RESEARCH REPORT 1419-F

PROPOSED GENERAL AVIATION CONSTRUCTION SPECIFICATIONS FOR TEXAS AIRPORTS

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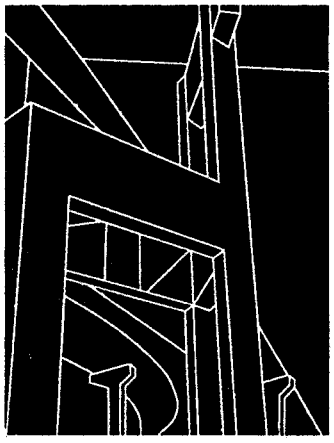

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16. Abstract

The Center for Transportation Research (CTR) performed a systematic review of applicable specifications in the Texas Department of Transportation (TxDOT) standard specifications book, "Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges," and those subsequently adopted Special Specifications that may be applicable to airport construction. This work continued the efforts begun under Project 2920, which was aimed at securing Federal Aviation Administration (FAA) approval of revised asphalt and base material specifications for general aviation airport construction. Existing TxDOT highway specifications were evaluated to determine if any current specifications would improve the performance or reduce the costs of airport construction. Revised specifications were prepared based on laboratory testing, current existing specifications, and input from industry representatives.

Initially, a series of meetings were held with the Project Director, FAA representatives, a TxDOT advisory committee, and consulting engineers experienced in construction of general aviation airports. The specifications under consideration were identified by item number and prioritized for study. Corresponding FAA specifications were identified for inclusion into the evaluation and comparison study.

An effort was made with all specifications to keep revisions as compatible as possible with existing TxDOT and FAA specifications, as well as with the requirements for good construction practices relating to general aviation airports.

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Research Project 0-1419
Consolidation of Aviation and Highway Construction Specifications

conducted for the

TEXAS DEPARTMENT OF TRANSPORTATION

in cooperation with the

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Federal Highway Administration

by the

CENTER FOR TRANSPORTATION RESEARCH
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IMPLEMENTATION STATEMENT

The Texas Department of Transportation (TxDOT) Aviation Division has recently been given block grant authority from FAA for funding airport improvement projects (AIP) within the state with the provision that FAA approved specifications be used. These FAA specifications were developed primarily for larger air carrier airports and must be broad enough to allow construction anywhere in the United States. However, the specifications are often excessively conservative and too costly for general aviation airports. Often a specification with an awareness of local materials, procedures, and climatic conditions can provide equal or better performance at greatly reduced cost.

If TxDOT highway specifications could be adopted or modified for TxDOT Aviation Division use at general aviation airports without sacrificing quality, there is a very high potential for significant cost savings.

The Center for Transportation Research (CTR) performed a systematic review of applicable TxDOT and FAA specifications as prioritized by the Project Director. As a result of this review, new specifications were drafted and current specifications were, in some cases, revised or recommended for use as currently written. With the successful FAA approval of these specifications, the unit costs for airport construction could be significantly reduced.

Prepared in cooperation with the Texas Department of Transportation and the U.S. Department of Transportation, Federal Highway Administration.

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The authors gratefully acknowledge the assistance and guidance provided by B. Fuller, TxDOT Project Director for this study.

DISCLAIMERS

The contents of this report reflect the views of the authors, who are responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official views or policies of the Texas Department of Transportation. This report does not constitute a standard, specification, or regulation.

There was no invention or discovery conceived or first actually reduced to practice in the course of or under this contract, including any art, method, process, machine, manufacture, design or composition of matter, or any new and useful improvement thereof, or any variety of plant, which is or may be patentable under the patent laws of the United States of America or any foreign country.

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BIDDING, OR PERMIT PURPOSES

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SUMMARY

The Center for Transportation Research (CTR) performed a systematic review of applicable specifications in the Texas Department of Transportation (TxDOT) standard specifications book, "Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges," and those subsequently adopted Special Specifications that may be applicable to airport construction. This work continued the efforts begun under Project 2920, which was aimed at securing Federal Aviation Administration (FAA) approval of revised asphalt and base material specifications for general aviation airport construction. Existing TxDOT highway specifications were evaluated to determine if any current specifications would improve the performance or reduce the costs of airport construction. Revised specifications were prepared based on laboratory testing, current existing specifications, and input from industry representatives.

Initially, a series of meetings were held with the Project Director, FAA representatives, a TxDOT advisory committee, and consulting engineers experienced in construction of general aviation airports. The specifications under consideration were identified by item number and prioritized for study. Corresponding FAA specifications were identified for inclusion into the evaluation and comparison study.

An effort was made with all specifications to keep revisions as compatible as possible with existing TxDOT and FAA specifications, as well as with the requirements for good construction practices relating to general aviation airports.

CHAPTER 1. INTRODUCTION

PURPOSE

The Texas Department of Transportation (TxDOT) Aviation Division is responsible for the planning and implementation of all public airport improvement projects within the state of Texas, except those designated as air carrier or reliever. All air carrier and reliever airports work directly with the Federal Aviation Administration (FAA) for their airport improvement projects. The FAA Airport Improvement Program (AIP) is the major source of funding for most airport pavement construction. This includes new construction and major rehabilitation of both asphalt and Portland cement concrete systems. In order to receive this federal funding, there is the requirement that FAA approved specifications are used in order to ensure that a quality product is constructed.

The FAA specifications were developed primarily for larger air carrier airports and must necessarily be broad enough to allow for their use anywhere in the United States. However, this additionally requires that the specifications sometimes be excessively conservative and too costly for general aviation projects and do not take into account local climatic conditions and the use of adequate local materials and procedures. Most general aviation airport pavements with traffic loads up to a maximum of 60,000 pounds gross aircraft weight are similar to light duty highway pavements. Although the FAA has a very limited budget for research and specification development and must rely on military airports and the US Corps of Engineers, it is still reluctant to allow all states to adopt their own specifications without assurance of their ability to perform satisfactorily in delivering the specified product.

The concerns for attempting to use FAA specifications for utility category airports began to become more focused when the new FAA P-401 "Plant Mix Bituminous Pavement Specifications," for asphalt construction was developed which placed the responsibility for quality control and quality assurance more on the contractor with incentives and disincentives dependent upon the quality of the constructed product. The resultant specification preceded the information and knowledge developed with the $50 million Strategic Highway Research Program's (SHRP) asphalt research study. The implementation of the latest revision of the national P-401 specification and the revocation of the regional P-401SW caused significant complaints from contractors, engineers and TxDOT on the ability of the pavements constructed to meet the percent within limits criteria for full payment.

Despite their reluctance, the FAA recognizes that the Texas Department of Transportation is a solid leader in pavement technology with an ongoing pavement research budget greater than that of the FAA. In addition, The Asphalt Research Program through the Center of Transportation

(CTR) at the University of Texas at Austin, was the prime contractor in the SHRP asphalt research and is now working closely with TxDOT in implementing the information, designs and procedures developed in SHRP. This knowledge allowed the FAA to proceed as a partner with the Aviation Division of TxDOT in funding research to be conducted by the aviation section of CTR in developing both asphalt and base specifications for those general aviation airports that are a part of TxDOT's responsibility. These specifications together with a compilation of the TxDOT test methods were reported in Research Report 2920-1F, "Proposed Asphalt and Base Specifications for TxDOT General Aviation Construction" (Ref. 1).

FAA is allowing the use of these specifications on an individual approval basis. TxDOT's Aviation Division has used their unmodified version of the hot-mix asphalt specification for three years and determined that there are a number of sections of the specification requiring changes of varying degree. The need for these changes resulted in a revision of the specification which is now being used by the department for hot-mix asphalt paving mixtures.

One determining factor in using the TxDOT specifications modified to apply to general aviation construction projects was the concept that the number of contractors familiar with TxDOT specifications would increase the competition for the work thereby effecting some degree of savings. Because of this potential benefit plus the metrication of TxDOT specifications, the department decided to review other specification standards for modification.

PROJECT SCOPE

The research team has worked closely with TxDOT, FAA, consulting engineers and laboratories, and industry personnel to review and evaluate existing TxDOT specifications for applicability to airport construction. It was anticipated that any modifications would result in the pertinent parts of the FAA specifications and any applicable industry standards being considered for becoming part of either a modified or new TxDOT standard specification.

The primary objectives of this project were to:

Evaluate and Compare Specifications. Continue efforts started under Research Project 2920 to aid in the implementation of the recommended revised asphalt and base specifications developed in that study for general airport construction. A detailed review of TxDOT specifications, FAA specifications and pertinent specifications from other organizations has been made to determine additional candidates for revision. This review was submitted to the Project Director for final selection and guidance together with an evaluation of the potential effect that may be anticipated with the revisions.

Prepare Draft TxDOT Specifications. Selected specifications were reviewed to determine which portions need revision and if there were sections that need to be deleted for the specification to properly apply to general aviation airport construction. Where possible, the TxDOT specification format was used and contain those modifications determined by that review plus those portions of the FAA specifications to yield a specification capable of providing the quality of construction desired. The revised specifications utilize TxDOT test methods to provide continuity for a broad base of bidding contractors.

Conduct Training. If the Project Director desires, training seminars and demonstration projects with the new specifications will be conducted.

ORGANIZATION OF REPORT

Chapter 2 describes the primary activities of the Research Team, Chapter 3 discusses the new specifications developed in this project. Chapter 4 presents the TxDOT specifications that can be used as written or with minor modifications and Chapter 5 discusses specifications investigated but not recommended for revision at this time.

Appendix A through L, following Chapter 5, include the complete specifications developed for this project.

CHAPTER 2. RESEARCH ACTIVITIES

The Center for Transportation Research (CTR) performed a systematic review of applicable specifications in the Texas Department of Transportation (TxDOT) standard specifications book titled "Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges" and those subsequently adopted Special Specifications that may be applicable to airport construction. This work continues the efforts began under Project 2920 which was aimed at securing Federal Aviation Administration (FAA) approval of revised asphalt and base material specifications for general aviation airport construction. Existing TxDOT highway specifications were evaluated to determine if any current specifications would improve the performance or reduce costs of airport construction. Revised specifications were prepared based upon laboratory testing, current existing specifications, and input from industry representatives.

Initially, a series of meetings were held with the Project Director, FAA representatives, a TxDOT advisory committee, and consulting engineers experienced in construction of general aviation airports. The specifications under consideration were identified by item number and prioritized for study. Corresponding FAA specifications were identified for inclusion into the evaluation and comparison study.

The TxDOT Microsurfacing Specificaton (Item 3042) and FAA-SW Micro-Surfacing Specifications were compared and also compared to the recommended guidelines published by the International Slurry Surfacing Association.

TxDOT specification, Item 506, "Temporary Erosion, Sedimentation, and Water Pollution Prevention and Control", was reviewed and compared to the FAA specification, Item P-156, "Temporary Air and Water Pollution, Soil Erosion, and Siltation Control".

The TxDOT fencing specifications for highways, Item 550, "Chain Link Fence" and Item 552, "Wire Fence" were compared to the FAA fencing specifications, Items F-160, F-161, and F-162.

The development of draft airport construction specifications, Item 132X, "Excavation and Embankment", Item 316X, "Modified Surface Treatment for Airports", Item 352X A/P, "Cleaning and/or Sealing Joints and Cracks (Asphaltic Concrete)", Item 433X A/P, "Cleaning and/or Sealing Joints and Cracks (Portland Cement Concrete)", and Item 626TEX, "Emulsified Asphalt Slurry Seal Surface Treatment" for the construction of airport facilities for TxDOT is based upon applicable or similar specifications from the FAA and pertinent TxDOT specifications.

