor shall provide cut sheet for tack coat to be provided.

MATERIALS

603MR-2.1 Bituminous materials. The bituminous material shall be an asphalt cement conforming to ASTM D6373 as a bituminous application for tack coat appropriate to local conditions or as designated by the Engineer. The grade of the asphalt cement shall be PG 64-22.

CONSTRUCTION METHODS

603MR-3.1 Weather limitations. The tack coat shall be applied only when the existing surface is dry; the atmospheric temperature is 50°F or above, and the temperature has not been below 35°F for the 12 hours prior to application; and when the weather is not foggy or rainy. The temperature requirements may be waived when directed by the Engineer.

603MR-3.2 Equipment. The Contractor shall provide equipment for heating and applying the bituminous material.

Provide a distributor with pneumatic tires of such size and number that the load produced on the base surface does not exceed 65.0 psi of tire width to prevent rutting, shoving or otherwise damaging the base, surface or other layers in the pavement structure. Design and equip the distributor to spray the bituminous material in a uniform coverage at the specified temperature, at readily determined and controlled rates from 0.05 to 0.10 gallons per square yard, with a pressure range of 25 to 75 psi and with an allowable variation from the specified rate of not more than $\pm 5\%$, and at variable widths. Include with the distributor equipment a separate power unit for the bitumen pump, full-circulation spray bars, tachometer, pressure gauges, volume-measuring devices, adequate heaters for heating of materials to the proper application temperature, a thermometer for reading the temperature of tank contents, and a hand hose attachment suitable for applying

bituminous material manually to areas inaccessible to the distributor. Equip the distributor to circulate and agitate the bituminous material during the heating process. If the distributor is not equipped with an operable quick shutoff valve, the prime operations shall be started and stopped on building paper. The Contractor shall remove blotting sand prior to asphalt concrete lay down operations at no additional expense to the Owner.

603MR-3.3 Application of bituminous material. Immediately before applying the tack coat, the full width of the surface shall be swept with a power broom to remove all loose dirt and other objectionable material.

The bituminous material including vehicle shall be uniformly applied with a bituminous distributor at the rate of 0.05 to 0.10 gallons per square yard depending on the condition of the existing surface. The type of bituminous material and application rate shall be approved by the Engineer prior to application. Apply the bituminous material to the underlying surface evenly in a uniform coat.

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 Engineer. The Contractor shall protect the tack coat and maintain the surface until the next course has been placed.

603MR-3.4 Freight and weigh bills. The Contractor shall submit waybills and delivery tickets during the progress of the work. Before the final estimate is allowed, file with the Engineer certified waybills and certified delivery tickets for all bituminous materials used in the construction of the pavement covered by the contract. Do not remove bituminous material from storage until the initial outage and temperature measurements have been taken. The delivery or storage units will not be released until the final outage has been taken.

METHOD OF MEASUREMENT

603MR-4.1 The bituminous material for tack coat shall be measured by the gallon. Volume shall be corrected to the volume at 60°F in accordance with ASTM D1250. The bituminous material paid for will be the measured quantities used in the accepted work, provided that the measured quantities are not 10% over the specified application rate. Any amount of bituminous material more than 10% over the specified application rate for each application will be deducted from the measured quantities, except for irregular areas where hand spraying of the bituminous material is necessary.

BASIS OF PAYMENT

603MR-5.1 The cost of P-603 installation is incidental to installation of Item P-401. The price for installation of the lighting system 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.

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 D633 | Standard Volume Correction Table for Road Tar |
| ASTM D1250 | Standard Guide for Use of the Petroleum Measurement Tables |
| ASTM D6373 | Standard Practice for Selection and Use of Emulsified Asphalts |

END OF SECTION P-603MR

End Revision 1, 1/21/2019

Item P-620MR Pavement Marking

DESCRIPTION

620MR-1.1 This item shall consist of the preparation and painting of numbers, markings, and stripes on the surface of runways, taxiways, and aprons, in accordance with these specifications and at the locations shown on the plans, or as directed by the Engineer. The terms “paint” and “marking material” as well as “painting” and “application of markings” are interchangeable throughout this specification.

620MR-1.2 Submittals. Submit the following in accordance with Section 61MR Submittal Procedures

a. SD-03 Product Data

- 1) **Marking materials data.** Contractor to provide manufacturer’s product information as per Paragraph 620MR-2.1
- 2) **Construction equipment list.** Contractor to provide the list of proposed equipment to be used in the performance of construction work, including descriptive data, shall be approved by the Engineer prior to use on the project

MATERIALS

620MR-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 and application requirements must be submitted and approved by the Engineer prior to the initial application of markings. The reports can be used for material acceptance or the Engineer may perform verification testing. The reports shall not be interpreted as a basis for payment. The Contractor shall notify the Engineer 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 Engineer. Material shall not be loaded into the equipment until inspected by the Engineer.