The following TxDOT and FAA drainage specifications were reviewed:

TxDOT Specifications

Item 462, "Concrete Box Culverts and Sewers"

Item 464, "Reinforced Concrete Pipe"

Item 465, "Manholes and Inlets"

Item 466, "Headwalls and Wingwalls"

Item 467, "Safety End Treatment"

Item 471, "Frames, Grates, Rings, and Covers"

Item 472, "Removing and Relaying Culvert and Storm Sewer Pipe"

Item 473, "Laying Culvert and Storm Sewer Pipe"

Item 474, "Slotted Drain"

Item 476, "Jacking, Boring or Tunneling Pipe"

Item 480, "Cleaning Existing Culverts"

FAA Specifications

Item D-701, "Pipe for Storm Drains and Culverts"

Item D-705, "Pipe Underdrains for Airports"

Item D-751, "Manholes, Catch Basins, Inlets and Inspection Holes"

Item D-752, "Concrete Culverts, Headwalls, and Miscellaneous Drainage Structures"

Item D-754, "Concrete Gutters, Ditches, and Flumes"

The TxDOT specification Item 666, "Reflectorized Pavement Markings", and the FAA specification Item P-620, "Runway and Taxiway Painting", were thoroughly reviewed. Our conclusion is that either the federal specification or the TxDOT departmental specification could be used at the discretion of TxDOT's aviation personnel.

The Item P-503, "Interlocking Concrete Paver Block Construction" specification was written as a compromise between the Interlocking Concrete Paver Institute, P-502 Specification which was used at the Dallas/Fort Worth International Airport and the Florida DOT, P-500 specification used with FAA approval for general aviation aprons in Florida. This specification was written to be used for aircraft or vehicle traffic. This specification could be used for aircraft of any

weight, but like the ICPI specification is specifically not recommended for runways or areas where full aircraft power or reverse jet thrust is encountered.

We investigated the possibility of using TxDOT specifications Item 260, "Lime Treatment for Materials used as Subgrade (Road Mixed)" and Item 264, "Lime and Lime Slurry" for lime stabilized subgrade in place of FAA Item P-155 for construction of general aviation airports in Texas. The objective was to provide contractors with an alternate specification that is widely used in Texas for highway construction with excellent results. The advantage of using the TxDOT specification might in certain situations be a small cost saving or added flexibility for construction.

It was concluded that the TxDOT Item 260 or Item 264 could be substituted for the FAA Item P-155 with no significant degradation in strength or durability. Therefore, it is recommended that for general aviation construction, the contractor be allowed to use either specification.

Another TxDOT specification considered is Item 300, "Asphalts, Oils and Emulsions". No action is recommended at this time since the Department is in the process of changing to the PG grading system developed by the Superpave program and being adopted by FHWA and TxDOT.

This chapter contains a general overview of the activities of the research group at the Center for Transportation Research which reviewed and evaluated TxDOT specifications that might be applicable to airport construction. Some new draft specifications have been written for use by the Aviation Division and are discussed in Chapter 3. In addition, the specifications are included as Appendices A through L. Chapter 4 discusses the TxDOT specifications that are recommended for use as they are currently written. Chapter 5 discusses specifications that were reviewed but not recommended for use or revision at this time.

CHAPTER 3. NEW RECOMMENDED SPECIFICATIONS FOR GENERAL AVIATION AIRPORT CONSTRUCTION

Texas Department of Transportation (TxDOT) developed two new hot-mix asphalt specifications when revising Special Specification 3063, SS 3116 version with English measurements and SS 3022 with metric values. Both versions were rewritten as specifications for general aviation airport construction and are identified as SS 3116A/P and SS 3022A/P.

The concrete pavement specification was not revised as a part of this study since it was determined that another major study for TxDOT is presently underway to revised the concrete pavement specification in an QC/QA format.

At the request of the Project Director a visit by the research team was made to the Burnet County airport to inspect the condition of the coal tar sealer and rejuvenator that had been applied to the runways and taxiways. Visual comparisons were made between those surfaces receiving the applications and areas that had been omitted due to seasonal weather changes. The improvement in appearance was readily apparently and close examination revealed the treated sections were in better condition than the untreated even though both were constructed at the same time.

An effort was made with all specifications to keep revisions as compatible as possible with existing TxDOT, FAA specifications, and the requirements for good construction practices on general aviation airports. Excavation and Embankment are two separate specifications for TxDOT but only one specification in FAA. The revisions for these items were combined into a single specification, Item 132X A/P "Excavation and Embankment." In a similar manner, the multiple specifications used by TxDOT for Surface Treatments were compared to a single FAA specification. Item 316X is a combination into a single specification for ordinary surface treatments.

The new draft specifications developed for this project are listed below:

Special Specification 3116 A/P	"Quality Control/Quality Assurance of Hot Mix Asphalt for airfield Pavements"-- English version
Special Specification 3022 A/P	"Quality Control/Quality Assurance of Hot Mix Asphalt for Airfield Pavements"-- Metric version
Special Specification 132X A/P	"Excavation and Embankment"
Special Specification 314X A/P	"Emulsified Asphalt Treatment"
Special Specification 315X A/P	"Asphalt Seal/Prime Coat"
Special Specification 316X A/P	"Modified Surface Treatments for Airports"
Special Specification 31XX A/P	"Emulsified Asphalt Slurry Seal Surface Treatment"
Special Specification 3042 A/P	"Micro-Surfacing (Polymer Modified) for Airport Construction"

Special Specification 30XX A/P "Coal Tar Sealer/Rejuvenator"
Special Specification 352X A/P "Cleaning and/or Sealing Joints and Cracks (Asphaltic Concrete)"
Special Specification 433X A/P "Cleaning and/or Sealing Joints and Cracks (Portland Cement Concrete)"
Item P-503 "Interlocking Concrete Paver Block Construction"

The includes the complete specifications as listed above are included as Appendices A through L.

Discussion of pertinent facets of the draft specifications follows below.

Item 132X/AP, "Excavation and Embankment"

FAA P152 has the same title but is difficult to follow. TxDOT uses two specifications, Item 110, "Excavation" and Item 132, "Embankment" to cover basically the same work but these have been combined here. The material quality requirements and definitions in the recommended specification are those from TxDOT. These have been worked into the fabric of the FAA specification that has been reformatted to clearly show separate articles for the two operations.

Item 316X, "Modified Surface Treatments for Airports"

Both FAA P609, "Seal Coats and Bituminous Surface Treatments" and TxDOT Item 316, "Surface Treatments" are the basis for this specification. The material qualities and grading types and identifications are from TxDOT Item 316. In addition, provisions for using or requiring precoated aggregate are a part of the modified specification. The gradings in FAA P609 were compare to those in the TxDOT aggregate specification and it was determined that TxDOT grades 3, 4, and 5 were practically identical. These were used together with the FAA recommended application rates.

Seal costs are ordinarily not the recommended paving method for airport runways. However, the use of precoated stone or the application of a cape seal may sometimes be the most economic choice in may locations. It is therefore recommended that this specification be made part of the airport standards.

Item 352X A/P, "Cleaning and/or Sealing Joints and Cracks (Asphaltic Concrete)"

FAA P609, "Joint Sealing Filler," is a specification covering materials for both asphalt and Portland cement concrete pavements. Modifying this specification was easier to accomplish by separating the two types of pavement. TxDOT's standard specification Item 352 has been used as the format with materials accepted for use in Texas on asphaltic concrete pavements. This specification has greater definition of the joint sealing materials than the FAA specification.

This recommended specification also includes materials for the sealing of cracks as well as for sealing the joints.

Item 433X A/P, "Cleaning and/or Sealing Joints and Cracks (Portland Cement Concrete)"

The problems noted with the FAA P609 specification with asphalt also apply to Portland cement concrete pavements. The TxDOT specifications have greater definition for the materials and the methods for using them. The FAA specification had a more in depth description for applying preformed joint sealant and was incorporated into this specification.

This recommended specification also combines two TxDOT specifications, Item 433, "Joint Sealants and Fillers," and Item 438, "Cleaning and/or Sealing Joints and Cracks (Portland Cement Concrete)." Both of these specifications are intended to be used with Portland cement concrete and, therefore, the combination formed a more complete basis for this specification.

Item 31XX, "Emulsified Asphalt Slurry Seal Surface Treatment"

This recommended specification is basically the same as the FAA specification P626 except the material requirements are changed to refer to TxDOT standard specification items, Item 300, "Asphalts, Oils and Emulsions" and Item 302, "Aggregate for Surface Treatments." As previously noted, test methods have been changed to reflect the TxDOT procedures and the measurement and payment articles compatible with the standard language in the TxDOT specifications.

P-503 Interlocking Concrete Paver Block Construction Specification

The P-503 Interlocking Concrete Paver Block Construction Specification was written as a compromise between the Interlocking Concrete Paver Institute, P-502 Specification that was used in Dallas/Fort Worth International Airport and the Florida DOT, P-500 Specification used with FAA Approval for general aviation aprons in Florida.

The following changes were made to the two previously FAA approved specifications.

Section 1.0 Description

Unlike the two previous specifications, this specification was written to be used for aircraft or vehicle traffic. The Florida specification was written only for general aviation aprons. The ICPI specification is written for any weight aircraft. This specification could be used for aircraft of any weight, but like the ICPI specification is specifically not recommended for runways or areas where full aircraft power or reverse jet thrust is encountered.

Section 2.0 Materials

This section essentially uses the more stringent ICPI specifications.

Hard face or coated pavers with special finishes shall not be used. In the future it is possible and feasible to manufacture concrete pavers with glass bead impregnation or have pavers with the color of yellow stripes. This could be approved for use only with FAA subsequent

approval. There are pavers that are commercially available that use a procedure in manufacture to save cost that hardens only the face of the block paver, these pavers are specifically excluded from this specification.

Typical edge restraints referred to in the ICPI specification are shown in the specification. However, there is a need for aircraft pavements to allow free draining at the edge and a raised rather than flush edge restraint is not recommended. The Engineer must specify the edge restraint.

The ICPI shape language was rewritten to include the type A block shape classification for aircraft trafficked pavers of the Cement and Concrete Association of Australia. The spirit of this language was rewritten to include fully interlocking blocks. Square shaped blocks should not be used. Rectangular blocks such as those used at DFW are also acceptable. However, the fully interlocking patterns available may provide better resistance to aircraft braking and turning of large aircraft when necessary.

The Florida DOT specification for Geotextiles was used.

Section 3.0 Initial Acceptance Requirements

This section is essentially from the ICPI specification with a few modifications in lot sizes and language.

The statement of Contractor Qualifications is identical to both Florida and ICPI statements but provides an opening for small jobs of less than 300,000 square feet that the contractor only has to have experience in the preceding 12 months of a job of equal size.

The test strip size of 10 feet by 10 feet was used rather than the Florida DOT size of 20 feet by 20 feet.

Section 4.0 Material Acceptance

The Florida DOT procedure allows Contractor Testing while the ICPI procedure requires independent Engineer testing at the engineer's expense. The ICPI procedures are generally followed in this section with changes in lot sizes.

After some discussion of the Abrasion Resistance of Concrete Pavers it was decided to keep ASTM Specification C-140 rather than substitute ASTM C-944. The Sand Blasting specification C-140 for abrasion resistance of concrete pavers can be too harsh based upon the experience of Texas suppliers. From the construction of many concrete paver sections in Texas, the experience is usually to waive the test requirements. The specification is tougher than normal 8000 psi concrete or paver blocks. The ASTM C-140 results for concrete pavers are nearly the same as pure granite but do not meet the initial ICPI standard. A substitute test by the rotary hammer method could be used if there is doubt in the quality of the pavers being delivered.

Section 5.0 Delivery, Storage and Handling (same as ICPI)

Section 6.0 Installation

This section is essentially the ICPI specification.

It is recommended that one inch maximum thickness of bedding sand be used for heavier aircraft loading from field test results at Waterways Experiment Station.

CHAPTER 4. CURRENT TXDOT SPECIFICATIONS RECOMMENDED FOR USE

Several TxDOT specifications found in the 1995 Standard Specification book (red book) and currently in use for highway construction were reviewed and are recommended for use as written or with minor modifications. These specifications, by category, are listed below.

MICRO-SURFACING SPECIFICATIONS

The two subject specifications have been compared and they have also been compared to the recommended guidelines published by the International Slurry Surfacing Association. As anticipated, there is considerable commonality between the three documents. In fact there are paragraphs in the TxDOT and the FAA-SW specifications that are exactly the same indicating that they were probably based on the same parent specification.

After making these comparisons it is recommended that the TxDOT specification be the one used for the following reasons:

- Both the FAA and Industry specs call for the asphalt emulsion to be a CSS-1h. This is a slightly harder (less viscous) asphalt than the CSS-1P required by TxDOT. The CSS-1P should produce a less stiff pavement which will resist aging and low temperature cracking better than CSS-1h.

- All of the specifications have a requirement for a minimum polymer residue amount after distillation. TxDOT requires a minimum of 3.0% versus 2.5% for FAA and Industry.

- Although TxDOT has aggregate gradations limits slightly larger than the other specs, the middle of all of them are practically identical. The TxDOT spec has a tighter tolerance on each sieve size and requires a higher sand equivalent which will also benefit durability.

- The mineral filler requirement in the FAA and Industry spec allows Portland cement, lime and limestone dust whereas TxDOT restricts this item to non-air-entrained Portland cement only.

- The FAA and Industry specifications require that the Marshall test be performed to determine that a minimum stability value of 1800 and a flow of 8 to 16 units be provided. TxDOT states that a minimum Hveem stability value will be required only when stated on the plans.

- Both specs restrict the asphalt content tolerance to ±0.5% by weight. However, the design limits for TxDOT are 6 to 9% by weight of the dry aggregate versus 6 to 12% for FAA. This should make the TxDOT specification a little more likely to be uniform.

The actual construction requirements are very similar and, as previously stated, sometimes identical. The FAA specification does have one requirement that should be incorporated into a

general aviation use of the TxDOT specification and that is the requirement to seal existing cracks if needed prior to applying the micro-surface.

FENCING SPECIFICATIONS

After careful review of the TXDOT fencing specifications (Items 550 and 552) for highways, it is proposed that the fencing specifications for highways be substituted in lieu of the FAA fencing specifications (Items F-160, F-161 and F-162) for general aviation airports. There are many similarities between the two specifications and the detail of the TXDOT highway specs greatly exceed the FAA specifications. Additionally, there are no specific references to highways in TXDOT Item 550 or 552.

After comparing TXDOT fencing specifications for highways with Florida and Illinois fencing specifications for airports, it was found the Florida and Illinois specifications were nearly identical to the FAA's, with a few minor differences. Since the TXDOT highway fencing specifications, with only a few minor exceptions, meet or exceed all of the FAA fencing specification requirements, the TXDOT highway specs can be used, to maintain consistency and commonality.

Item 550 - Chain Link Fence

TXDOT only allows galvanized steel, but FAA also allows polyvinyl chloride coated steel, aluminum alloy fabric or zinc 5% aluminum mischmetal alloy coated steel. For the FAA, wire mesh must the requirements of ASTM A392, Class 2; for TXDOT, mesh must meet the requirements of ASTM A392, Class 1; and for Illinois DOT, AASHTO M 181, Type I, Class B.

ASTM A392 Classes 1 and 2 specify the weight of the galvanized zinc coating for the wire mesh. Class 2 coatings weigh 2 oz/ft^2, while Class 1 weighs 1.2 oz/ft^2. After consulting with several fence contractors, it was found that Class 2 wire mesh costs 10 cents per square foot more than Class 1. One contractor also recommended using Class 2 in coastal areas, to prevent corrosion. However, the Corpus Christi area office of TxDOT reports no problems with Class 1 mesh and no contractors in the Austin area stock Class 2 mesh. As a result, it is recommended that Class 1 wire mesh be used for airports.

Additionally, the FAA requires horizontal brace rails at all terminal posts. There are no specifications for horizontal bracing by TxDOT. All other specifications are the same except for electrical grounds. For electrical grounds, the FAA is more restrictive, requiring a spacing of 150 m, versus 300 m from TXDOT.

Item 552 - Wire Fence

Barbed Wire

FAA requires a spacing between barbs of not less than 100 mm (4 in), while TXDOT requires 127 mm (5 in). TXDOT specifies conformity with ASTM A121, Class 1, while the FAA follows Fed. Spec. RR-F-221 Type A. FAA also allows copper-covered aluminum covered barbed wire; where TXDOT does not.

Wire Mesh

The same wire gauges are used, but FAA specifies Fed. Spec. RR-F-221, Type B while TXDOT uses ASTM A 116 Class 1.

Staples

FAA requires 25 mm (1 in) for hardwood posts, 37 mm (1.5 in) for softwood posts using 9 gauge galvanized steel wire staples.

TXDOT requires 40 mm (1.5 in) galvanized wire staples only.

Wood Posts

TXDOT is more selective in wood permitted for fence post use. It is very similar to FAA in quality. The FAA specifies that post tops must be sawed off with a 1-to-3 pitch. FAA specifies that the bottom wire must be between 1-4 inches above ground surface.

Steel Posts

FAA specifies that zinc-coated (galvanized) posts only must meet Fed. Spec. RR-F-191. TXDOT specifies conformity with ASTM A-120 and A-123 but allows non-galvanized steel posts to be painted with approved non-corrosive paint.

TEMPORARY EROSION CONTROL SPECIFICATIONS

The initial task was to review TxDOT SS-5004. However, TxDOT now has a permanent specification for Temporary Erosion, Sedimentation Water Pollution Prevention and Control (Item 506). Having carefully reviewed this new specification, it is proposed that Item 506 for highways be substituted in lieu of the FAA Item P-156, Temporary Air and Water Pollution, Soil Erosion, and Siltation Control. The TxDOT specification is far more detailed than the FAA specification and is inclusive of all information contained in Item P-156. Additionally, there are no specific references to highway construction contained in Item 506.

Item 506: Temporary Erosion, Sedimentation and Water Pollution Prevention and Control

Materials

FAA specifies grass, mulches, fertilizer, and slope drains as acceptable materials for control measures while TxDOT includes all of these materials, with the exception of fertilizer , and also includes sediment control fences, baled hay, rock filter dams, dikes, swales, sediment traps and basins, paved flumes, construction exits, and soil retention blankets.

Construction Requirements

FAA simply requires that the contractor, prior to the start of construction, submit schedules for accomplishment of temporary and permanent erosion control measures and that the contractor incorporate all permanent erosion control features into the project at the earliest practical time. The TxDOT specification includes these requirements as well as very specific provisions regarding stabilization of disturbed areas, limiting the amount of disturbed earth and vegetation in construction areas, minimizing sediment and runoff of pollutants, clearing of sediment off of paved surfaces and clearing of temporary construction measures in and over waterways.

DRAINAGE SPECIFICATIONS

The following TxDOT and FAA drainage specifications were reviewed:

TxDOT Specifications		**FAA Specifications**	
Item 432	Riprap	Item D-701	Pipe for Storm Drains and Culverts
Item 462	Concrete Box Culverts and Sewers	Item D-705	Pipe Underdrains for Airports
Item 464	Reinforced Concrete Pipe	Item D-751	Manholes, Catch Basins, Inlets and Inspection Holes
Item 465	Manholes and Inlets	Item D-752	Concrete Culverts, Headwalls, and Miscellaneous Drainage Structures
Item 466	Headwalls and Wingwalls	Item D-754	Concrete Gutters, Ditches, and Flumes
Item 467	Safety End Treatment		
Item 471	Frames, Grates, Rings, and Covers		
Item 472	Removing and Relaying Culvert and Storm Sewer Pipe		
Item 473	Laying Culvert and Storm Sewer Pipe		
Item 474	Slotted Drain		
Item 476	Jacking, Boring or Tunneling Pipe		
Item 480	Cleaning Existing Culverts		

The specifications, both TxDOT's and the FAA's, are quite comprehensive. The TxDOT specifications tend to be more limited in scope than the FAA specifications in the area of types of materials. The TxDOT and FAA specifications, while structured a bit differently, are very similar in content and application. It is recommended aviation (GA) airports and that either the FAA or the TxDOT specifications be used for airport drainage projects.

Items D-701,705: Pipe for Storm Drains and Culverts, Pipe Underdrains for Airports

The TxDOT material specifications are much more limited than those in the FAA spec. FAA specifies many more different kinds of pipes that can be used and the related ASTM standards for these various types. TxDOT only allows the use of concrete piping for culverts, storm sewers and underdrains. The TxDOT specification requires conformance to Items 420, 421, 440 and 464 which are the construction specifications for Concrete Structures, Portland Cement Concrete and Reinforced Concrete Pipe including requirements for reinforcing steel. There is not a significant difference between the TxDOT and FAA specifications for concrete culverts and pipes. Consequently, if concrete pipes and culverts are being used for an airport drainage project, the TxDOT specification should be adequate. The FAA specification should be consulted if any other type of pipe is going to be used.

Item D-751: Manholes, Catch Basins, Inlets and Inspection Holes

There are two TxDOT specifications that cover these areas with the exception of inspection holes. They include Items 465 and 471, *Manholes and Inlets* and *Frames, Grates, Rings, and Covers*, respectively. Again, the FAA specification is much broader in scope and application because it covers a larger range of materials. Along with the TxDOT's more general specifications for concrete construction, Items 465 and 471 are not significantly different and would be adequate for use with this type of construction. There are no TxDOT guidelines regarding inspection holes, so for this type of construction, the FAA specification would have to be used.

Item D-752: Concrete Culverts, Headwalls, and Miscellaneous Drainage Structures

For guidelines on construction methods in the area of excavation, the corresponding TxDOT specification regarding culverts and headwalls refers to Item 400 *Excavation and Backfill for Structures*. TxDOT's Item 400 is much more comprehensive than the FAA's guidelines in this area. FAA Item D-752, refers to Item P-610 *Structural Portland Cement Concrete* for materials, fabrication and construction methods guidelines for concrete culverts, headwalls, and Miscellaneous Drainage Structures. The TxDOT specification once again refers to TxDOT's more general specifications for concrete structures, Items 420, 421, 440 and 464. The TxDOT specification is more detailed and it is recommended that it be used at general aviation airports for any of the concrete drainage structures contained within FAA Item D-752.

Item D-754: Concrete Gutters, Ditches and Flumes

TxDOT does not have specifications for this type of construction and the FAA specification, or TxDOT's more general specifications for concrete structures, would have to be used for projects of this kind.

LIME STABILIZATION SPECIFICATIONS

The Center for Transportation Research (CTR) was asked to investigate the possibility of using TxDOT Specifications Items 260 and 264 for lime stabilized subgrade in place of FAA Item P-155 for construction of general aviation airports in Texas. The objective was to provided contractors with an alternate specification that is widely used in Texas for highway construction with excellent results. The advantage of using the TxDOT specification might in certain situations be a small cost savings or added flexibility for construction.

The CTR research team concluded that the TxDOT lime stabilized subgrade in Item 260 or Item 264 could be substituted for FAA Item P-155 with no significant degradation in strength or durability. The FAA and TxDOT specifications are both very good specifications and will provide adequate lime stabilization subgrade for airport pavement construction. However, it is not expected that significant monetary savings would results from using the TxDOT specification as a substitute for FAA specification. If there were any savings to be made from the substitution, it would be from the familiarity and experience that contractors have with the specification or with added flexibility to use quicklime which is not permitted in the FAA specification. CTR recommends that for TxDOT general aviation construction that the contractor be allowed to use either specification.