620MR-2.2 Marking materials. Paint shall be waterborne in accordance with the requirements of paragraph 620MR-2.2a. Paint shall be furnished in White – 37925, Blue – 15056, and Yellow 33538 or 33655 in accordance with Federal Standard No. 595.

- a. Waterborne.** Paint shall meet the requirements of Federal Specification TT-P-1952E, Type I. 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.

620MR-2.3 Reflective media. Glass beads are not required.

CONSTRUCTION METHODS

620MR-3.1 Weather limitations. Painting shall only be performed when the surface is dry, and the ambient temperature and the pavement surface temperature meet the manufacturer's recommendations in accordance with paragraph 620MR-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 inclement weather is imminent within the recommended application curing time.

620MR-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 atomizing 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.

620MR-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 foreign material 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 and blower, water blasting, or by other methods approved by the Engineer to remove all contaminants, including PCC curing compounds, without damage to the pavement surface.
- b. **Preparation of pavement to remove existing markings.** Existing pavement markings shall be removed by rotary grinding or by other methods approved by the 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 with a method as approved by the Engineer. After removal, the surface shall be cleaned of all residue or debris.

Prior to the initial 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 manufactures application and surface preparation requirements must be submitted to the Engineer prior to the initial application of markings.

620MR-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 shown on the plans.

620MR-3.5 Application. Paint shall be applied at the locations and to the dimensions and spacing shown on the plans. Paint shall not be applied until the layout and condition of the surface has been approved by the Engineer. The edges of the markings shall not vary from a straight line more than 1/2 inch (12 mm) in 50 feet (15 m), and marking dimensions and spacings shall be within the following tolerances:

Dimension and Spacing	Tolerance
36 inch (910 mm) or less	±1/2 inch (12 mm)
greater than 36 inch to 6 feet (910 mm to 1.85 m)	±1 inch (25 mm)
greater than 6 feet to 60 feet (1.85 m to 18.3 m)	±2 inch (50 mm)
greater than 60 feet (18.3 m)	±3 inch (76 mm)

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. The addition of thinner will not be permitted. A period of 30 days shall elapse between placement of an asphalt surface course or seal coat and application of the paint.

Table 1. Application Rates for Paint and Glass Beads
(See Note regarding Red and Pink Paint)

Paint Type	Paint Square feet per gallon, ft ² /gal (Sq m per liter, m ² /l)	Glass Beads, Type I, Gradation A Pounds per gallon of paint-lb/gal (Kg per liter of paint-kg/l)
Waterborne Type I or II	115 ft ² /gal max (2.8 m ² /l)	7 lb/gal min (0.85 kg/l)

Note: The 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. Glass beads shall not be used in black and green paint.

Glass beads shall be distributed upon the marked areas at the locations shown on the plans 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. 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.

620MR-3.6 Preformed thermoplastic pavement markings are not allowed.

620MR-3.7 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 or unadhered reflective media, and by-products generated by the surface preparation and application operations to the satisfaction of the 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

620MR-4.1 The quantity of pavement markings to be paid for shall be lump sum price performed in accordance with the specifications and accepted by the Engineer.

BASIS OF PAYMENT

620MR-5.1 Payment shall be made at the respective contract price for lump sum price. This price shall be full compensation for furnishing all materials and for all labor, equipment, tools, and incidentals necessary to complete the item.

Payment will be made under:

Item P-620MR-5.1-1 Surface Preparation lump sum

Item P-620MR-5.1-2 Pavement Marking lump sum

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 D476	Standard Classification for Dry Pigmentary Titanium Dioxide Products
ASTM D968	Standard Test Methods for Abrasion Resistance of Organic Coatings by Falling Abrasive
ASTM D1652	Standard Test Method for Epoxy Content of Epoxy Resins
ASTM D2074	Standard Test Method for Total, Primary, Secondary, and Tertiary Amine Values of Fatty Amines by Alternative Indicator Method
ASTM D2240	Standard Test Method for Rubber Property - Durometer Hardness
ASTM D7585	Standard Practice for Evaluating Retroreflective Pavement Markings Using Portable Hand-Operated Instruments
ASTM E303	Standard Test Method for Measuring Surface Frictional Properties Using the British Pendulum Tester
ASTM E1710	Standard Test Method for Measurement of Retroreflective Pavement Marking Materials with CEN-Prescribed Geometry Using a Portable Retroreflectometer
ASTM E2302	Standard Test Method for Measurement of the Luminance Coefficient Under Diffuse Illumination of Pavement Marking Materials Using a Portable Reflectometer

ASTM G154 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 Specifications (FED SPEC)

FED SPEC TT-B-1325D

Beads (Glass Spheres) Retro-Reflective

FED SPEC TT-P-1952E

Paint, Traffic and Airfield Marking, Waterborne

FED STD 595

Colors used in Government Procurement

Commercial Item Description

A-A-2886B

Paint, Traffic, Solvent Based

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

END OF SECTION P-620MR