In comparison, the FAA only permits the use of lime slurry and hydrated lime. TxDOT permits the use of lime slurry (Type B), hydrated lime (Type A) or quicklime (Type C). In the past, quicklime was placed in a dry power form which can be a safety issue. However, it is commercially available and widely used in pelletized or pebble form which avoids the dust problem and allows good efficient production.

The remaining differences between the FAA and TxDOT specification are minor. TxDOT specifies testing using TEX-600-J Lime Testing Procedure and FAA uses ASTM C977 Quicklime and Hydrated Lime for Soil Stabilization. FAA P-155 requires a solids content of lime slurry with a minimum of 70 percent by weight of CaO and MgO. TxDOT Item 264 requires a minimum active lime content of 87 percent. There are slight differences specified on the amount of lime slurry residue retained on the #6 and #30 sieves.

There is considerable experience in Texas with using lime stabilization of expansive soils dating back to the first runway at Bergstrom AFB in 1957 and early highways which have been pioneered by the Texas Highway Department. The Lime Association of Texas is very active in promoting lime stabilization and educating contractors in the correct procedures. There is probably more experience with lime stabilization of airfield and highways in Texas than any other state.

It is the recommendation of this research that the TxDOT Item 264 and Item 260 be permitted as alternate specifications to FAA P-155 for all airport construction in Texas. There is no reason to restrict contractors from the option to use quicklime in pelletized form and there is no measurable difference in quality or performance between the two specifications.

REFLECTORIZED PAVEMENT MARKING SPECIFICATIONS

The TxDOT specification Item 666, *Reflectorized Pavement Markings*, and the FAA specification Item P-620, *Runway and Taxiway Painting*, were thoroughly reviewed. The TxDOT specification allows only two types of pavement markings and refers to them as either Type I or Type II Marking Materials. Type I markings refer to thermoplastic-type materials and Type II markings are paint-type materials. The FAA specification provides guidelines for waterborne, epoxy, methacrylate, or solvent based paints. TxDOT ceased the use of all non-water based paints in 1991 due concerns over possible impending federal regulation of volatile organic compounds in traffic paint; therefore, review of the FAA specification was limited to waterborne paint only.

FAA requires that all waterborne paints meet the requirements of Federal Specification TT-P-1952, *Paint, Traffic and Airfield Marking, Waterborne*. The TxDOT specification states that all Type II marking materials must conform to Departmental Materials Specifications D-9-8200, YPT-10 and/or WPT-10 and D-9-8290. These specifications were obtained and carefully reviewed.

The federal specification for waterborne paints is much more comprehensive than the TxDOT Departmental specification with regards to testing standards and procedures. The federal and TxDOT specifications are very similar in their requirements regarding appearance and consistency (viscosity). For heat shear stability and skinning the TxDOT specification is more stringent. However, the federal specification provides specific requirements and test procedures for flexibility, water resistance, freeze-thaw stability, reflectance, yellow color match, dry through, abrasion resistance and scrub resistance while the TxDOT specification has no requirements in these areas. It is our belief that this is a maintenance, rather than a safety issue in that the federal specification is designed to increase the durability of the paint. Therefore, either the federal specification or the TxDOT departmental specification could be used at the discretion of TxDOT's aviation personnel.

TxDOT requires glass beads on paint-type markings in order to increase reflectivity. There is no specific standard or requirements for these glass beads other than that they be purchased on the open market. FAA Item 620, Section 620-2.3, *Reflective Media*, specifies that glass beads meet the requirements of Federal Specification TT-B-1325 which has rather strict guidelines regarding gradation. However, AC 150/5340-1G, *Markings for Paved Runways and Taxiways*, states explicitly that "glass beads *may* be used to increase the conspicuity of markings on taxiways or aprons *but not on runways*". Because FAA has no specific requirement mandating the use of glass beads on paint-type pavement markings, we recommend that TxDOT use glass beads on Type II pavement markings, with no requirement as to gradation, on taxiways and aprons but not on runways at general aviation airports.

FAA does not provide guidelines for thermoplastic-type materials. Thermoplastic markings are now widely used by TxDOT due to the lack of durability of water-based markings. There are

two areas of concern regarding the use of thermoplastic markings on runways and taxiways; skid resistance and foreign object damage from the thermoplastic material as it ages and comes up.

The Florida Department of Transportation does not allow the use of thermoplastic markings on general aviation airports due to potential skid problems with these markings. Field personnel were contacted in several TxDOT districts including Abilene, Amarillo, Atlanta, Austin, El Paso, Fort Worth and Laredo in order to assess the potential for foreign object damage from these marking materials. While most of the districts have been very satisfied with the durability of the thermoplastic markings, the opinion was widely expressed that, as the markings wear, the material tends to come up in pieces that would be large enough to cause foreign object damage to aircraft. Due to these concerns, it is recommended that thermoplastic materials not be used for runway and taxiways at TxDOT's general aviation airports.

CHAPTER 5. SPECIFICATIONS CONSIDERED FOR REVISION BUT NOT RECOMMENDED AT THIS TIME

TxDOT Item 300, "Asphalts, Oils, and Emulsions" was considered for revision in this project. However, the Department is in the process of changing to the PG grading system developed by the Superpave program and being adopted by the FHWA and TxDOT, hence, no action is recommended at this time.

The specification for the construction of concrete pavements, Item 360, "Concrete Pavement," has been considered, but this specification is currently under revision as a Quality Control/Quality Assurance based specification. Therefore, no action is recommended at this time on this specification.

There is considerable interest in applying a commercial porous asphalt overlay material on airport pavements available under the tradename "Novachip". Several districts have reported excellent results with this product and a previous research project studied a test section for three years in San Antonio. The Novachip product is paver-laid and can be opened to traffic five minutes after it is laid. It has potential to replace FAA P-402 Porous Asphalt as an overlay material. One advantage for commercial service airports is that a porous surface such as P-402 or Novachip is free draining and need not be grooved as is required for dense asphalt and concrete pavements.

TxDOT Item 3012, "Paver-Laid Surface Treatment," was also reviewed as used in three TxDOT jobs for the Novachip product. It may be a viable specification for use in aviation construction projects, but a test section should be constructed prior to any recommendations. Currently, the Texas licensee of the Novachip product is planning a test strip on a taxiway at Austin Robert Mueller Airport.

REFERENCES

APPENDIX A

SPECIAL SPECIFICATION

ITEM 132X A/P

EXCAVATION AND EMBANKMENT

DRAFT

SPECIAL SPECIFICATION

ITEM 132X A/P

EXCAVATION AND EMBANKMENT

132X.1. Description. This item shall govern for the excavation, disposal, placement, and compaction of all materials within the limits of the work required to construct runway safety areas, runways, taxiways, aprons, and intermediate as well as other areas for drainage, support traffic pavements, parking, or other purposes in accordance with these specifications and in conformity to the dimensions and typical section shown on the plans.

132X.2. Excavation.

(1) Classification. All material excavated shall be classified as defined below.

(a) Unclassified. Excavation.Unclassified excavation shall consist of the excavation and disposal of all material, regardless of its nature.

(b) Rock Excavation. Rock cuts will be classified as Nonhomogeneous and Homogeneous.Rock excavation shall include all solid rock in ledges, in bedded deposits, in unstratified masses, and conglomerate deposits which are so firmly cemented they cannot be removed without blasting or using rippers.

(c) Earth Excavation. Earth excavation shall include all natural deposits of soil, sand, clays and any other material not previously classified as rock.

(d) Waste. Unsuitable excavation and excavation in excess of that needed for construction.

(e) Unclassified. Unclassifiedshall be defined as all material, regardless of its nature, not otherwise classified or bid under the previous classifications.

(2) Construction Methods. All excavationshall be performed as specified herein and the completed item shall conform to the alignment, grades and typical sections as shown on the

plans or project cross sections or as established by the Engineer. Before beginning excavation, grading, and embankment operations in any area, the area shall be completely cleared and grubbed in accordance with Item 100, "Preparing Right Of Way".

The suitability of material to be placed in embankments shall be subject to approval by the Engineer. All material identified as "Waste" shall be disposed of in waste areas shown on the plans. All waste areas shall be graded to allow positive drainage of the area and of adjacent areas. The surface elevation of waste areas shall not extend above the surface elevation of adjacent usable areas of the airport, unless specified on the plans or approved by the Engineer.Unsuitable material encountered below subgrade elevation in the cuts, when declared "Waste" by the Engineer, shall be replaced with material from acceptable excavation or other suitable material as approved by the Engineer.This work will be done in accordance with the provisions of the applicable bid items.

Material, when approved by the Engineer as suitable to support vegetation, may be used on the embankment slope.

When excavated materials, including topsoil, are utilized in constructing the required sections, payment for placement will be made under the pertinent placement specification.

When the Contractor's excavating operations encounter artifacts of historical or archaeological significance, the operations shall be temporarily discontinued. At the direction of the Engineer, the Contractor shall excavate the site in such a manner as to preserve the artifacts encountered and allow for their removal. Such excavation will be paid for as extra work.

During construction the roadbed and ditches shall be maintained in such condition as to insure proper drainage at all times.Ditches and channels shall be so constructed and maintained as to avoid damage to roadway section.During construction, channels shall be kept drained, insofar as practicable, and the work shall be prosecuted in a neat and workmanlike manner.If it is necessary to interrupt existing surface drainage, sewers or underdrainage, conduits, utilities, or similar underground structures the Contractor shall be responsible for and shall take all necessary precautions to preserve them or provide temporary services. When such facilities are encountered, the Contractor shall notify the Engineer, who shall arrange for their removal if necessary. The Contractor shall, at his/her own expense, satisfactorily repair or pay the cost of all damage to such facilities or structures which may result from any of the Contractor's operations during the period of the contract.

(a) Excavation. No excavation shall be started until the work has been staked out by the Contractor and the Engineer has obtained elevations and measurements of the ground surface. All suitable excavated material shall be used in the formation of embankment, subgrade, or for other purposes shown on the plans. All unsuitable material, "Waste", shall be disposed of as shown on the plans.

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

(a.1) Rock Cuts. In nonhomogeneous rock cuts, the Contractor shall either excavate to subgrade elevation, manipulate and compact the subgrade in accordance with the paragraph "Embankment" under this Item or excavate below grade (undercutting) and replace with embankment material indicated on the plans or approved by the Engineer with compaction as noted under "Embankment".With homogeneous rock cuts, the Contractor has the additional option of excavating to finish subgrade elevation.

(a.2) Earth Cuts. When base and/or pavement structure is placed under this project, all earth cuts shall be scarified to a uniform depth of at least 150 millimeters below the finished subgrade elevation of the entire construction width.When designated as suitable by the plans or the Engineer the excavated suitable material shall be used in constructing the embankment or in capping the pavement subgrade. If, at the time of excavation, it is not possible to place this material in its final location, it shall be stockpiled in approved areas.

(a.3) Undercutting. Undercutting rock, shale, hardpan, loose rock, boulders, or other material unsatisfactory for runway safety areas, subgrades, roads, shoulders, or any areas intended for turfing shall be excavated to a minimum depth of 12 inches (300 mm), or to the depth specified by the Engineer, below the subgrade. Muck, peak, matted roots, or other yielding material, unsatisfactory for subgrade foundation, shall be removed to the depth specified. Unsuitable materials shall be disposed of at locations shown on the plans. The excavated area shall be refilled with suitable material, obtained from the grading operations or borrow areas and thoroughly compacted as specified under the paragraph "Embankment" in this Item. The necessary refilling will constitute a part of the embankment. Where rock cuts are made and refilled with selected material, any pockets created in the rock surface shall be drained in accordance with the details shown on the plans.

(a.4) Borrow Excavation. Borrow area(s) within the airport property are indicated on the plans. Borrow excavation shall be made only at these designated locations and within the horizontal and vertical limits as staked or as directed.

When borrow sources are outside the boundaries of the airport property, it shall be the Contractor's responsibility to locate and obtain the supply, subject to the approval of the Engineer. The Contractor shall notify the Engineer, at least 15 days prior to beginning the excavation, so necessary measurements and tests can be made. All unsuitable material shall be disposed of by the Contractor. All borrow pits shall be opened up to expose the vertical face of various strata of acceptable material to enable obtaining a uniform product. Borrow pits shall be excavated to regular lines to permit accurate measurements, and they shall be drained and left in a neat, presentable condition with all slopes dressed uniformly.

(3) Subgrade Tolerances. Tolerances shall be as follows.

(a) Stage Construction. Any deviation is excess of 30 millimeters is cross section and 30 millimeters in five (5) meters measured longitudinally shall be corrected by loosening, adding or removing the material, reshaping and compacting by sprinkling and rolling.

(b) Turn Key Construction. Any deviation in excess of 15 millimeters in cross section and 15 millimeters in five (5) meters measured longitudinally shall be corrected by loosening, adding or removing the material, reshaping and recompacting by sprinkling and rolling.

132X.3. Embankment.

(1) Materials. Materials may be furnished from required excavation in the areas shown on the plans or from off site sources obtained by the Contractor and meeting the requirements herein.All embankment shall conform to one of the following types as shown on the plans.

Type A.This material shall consist of suitable granular material free from vegetation or other objectionable matter, and reasonably free from lumps of earth.This material shall be suitable for forming a stable embankment and, when tested in accordance with Test Methods Tex-104-E, Tex-105-E, Tex 106-E and Tex-107-E, Part II shall meet the following requirements.

The liquid limit shall not exceed 45

The plasticity index shall not exceed.....15

The bar shrinkage shall not be less than 2

Type B. This material shall consist of suitable earth material such as rock, loam, clay, or other such materials as approved by the Engineer that will form a stable embankment.

Type C. This material shall be suitable and shall conform to the specification requirements shown on the plans.

Type D. This material shall be that obtained from required excavation areas shown on the plans and will be used in embankment.

(2) Construction Methods.

(a) General. When off site sources are involved, the Contractor's attention is directed to Item 7, "Legal Relations and Responsibilities to the Public".Prior to placing any embankment, all work in accordance with Item 100, "Preparing Right of Way", shall have been completed on the areas over which the embankment is to be placed.Stump holes or other small excavations in the limits of the embankments shall be backfilled with suitable material and thoroughly tamped by approved methods before commencing embankment construction.The surface of the ground, including disk-loosened ground or any surface roughened by small washes or otherwise, shall be restored to approximately its original slope by blading or other methods.Where shown on the plans or required by the Engineer, the ground surface thus prepared shall be compacted by sprinkling and rolling.

The Engineer shall be notified sufficiently in advance of opening any material source to allow performance of any required testing.

Unless otherwise shown on the plans, the surfaces of unpaved areas (except rock) which are to receive embankment shall be loosened by scarifying to a depth of at least 150 millimeters.Materials which have been loosened shall be recompacted simultaneously with the new embankment materials placed upon it.The total depth of loosened and new material shall not exceed the permissible depth of the layer to be compacted as specified herein.Where an embankment is to be constructed to a height of 120 m or less, all sod and vegetable matter shall be removed from the surface upon which the embankment is to be placed.

Where embankments are to be placed on natural slopes steeper than 3 to 1, horizontal benches shall be constructed as shown on the plans.Placement of embankment materials shall begin at the low side of hillsides and slopes.

Trees, stumps , roots vegetation or other unsuitable materials shall not be placed in embankment.

Unless otherwise shown on the plans, all embankment shall be constructed in layers approximately parallel to the finished grade of the site bed.

Embankments shall be constructed to the grade and sections shown on the plans or as established by the Engineer.After completion, the site shall be continuously maintained to its finished section and grade until the project is accepted.

When topsoil is specified or required as shown on the plans, it shall be salvaged from stripping or other grading operations. If, at the time of excavation or stripping, the topsoil cannot be placed in its proper and final section of finished construction, the material shall be stockpiled at approved locations. Stockpiles shall be placed a safe distance, in the judgment of the Engineer, from the edge of runway and taxiway pavements and shall not be placed on areas which subsequently will require any excavation or embankment. If, in the judgment of the Engineer, it is practical to place the salvaged topsoil at the time of excavation or stripping, the material shall be placed in its final position without stockpiling or further rehandling.

(b) Constructing Embankments.

(b.1) Earth Embankments. Earth embankments shall be defined as those composed principally of material other than rock, and shall be constructed of acceptable material from approved sources.

Unless otherwise specified, earth embankments shall be constructed in successive layers of 200 millimeters more or less in depth for the full width of the individual site cross section and in such lengths as best suited to the sprinkling and compacting methods utilized.Layers of embankment may be formed by utilizing equipment and methods which will evenly distribute the material.

Each layer of embankment shall be uniform as t material, density and moisture content before beginning compaction.Where layers of unlike materials abut each other, each layer shall be

featheredged for at least 30 meters, or the material shall be so mixed as to prevent abrupt changes in the soil.No material placed in the embankment by dumping in a pile or window shall be incorporated in a layer in that position, but all such piles or windrows shall be moved by blading or similar methods.Clods or lumps of material shall be broken and the embankment material mixed by blading, harrowing, disking or similar methods until a uniform material of uniform density is achieved in each layer.

Sprinkling required to achieve the moisture content necessary for compaction shall meet the material requirements of Item 204, "Sprinkling".It shall be the responsibility of the contractor to secure a uniform moisture content throughout the layer by such methods as may be necessary.

The material in the layer shall be within ±2 percent of optimum moisture content before rolling to obtain the prescribed compaction. In order to achieve a uniform moisture content throughout the layer, wetting or drying of the material and manipulation shall be required when necessary. Should the material be too wet to permit proper compaction or rolling, all work on all of the affected portions of the embankment shall be delayed until the material has dried to the required moisture content. Sprinkling of dry material to obtain the proper moisture content shall be done with approved equipment that will sufficiently distribute the water. Sufficient equipment to furnish the required water shall be available at all times. Samples of all embankment materials for testing, both before and after placement and compaction, will be taken for each 30 cubic meters or as approved by the Engineer. Based on these tests, the Contractor shall make the necessary corrections and adjustments in methods, materials or moisture content in order to achieve the correct embankment density.In order to facilitate uniform wetting of the embankment material, the contractor may apply water at the material source if the sequence and methods used do not cause an undue waste of water.Such procedures shall be subject to the approval of the Engineer.

Operations on earthwork shall be suspended at any time when satisfactory results cannot be obtained because of rain, freezing, or other unsatisfactory conditions of the field. The Contractor shall drag, blade, or slope the embankment to provide proper surface drainage.

(b.2) Rock Embankments. Rock embankments shall be defined as those composed principally of rock, and shall be constructed of acceptable material.

Unless otherwise specified, rock embankments normally shall be constructed in successive layers for the full width of the individual site cross section and of 450 millimeters or less in depth.When, in the opinion of the Engineer, the rock sizes necessitate a greater depth of layer, the

layer depth may be increased as necessary, but in no caseshall the depth of layer exceed 0.75 meter.Each layer shall be constructed in such a manner that the interstices between the larger stones are filled with smaller stones and spalls which have been created by this operation as well as from the placement of succeeding layers of material.

The maximum dimension of any rock used in embankment layer, and in no case shall any rock over 0.6 meter in its greatest dimension be placed in the embankment unless approved by the Engineer.Unless otherwise shown on the plans, the upper or final layer of the embankment shall be composed of material so graded that the density and uniformity of the surface may be secured by the "Ordinary Compaction" or "Density Control" method.Exposed oversize material shall be reduced by sledging or other methods as approved by the Engineer.

When "Ordinary Compaction" is specified, each embankment layer shall be rolled and sprinkled when and to the extent directed by the Engineer.When "Density Control" is specified, each layer shall be compacted to the required density as outlined for "Earth Embankments", except that in those layers where rock will make density difficult, when shown on the plans, the Engineer may require the layer to be proof rolled to insure proper compaction.

(b.3) Embankment Adjacent to Culverts and Bridges. Embankments adjacent to culverts and bridges shall be compacted in the manner prescribed under Item 400, "Excavation and Backfill for Structures", or other appropriate bid items.

As a general practice, embankment material placed adjacent to any portion of any structure and inthe first two layers above the top of any culvert or similar structure shall be free of any appreciable amount of gravel or stone particles more than 100 millimeters in greatest dimension and of such gradation as to permit thorough compaction.When, in the opinion of the Engineer, such material is not readily available, the use of rock or gravel mixed with earth will be permitted, in which case no particle larger than 300 millimeters in greatest dimension and 150 millimeters in least dimension may be used.The percentage of fines shall be sufficient to fill all voids and insure a uniform and thoroughly compacted mass of proper density.

(c) Compaction Methods. Compaction of embankments shall be by "Ordinary Compaction" or "Density Compaction" as shown on the plans.

(c.1) Ordinary Compaction. When "Ordinary Compaction" is shown on the plans, the following provisions shall govern.

Each layer shall not exceed 200 millimeters of loose depth, unless otherwise directed by the Engineer.Each layer shall be compacted in accordance with the provisions governing the Item or Items of "Rolling".Unless otherwise specified on the plans, the rolling equipment shall be as approved by the Engineer.Compaction shall continue until there is no evidence of further compaction.Prior to and in conjunction with the rolling operation, each layer shall be kept leveled with suitable equipment to insure uniform compaction over the entire layer.Should the subgrade, for any reason or cause, lose the required stability or finish, it will be recompacted and refinished at the Contractor's expense.

(c.2) Density Control. When "Density Control" is shown on the plans, the following provisions shall apply.

Each layer shall be compacted to the required density by any method, type and size of equipment which will give the required compaction.The depth of layers, prior to compaction, shall depend upon the type of sprinkling, mixing and compacting equipment used.However, maximum depth (400 millimeters loose and 300 millimeters compacted) shall not be exceeded unless approved by the Engineer.Prior to and in conjunction with the rolling operation, each layer shall be brought to the moisture content necessary to obtain the required density and shall be kept leveled with suitable equipment to insure uniform compaction over the entire layer.

Each layer shall be sprinkled as required and compacted to the extent necessary to provide the specified below, unless otherwise shown on the plans.

DescriptionDensity,Percent Moisture

Non-swelling soils with Not less than 98

plasticity index less than 20

Swelling soils with plasticityNot less than 98 Not less than

index of 20 to 35nor more than 102 optimum

Swelling soils with plasticityNot less than 95 Not less than

index over 35 nor more than 100 than optimum

The density determination will be made in accordance with Test Method Tex-114-E.Field density determination will be made in accordance with Test Method Tex-115-E.

After each layer of earth embankment is complete, tests as necessary may be made by the Engineer.When the material fails to meet the density requirements or should the material lose the required stability, density, moisture or finish before the next course is placed or the project is accepted, the layer shall be reworked as necessary to obtain the specified compaction, and the compaction method shall be altered on subsequent work to obtain specified density.Such procedures shall be subject to the approval of the Engineer.

Excessive loss of moisture shall be construed to exist when the subgrade soil moisture content is four (4) percent less than the optimum.

The Contractor may be required to remove a small area of the layer in order to facilitate the taking of density tests.Replacement and compaction of the removed material in the small area shall be at the Contractor's expense.

When shown on the plans and when directed by the Engineer, the Contractor shall proof roll in accordance with Item 216, "Rolling (Proof)".Soft spots shall be corrected as directed by the Engineer.

(3) Tolerances. The tolerances shall be as follows.

(a) Grade Tolerances.

(a.1) Stage Construction. Any deviation in excess of 30 millimeters in cross section and 30 millimeters in five (5) meters measured longitudinally shall be corrected by loosening, adding or removing the material, reshaping and recompacting by sprinkling and rolling.

(a.2) Turn Key Construction. Any deviation in excess of 15 ,millimeters in cross section and 15 millimetersin five (5) meters measured longitudinally shall be corrected by loosening, adding or removing the material, reshaping and recompacting by sprinkling and rolling.

(b) Gradation Tolerances. The Engineer may accept the material providing not more than one (1) out of the most recent five (5) gradation tests performed are outside the specified limit on any individual sieve by more than five (5) percent.

(c) Density Tolerances. The Engineer may accept the work providing not more than one (1) out of the most recent five (5) density tests performed is outside the specified density, provided the failing test is no more than 50 kilograms per cubic meter outside the specified density.

(d) Plasticity Tolerances. The Engineer may accept the material providing not more than one (1) out of the most recent five (5) plasticity index samples tested are outside the specified limit by no more than two (2) points.

132X.4. Measurement.

(1) Excavation. Excavation will be measured by the cubic meter in its original position as computed by the method of average end areas.

This is a plans quantity measurement item and the quantity to be paid for will be that quantity shown in the proposal and on the "Estimate and Quantity" sheet of the contract plans, except as may be modified by Article 9.8 of Item 9, "Measurement and Payment". If no adjustment of quantities is required, additional measurements or calculations will not be required.

Excavation in backfill areas of retaining walls will not be measured for payment.Limits of measurement for excavation in retaining-wall areas will be as shown on Standard Details Sheet "Earthwork Measurement at Retaining Walls" (EMRW) in the plans.

(2) Embankment. The embankment portion of this Item will be measured as follows.

(a) General. Retaining-wall-backfill areas which are also in embankment areas will be measured for payment as embankment except as shown on the plans; such material shall meet the requirements for backfill material of the pertinent retaining-wall item(s)Limits of measurement for embankment in retaining-wall areas will be as shown on Standard Detail Sheet "Earthwork Measurement at Retaining Walls" (EMRW) in the plans.

Shrinkage or swelling factors will not be considered in determining the calculated quantities.

(b) Class 1. Embankment will be measured in its original, natural position, and the volume computed in cubic meters by the method of average end area.

(c) Class 2. Embankment will be measured by the cubic meter in vehicles as delivered on the site.

(d) Class 3. Embankment will be measured by the cubic meter in its final position as the volume of embankment computed in place between (1) the original ground surfaces or the surface upon which the embankment is to be constructed, and (2) the lines, grades and slopes of the accepted embankment, using the average end area method.

Class 3 is a plans quantity measurement item and the quantity to be paid for will be that quantity shown in the proposal and on the "Estimate and Quantity" sheet of the contractplans, except as may be modified by Article 9.8 of Item 9, "Measurement and Payment".If no adjustment of quantities is required, additional measurements or calculations will not be required.

132X.5. Payment.

(1) Excavation. The work performed and the materials furnished in accordance with this Item and measured under "Measurement" will be paid for at the unit price bid for "Excavation (Roadway)", "Excavation (Channel)", "Excavation (Special)" or "Excavation (Roadway and Channel)".This price shall be full compensation for all authorized excavation; for undercutting subgrade and reworking or replacing the undercut material; for all hauling; for all work required for disposal of material not used elsewhere on the project and for furnishing all labor, materials, tools, equipment and the incidentals necessary to complete the work.

When a slide, not due to the Contractor's negligence or operation occurs, payments for removal and disposal of the slide material will be in accordance with Article 9.8.

(2) Embankment. The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Embankment", of the compaction method, type and class specified.This price shall be full compensation for furnishing embankment; for hauling; for placing, compacting, finishing and reworking; and for all labor, royalty, tools, equipment and incidentals necessary to complete the work.

When proof rolling is shown on the plans and directed by the Engineer, it shall be paid for in accordancewith Item 216, "Rolling (Proof)".

When "ordinary Compaction" is shown on the plans, all sprinkling and rolling, except proof rolling, will not be paid for directly, but will be considered subsidiary to this Item, unless otherwise shown on the plans.

When "Density Control" is shown on the plans, all sprinkling and rolling, except proof rolling, will not be paid for directly, but will be considered subsidiary to this Item.

When subgrade is constructed under this project, correction of soft spots in the subgrade will be at the Contractor's expense.When subgrade is not constructed under this project, correction of soft spots in the subgrade will be in accordance with Article 4.3 of Item 4, "Scope of Work"

APPENDIX B

SPECIAL SPECIFICATION

ITEM 314X A/P

EMULSIFIED ASPHALT TREATMENT

Draft 314XA/P

SPECIAL SPECIFICATION

ITEM 314X A/P

EMULSIFIED ASPHALT TREATMENT

314X.1. Description. This item shall govern for one (1) or more applications of a mixture of emulsified asphalt and water used as a base or subgrade treatment, earthwork or mulch sod seal for erosion control, prime coat or dust preventative in the construction of airport facilities and applicable earthwork and constructed in accordance with the prescribed specifications and plans.

314X.2. Materials. All materials shall conform to the pertinent requirements of the following Items.

Item 204, "Sprinkling"

Item 300, "Asphalts, Oils and Emulsions"

The amount of emulsified asphalt in the mixture, expressed as a percent by volume of the total mixture, shall be within the limits and shall be of the type and grade shown on the plans.

314X.3. Construction Methods.

(1) General. The emulsified asphalt and water mixture shall be applied by a self-propelled sprinkler meeting the requirements of Item 204, "Sprinkling", or other equipment approved by the Engineer that will uniformly distribute the mixture in the quantity determined by the Engineer.

The mixture shall be applied at the locations and to the extent shown on the plans or as directed by the Engineer.

The Contractor shall make suitable provisions for agitating the two (2) materials sufficiently to produce a uniform blend.The sprinkler or other equipment and/or the measuring devices shall have been recently calibrated, and the Engineer shall be furnished an accurate and satisfactory record of such calibration.After beginning the work, should the yield of the mixture applied appear

to be in error, the sprinkler or other equipment and/or the measuring device shall be calibrated in a manner satisfactory to the Engineer before proceeding with the work.

(2) Base or Subgrade Treatment. Where indicated on the plans, "Emulsified Asphalt Treatment" shall be mixed with the base or subbase material.The emulsified asphalt and water mixture shall be applied and incorporated into the top portion of the subbase or base course layers to the depth and width shown on the plans.Successive applications of the mixture of emulsified asphalt and water shall be applied until the specified amount of emulsified asphalt has been incorporated into the material.

The percentage of emulsified asphalt in the mixture shall be regulated to insure that the specified amount of emulsified asphalt is incorporated into the material, while maintaining the proper moisture content.

The treated material shall be mixed by blading, then shaped and compacted as required by the pertinent specification for the particular course, to the lines, grades and typical sections shown on the plans. The surface shall be maintained with light applications of emulsified asphalt and water mixture or water, as directed by the Engineer, during curing of the course.

(3) Earthwork or Mulch Sod Seal or Dust Preventative. The emulsified asphalt and water mixture shall be applied as approved by the Engineer, where indicated on the plans or directed by the Engineer.

(4) Prime Coat. Where indicated on the plans, "Emulsified Asphalt Treatment" shall be applied at the width shown on the plans.Successive applications of the mixture shall be applied until the specified amount of emulsified asphalt has been distributed.The percentage of emulsified asphalt in the mixture shall be regulated to insure that the specified amount of emulsified asphalt has been distributed.

314X.4. Measurement. This Item will be measured by the liter of emulsified asphalt used in the emulsified asphalt and water mixture.

314X.5. Payment. The work performed and the materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Emulsified Asphalt", "Emulsified Asphalt (Base or Subgrade Treatment)", or "Emulsified Asphalt (Erosion Control)" of the type and grade specified.This price shall be full compensation for

furnishing all required materials, including mixing water for application; for all freight involved; for all hauling, mixing and distributing the mixture as specified; and for all manipulation, labor, tools, equipment and incidentals necessary to complete the work.

APPENDIX C

SPECIAL SPECIFICATION

ITEM 315X A/P

ASPHALT SEAL/PRIME COAT

DRAFT 315A/P

SPECIAL SPECIFICATION

ITEM 315X A/P

ASPHALT SEAL/PRIME COAT

315X.1. Description. This item shall govern for one (1) or more applications of an asphaltic material, a mixture of an asphaltic material and sand or a mixture of emulsified asphalt and water used as an application on a completed base, prime coat, aggregate loss preventative, or surface seal in the construction of airport runways, taxiways, other pavements and applicable earthwork and constructed in accordance with the prescribed specifications and plans.

315X.2. Materials. All materials shall conform to the pertinent requirements of the following items of the Department's standard specifications.

Item 204, "Sprinkling"

Item 300, "Asphalts, Oils and Emulsions"

When using the mixture of cutback asphalt and sand, the base course sweepings shall be those sweepings obtained from cleaning the base and the native sand shall be material obtained from sources approved by the Engineer.

When specifying emulsified asphalt, the amount of emulsified asphalt in the mixture, expressed as a percent by volume of the total mixture, shall be within the limits and shall be of the type and grade shown on the plans.

315X.3. Construction Methods.

The Engineer will select the temperature of application within the limits recommended in Item 300, "Asphalts, Oils and Emulsions".The Contractor shall apply the asphalt at a temperature within 8°C of the temperature selected.

No traffic, hauling or placing of any subsequent courses shall be permitted over the freshly applied prime coat until authorized by the Engineer.

The Contractor shall be responsible for the maintenance of the surface until the work is accepted by the Engineer.

The Contractor shall provide all necessary facilities and equipmentfor determining the temperature of the asphaltic material in all of the heating equipment and in the distributor, for determining the rate at which it is applied, and for securing uniformity at the junction of two (2) distributor loads.

(1) Prime Coat.

(a) Cutback Asphaltic Material. Prime coat shall not be applied when the air temperature is below 15° C and falling, but it may be applied when the air temperature is above 10° C and rising, the air temperature being taken in the shade and away from artificial heat.Asphaltic material shall not be placed when general weather conditions, in the opinion of the Engineer, are not suitable.

When in the opinion of the Engineer, the area and/or base is satisfactory to receive the prime coat, the surface shall be prepared by sweeping or other approved methods.If found necessary by the Engineer, the surface shall be lightly sprinkled just prior to application of the asphaltic material.

The asphaltic material shall be applied on the prepared surface by an approved self-propelled pressure distributor so operated as to distribute the material at the rate directed by the Engineer, evenly and smoothly, under a pressure necessary for proper distribution.

(b) Cutback Asphaltic Material and Sand. Prime coat shall not be applied when the air temperature is below 15° C and falling, but may be applied when the air temperature is above 10°C and rising, the air temperaturebeing taken in the shade and away from artificial heat.Asphaltic material shall not be placed when general weather conditions, in the opinion of the Engineer, are not suitable.

Native sand, as specified above, shall be hauled in vehicles of uniform capacity unless otherwise authorized by the Engineer.When in the opinion of the Engineer, the area and/or base is satisfactory to receive the prime coat, the surface shall be prepared by sweeping or other approved methods.If found necessary by the Engineer, the surface shall be lightly sprinkled just prior to application of the asphaltic material.

Asphaltic material shall be applied on the prepared surface by an approved self-propelled pressure distributor so operated as to distribute thematerial at the rate directed by the Engineer, evenly and smoothly, under a pressure necessary for proper distribution.

The surface shall then be covered with base sweeping and/or native sand as directed by the Engineer. The surface shall then be dragged with an approved type of drag broom so as to evenly and smoothly distribute the cover material.This brooming or dragging shall continue, in the opinion of the Engineer, the prime coat has properly cured.The surface shall be cleared of any surplus sand or sweepings by the Contractor by sweeping or other approved methods, when directed by the Engineer.

(c) Emulsified Asphalt Seal. Unless otherwise permitted by the Engineer, emulsified asphalt seals shall not be applied when the air temperature is below 15°C and is falling, but may be applied when the air temperature is above 10°C and is rising, the air temperature being taken in the shade and away from artificial heat.Asphalt material shall not be placed when general weather conditions, in the opinion of the Engineer, are not suitable.

The emulsified asphalt and water mixture shall be applied by an approved self-propelled pressure distributor so operated as to distribute the material at the rate directed by the Engineer, evenly and smoothly, under a pressure necessary for proper distribution.

315X.4. Equipment. The Contractor shall provide all necessary facilities and equipment for determining the temperature of the asphaltic material in all of the heating equipment and in the distributor, for determining the rate at which it is applied, and for securing uniformity at the junction of two (2) distributor loads.

The distributor tank, when used for pay purposes, shall have been calibrated within three (3) years from the date it is first used on this project.The tank calibration procedure shall bein accordance with Test Method Tex-922-K, Part 1, and shall be signed and sealed by a registered professional engineer.Unless otherwise shown on the plans, the Contractor shall provide the tank calibration record and shall furnish the Engineer an accurate and satisfactorycalibration record prior to beginning the work.The Engineer may at any time verify calibration accuracy in accordance with Test Method Tex-92-K, Part II, and may perform the required recalibration at the expense of the Contractor if the calibration is found to be in error.

All equipment used in storing or handling asphaltic material shall be kept clean and in good operating condition at all times and shall be operated in such manner that there will be no contamination of the asphaltic material. When the asphaltic material is stored in a storage unit equipped with a heater, the Contractor shall provide and maintain a recording thermometer to continuously indicate the asphaltic material temperature.

315X.5. Measurement.

(1) Cutback Asphaltic. The asphaltic material for prime coat will be measured at the point of delivery on the road in liters at the applied temperature.The quantity to be measured for payment shall be the number of liters used, as directed, of the specified prime coat.

Native sand will be measured by the cubic meter in vehicles as applied on the road, unless otherwise shown on the plans.

(2) Emulsified Asphalt. The emulsified asphalt will be measured by the liter of emulsified asphalt used in the emulsified asphalt and water mixture.

315X.6. Payment. The work performed and the materials furnished in accordance with this item and measured as provided under "Measurement" will be paid for at the unit price bid for "Asphaltic Material" of the type and grade specified, "Emulsified Asphalt" of the type and grade specified and "Native Sand" when specified.This price shall be full compensation for furnishing all required materials, including mixing water for application where specified; for all hauling, mixing, heating, and distributing the mixture as specified; and for all manipulation, tools, labor, equipment and incidentals necessary to complete the work.

APPENDIX D

SPECIAL SPECIFICATION

ITEM 316X A/P

MODIFIED SURFACE TREATMENTS FOR AIRPORTS

DRAFT

SPECIAL SPECIFICATION

ITEM 316X A/P

MODIFIED SURFACE TREATMENTS FOR AIRPORTS

316X.1. Description. This item shall govern for the construction of a surface treatment for airport runways, taxiways and support pavements and shall be composed of a single, double or triple application of asphaltic material, each covered with aggregate, constructed on an existing pavement surface, the preparedbase course or properly cured wearing surface in accordance with these specifications, and shall conform to the dimensions and typical cross-section shown on the plans.This Item shall also govern for the furnishing of Aggregates (Stockpiled) Quantities for the materials will be as shown on the Basis of Estimate in the Plans.

316X.2. Materials. All materials shall be of the type(s) and grade(s) shown on the plans and shall conform to the pertinent material requirements of this specification and the following Itemsas applicable.

Item 300, "Asphalts, Oils and Emulsions"

Item 301, "Asphalt Antistripping Agents"

Item 302, "Aggregate for Surface Treatments"

(1) Aggregate. The aggregate material shall meet the quality requirements of Item 302, "Aggregates for Seal Coats" with the exception that the polish value requirement is not applicable. The aggregate material shall be either crushed stone, crushed gravel, or crushed slag and, when specified, may be precoated as specified in Item 302.

(a) Aggregate Types.

(a.1) Uncoated Aggregate Types.

Type D.Type D aggregate shall consist of crushed gravel, crushed stone or crushed slag.

Type E.Type E aggregate shall be as shown on the plans.

(a.2) Precoated Aggregate Types.

Type PD. Type PD aggregate shall be precoated aggregate consisting of crushed gravel, crushed slag or crushed stone.

Type PE. Type PE shall be precoated aggregate as shown on the plans.

If the material is to be crushed stone or crushed gravel, it shall be manufactured from sound, hard durable rock of acceptable quality and crushed to specification size.

(b) Aggregate Gradation. The crushed aggregate for the applications shall meet the requirements for gradation given in Table 1 when tested in accordance with Test Method Tex-200-F, Part I.

The gradations in the table represent the limits which shall determine suitability of aggregate for use for the specified applications.

The cover aggregate used in the third application shall be a light colored material whose color and reflectivity shall be approved by the Engineer.

The aggregate to be used shall show no evidence of stripping or swell when tested in accordance with Texas Test Method Tex-530-C.The use of antistrip agents meeting Item 301, "Asphalt Antistripping Agents" for the control of stripping shall be used if necessary.

(2) Asphaltic Material. The asphalt material, and precoating material where applicable, shall meet the requirements of Item 300, "Asphalts, Oils and Emulsions".The Engineer shall designate the specific material to be used.

(3) Precoated Aggregate. Precoated aggregate shall be aggregate of the type and grade specified, coated with 0.5 to 1.5 percent, by mass, of residual asphalt from a precoating material.

The material may be mixed on the job or at a central mixing plant and shipped ready for use.Mixes that do not maintain flow qualities such that the precoated aggregate may be satisfactorily spread by approved mechanical spreading devices will not be acceptable.Materials that are not uniformly and/or properly coated, in the opinion of the Engineer will not be accepted for use.

TABLE 1. REQUIREMENTS FOR GRADATION OF AGGREGATE

Sieve Designation Percentage by Weight	Retained on Sieves (square openings)
Grade 3. Aggregate for first application	
19.0 mm	0
16.0 mm	0 - 2
12.5 mm	20 - 40
9.5 mm	80 - 100
6.3 mm	9 5 - 100
2.00 mm	99 - 100
Grade 4. Aggregate for second application	
16.0 mm	0
12.5 mm	0- 2
9.5 mm	20-35
4.75 mm	95- 100
2.00 mm	99 - 100
Grade 5. Aggregate for third application	
12.5 mm	0
9.5 mm	0-5
4.75 mm	40-85
2.00 mm	98 - 100
850 µm	99 - 100

(4) Water. Water in the amount not to exceed three (3) percent by mass of the mixture may be used in precoating aggregate.

316X.3. Application Rates. The approximate amounts of materials per squaremeter for the bituminous surface treatment shall be as provided in Table 2 for the treatment specified on the plans or in the special provision. The exact amounts to be used shall be determined by the Engineer.

TABLE 2. QUANTITIES OF MATERIALS

KEY. [1] = Application Number
[2] = Quantity of Aggregate, kg/sq m
[3] = Quantity of Asphalt, liters/sq m
[4] = Type of Asphalt

[1]	[2]	[3]	[4]
121.7	27.11.58	2.03	Asphalt Cement
1.81	2.26		Emulsified Asphalt
210.9	13.60.68	1.13	Asphalt Cement
0.90	1.58		Emulsified Asphalt
38.1	10.90.68	090	Emulsified Asphalt

The recommended quantities of asphalt shown in Table 2 cover the average range of conditions that include primed granular bases and old pavement surfaces. The actual quantities and types of materials should take into consideration local conditions and experience.The asphalt content selected should reflect the condition of the pavement. If the pavement is highly oxidized, badly cracked, or coarse more asphalt should be used.

The final design asphalt type and amount will be determined by the contractor and approved by the Engineer.

316X.4. Construction.

(1) Weather Limitations. Surface treatments shall not be applied when the air temperature is below 15°C and is falling, but may be applied when the air temperature is above 10° C and rising, the air temperature being taken in the shade and away from artificial heat.Surface Treatments shall not be applied when the temperature of the surface on which the surface is to be applied is below 15°C.When latex modified asphalt cement is specified, surface treatments shall not be applied when the air temperature is below 25°C and is falling, but may be applied when the air temperature is above 20°C and is rising and shall not be applied when the temperature of the surface on which the surface treatment is to be applied is below 20°C.When asphaltic materials designed for cool weather placement are used, application may occur whenever the air and surface temperatures are acceptable to the Engineer.No material shall be applied when rain is imminent,when dust or sand is blowing or when general weather conditions, in the opinion of the Engineer, are not acceptable..

(2) Equipment. The Contractor shall furnish all equipment, tools, and machines necessary for the performance of the work.

(a) Pressure Distributor. The distributor shall be designed, equipped, maintained, and operated so that bituminous material at even heat may be applied uniformly on variable widths of surface at the specified rate. The allowable variation from the specified rate shall not exceed 10 percent. Distributor equipment shall include a tachometer, pressure gauges, volume measuring devices or a calibrated tank, and a thermometer for measuring temperatures of tank contents. The distributor shall be self-powered and shall be equipped with a power unit for the pump and full circulation spray bars adjustable laterally and vertically.

The distributor tank, when used for pay purposes, shall have been calibrated within three (3) years from the date it is first used on this project.The tank calibration procedure shall be in accordance with Test Method Tex-922-K, Part I, and shall be signed and sealed by a registered professional engineer.Unless otherwise shown on the plans, the Contractor shall provide the tank calibration and shall furnish the Engineer anaccurate and satisfactory calibration record prior to beginning the work.The Engineer may at any time verify calibration accuracy in accordance with Test Method Tex-922-K, Part II, and may perform the required recalibration if the calibration is found to be in error.

When a uniform application of asphaltic material is not being achieved, the Engineer may require that the spray bars on the distributor be controlled by an operator riding in such a position at the rear of the distributor that the operation of all sprays is in full view.

(b) Aggregate Spreader. The aggregate spreader shall be a self-propelled mechanical spreadercapable of uniformly distributing aggregate at the specified rates.

(c) Rollers. Rolling equipment shall meet the governing specifications for Item 210, "Rolling (Flat Wheel)" and Item 213, "Rolling (Pneumatic Tire)".

(d) Broom.The broom shall be a rotary, self-propelled power broom for cleaning existing surfaces.

(e) AsphalticStoring and Handling Equipment. All equipment used in storing or handling asphaltic material shall be kept clean and in good operating condition at all times and shall be operated in such a manner that there will be no contamination of the asphaltic material.The Contractor shall provide and maintain a recording thermometer to continuously indicate the temperature of the asphaltic material at the storage heating unit when storing of asphalt is permitted.

(3) Preparing Underlying Surface. The surface of the underlying course shall be prepared, shaped, and conditioned to a uniform grade and section, as shown on the plans and as specified. Loose dirt and other objectionable material shall be removed from the surface.

On those type of bases where a prime coat is required and specified, the prime shall be applied and satisfactorily cured before starting the surface treatment.

When specified, the Contractor shall be required to patch, with premixed material, any holes or other malformations deviating from the true cross-section and grade. The premixed

material shall be made of the asphaltic material specified in the proposal or plans and prepared by the method as directed by the Engineer. All small patches shall be thoroughly hand tamped while the large patches shall be rolled with a power or pneumatic roller.

(4) Application ofAsphaltic Material. Asphaltic material shall be applied upon the properly prepared surface at the rate and temperature specified using a pressure distributor to obtain uniform distribution at all points. To insure proper drainage, the strips shall begin along the centerline of the pavement on a crowned section or on the high side of the pavement with a one-way slope. During all applications, the surfaces of adjacent structures shall be protected in such manner as to prevent their being spattered or marred. Bituminous materials shall not be discharged into borrow pits or gutters or upon the airport area.

The Contractor shall apply the asphaltic material at a temperature within 8°C of the temperature selected.

The width of each application of asphaltic material shall be such to allow uniform application and immediate covering with aggregate.The Contractor shall be responsible for uniform application of asphaltic material at the junction of distributor loads.Paper or other suitable material shall be used to prevent overlapping of transverse joints.Longitudinal joints shall match lane lines unless otherwise authorized by the Engineer.Application of asphaltic material will be measured as necessary to determine the rate of application.

(5) Application of Aggregate Material. Immediately after the application of the asphalticmaterial or when directed, the aggregates at the rate specified for each designated application shall be spread uniformly over the asphaltic material.The aggregate shall be spread in the same width of application as the asphaltic material and shall not be applied in such thickness as to cause blanketing. Back spotting or sprinkling of additional aggregate material, and pouring additional asphaltic material over areas that show up having insufficient cover or asphalt, shall be done by hand whenever necessary. Additional spreading of aggregate material shall be done by means of a motor patrol grader equipped with broom moldboard, a broom drag, or a power broom, as directed by the Engineer.

Immediately after spreading each application, the aggregate shall be rolled. The rolling shall be continued until no more aggregate material can be worked into the surface. In the construction of a second and third application, blading with the wire broom moldboard attachment or broom

dragging shall begin as soon as possible after the rolling has started and after the surface has set sufficiently to prevent excessive marking. Further blading and rolling on the strip being placed and on adjacent strips previously placed, shall be done as often as necessary to keep the aggregate material uniformly distributed. These operations shall be continued until the surface is evenly covered and cured to the satisfaction of the Engineer.

Succeeding applications shall not be applied until the preceding application has set and in no case until at least 24 hours have elapsed. If dust, dirt, or other foreign matter accumulates on the surface between the applications, the Contractor shall be required to sweep and clean the surface as specified herein. The asphaltic material and the aggregate shall be spread upon the clean and properly cured surface and handled as required. Extreme care shall be taken in all applications to avoid brooming or tracking dirt or any foreign matter on any portion of the pavement surface under construction.

All surplus aggregate from the final application shall be swept off the surface and removed prior to final acceptance of the work.

316X.5. Correction of Defects. Any defects, such as raveling, low centers, lack of uniformity, or other imperfections caused by faulty workmanship, shall be corrected to the satisfaction of the Engineer.

All defective materials resulting from overheating, improper handling, or application shall be removed by the Contractor and replaced with approved materials as provided for in these specifications.

316X.6. Measurement.

(1) Asphaltic Material. Asphaltic material will be measured as follows and as specified on the plans.

(a) Volume. Asphaltic material will be measured at point of application on the road in liters at the applied temperature.The quantity to be measured for payment shall be the number of liters used, as directed, in the accepted surface treatment.

(b) Mass. Asphaltic material will be measured in megagrams at the point of origin.Weighing will be done by a certified public weigher and the transporting vehicle shall have a seal attached to the draining device and other openings.At the contractor's expense, the Engineer

may require random checking by reweighing on public scales to verify mass accuracy.An asphalt storage tank shall not be permitted unless approved by the Engineer. If an asphalt storage tank is used, the Contractor shall provide an acceptable means of measuring the amount of asphaltic material received to assure that all material measured at the point of origin is received and used on the project.Upon completion or temporary suspension of the prescribed work, any remaining asphaltic material will be weighed by a certified public weigher or shall be measured by volume in a calibrated distributor or calibrated tank and the quantity converted to megagrams with respect to the measured temperature.The quantity to be measured for payment shall be the number of megagrams received minus the number of megagrams remaining after all directed work is complete and minus the amount for other items.

(2) Aggregates. Aggregate will be measured by the cubic meter in vehicles as applied on the road.

Aggregate (stockpiled), if required to be furnished, will be measured by the cubic meter of material in vehicles at the point of stockpiling or by the cubic meter in the stockpile as computed by the method of average end areas.

When "Loading, Hauling and Distributing Aggregate" is a bid Item, it will be measured by the cubic meter in vehicles as applied on the road.

316X.7. Payment. The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit prices bid for "Asphalt", "Aggregate" and "Aggregate (Stockpiled)", if required, of the type and grade specified.These prices shall each be full compensation for cleaning and sprinkling the existing surface; for furnishing, preparing, hauling, andplacing all materials; for protecting existing pavement markers;for rolling, removing excess aggregate, and cleaning up stockpiles; for all freight and heating involved; and for all manipulations, labor, tools, equipment and incidentals necessary to complete the work.

When "Loading, Hauling and Distributing Aggregate" is a bid Item, the work performed and measured as provided for herein will be paid for at the unit price bid for "Loading, Hauling and Distributing Aggregate".This price shall be full compensation for loading, hauling, applying and distributing aggregate; for protecting existing pavement markers; for rolling, removing excess aggregate, and cleaningup stockpiles; and for all manipulation, labor, tools, equipment and incidentals necessary to complete the work.

APPENDIX E

SPECIAL SPECIFICATION

ITEM 352X A/P

CLEANING AND/OR SEALING JOINTS AND CRACKS

(ASPHALTIC CONCRETE)

DRAFT

SPECIAL SPECIFICATION

ITEM 352X A/P

CLEANING AND/OR SEALING JOINTS AND CRACKS

(ASPHALTIC CONCRETE)

352X.1. Description. This Item shall govern for the cleaning and sealing of joints and cracks that are two (2) millimeters or greater in width in asphaltic concrete pavements for runways, taxiways, aprons, runway safety areas and supporting pavements and parking areas.The work will be done in accordance with the details on the plans or as directed by the Engineer.

352X.2. Materials. Joints and/or cracks shall be sealed with the materials shown on the plans.Materials shall meet the requirements shown as follows.

MaterialSpecificationRecommended Use

Polymer ModifiedItem 300

EmulsionSubarticle 300.2.(8)Fine Cracks

Rubber-Asphalt Crack Item 300

Sealing CompoundSubarticle 300.2.(8)Cracks

Hot Poured Rubber Item 433 Joints and Cracks

Article 433.2

Self-Leveling Low Item 433

Modulus Silicone Article 433.2 Joints

Fine aggregate used to cover the crack sealing compound shall meet with the approval of the Engineer .

352X.3. Equipment. Equipment, tools and machinery necessary for proper prosecution of the work shall be on the project and approved by the Engineer prior to beginning of the joint and crack cleaning and sealing operations.

(1) Heating and Application Equipment.

(a) Polymer Modified Emulsion. Polymer modified emulsion may be heated in a conventional asphalt distributor or in an asphalt heater equipped with an agitator to insure that the emulsified asphalt is circulated during the heating process to achieve a uniform temperature rise.Temperature gauges shall be provided at strategic locations to enable the operator to accurately control the temperature of the emulsion to avoid overheating the material.The unit shall be equipped with a gear-driven asphalt pump with adequate pressure to dispense the emulsion in joints and cracks.

(b) Rubber-Asphalt Crack Sealing Compound and Hot Poured Rubber. These sealants shall be heated in a double jacketed heater using a heat transfer oil so that no direct flame comes in contact with the shell of the vessel containing the sealing compound.The heater reservoir shall be equipped with an agitator to insure that the sealing compound is circulated during the heating process to achieve a uniform temperature rise and to maintain the desired temperature .Accurate temperature gauges shall be provided to monitor the temperatureof the vessel contents and avoid overheating the material.The heater shall be equipped with a gear-driven asphalt pump with adequate pressure to dispense the rubber-asphalt crack sealing compound or the hot poured rubber.

(c) Self-Leveling Low Modulus Silicone. This sealant shall be prepared and dispensed using the manufacturer's recommended equipment.

(2) Joint and Crack Cleaning Equipment. All equipment used in cleaning joints and cracks shall be capable of delivering a sufficient volume of filtered air, free of oil, water or other contaminants, to remove all loose debris from the joints or cracks to be sealed.

(3) Joint Router. When specified on the plans, joints shall be routed.The router shall be of sufficient size to rout the joints to the widths and depths shown on the plans.

352X.4. Construction Methods. All joints and cracks shall be cleaned of infiltrated material with compressed air or other methods approved by the Engineer to a depth at least twice

the joint or crack width.When routing of the joints is indicated on the plans, the joints shall be routed and blown clean with filtered compressed air.All material removed from joints and cracks shall be removed from the paved surface of the roadway.

The joint or crack sealing material shall be applied using a pressure nozzle.Polymer modified emulsion, rubber-asphalt crack sealing compound and hot poured rubber shall penetrate and completely fill each crack and/or joint.The amount of sealing compound used shall be limited so that after the squeegee has been applied, the finished band shall not be more than 40 millimeters wide and shall not exceed a depth of three (3) millimeters above the pavement surface.All cracks and/or joints filled with these materials shall be squeegeed.Self-leveling low modulus silicone joint sealing compound shall be applied so that it penetrates the joint and fills so that the top of the sealant shall be six (6) millimeters to ten (10) millimeters below the pavement surface.

When directed by the Engineer, a light coating of fine aggregate shall be applied to the cracks and joints prior to opening to traffic to prevent tracking.

When the number of cracks is so great that crack sealing in the described manner is impractical, the area shall be squeegee sealed.When all cracks in the area have been cleaned, the crack sealing material shall be applied and the excess shall be squeegeed over the area between the cracks.Areas to be squeegee sealed will be determined and marked by the Engineer.All polymer modified emulsion or hot poured rubber squeegee sealed areas shall be covered immediately with a light coating of fine aggregate.

No sealing of any joints or cracks shall be done when the joints or cracks are damp, unless drying of the joints and cracks with compressed air can be demonstrated and meets with the approval of the Engineer.

352X.5. Measurement. This Item will be measured by one or more of the following methods as shown on the plans.

(1) Square Meter Method (Squeegee Seal). When cleaning and sealing of joints and cracks is either by the meter method or the lane kilometer method, squeegee-sealed areas will be measured by the square meter of surface area sealed.The square meter calculations for squeegee seal will be based on the neat dimensions of the sealed area.

(2) Meter Method. Measurement will be made by the meter of joints and cracks cleaned and sealed, excluding squeegee sealed areas.Squeegee sealed areas are to be paid for separately.

(3) Lane Kilometer Method. Measurement will be made by the lane kilometer for cleaning and sealing all joints and cracks in the entire lane width and length, including lane lengths with squeegee sealed areas.Squeegee sealed areas are to be paid for separately.The shoulder shall be considered as an additional lane.

(4) Kilogram Method. Measurement will be made by the kilograms of rubber-asphalt crack sealing compound or hot poured rubber used for cleaning and sealing joints and cracks, including squeegee sealed areas.

(5) Liter Method. Measurement will be by the liters of polymer modified emulsion or self-leveling low modulus silicone used for cleaning and sealing joints and cracks, including squeegee sealed areas.

352X.6. Payment. The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Joint and Crack Sealing", of the type of sealant specified; "Joint and Crack Sealing (Squeegee)"; or "Joint and Crack Sealing".This price shall be full compensation for routing, cleaning and sealing all joints and cracks, for furnishing and placing all materials including fine aggregate and for all labor, equipment, tools and incidentals necessary to complete the work.

APPENDIX F

SPECIAL SPECIFICATION

ITEM 433X A/P

CLEANING AND/OR SEALING JOINTS AND CRACKS

(PORTLAND CEMENT CONCRETE)

DRAFT

SPECIAL SPECIFICATION

ITEM 433X A/P

CLEANING AND/OR SEALING JOINTS AND CRACKS

(PORTLAND CEMENT CONCRETE)

433X.1. Description. This Item shall govern thematerial requirements and installation for joint sealants, backing materials and joint fillers and for the cleaning and/or sealing joints and cracks in Portland cement concrete airfield runways, taxiways, safety areas and other support pavements.

433X.2. Materials. The materials for this Item shall conform to the following.

(1) Joint Sealant Materials. Joint sealant material shall be the class indicated on the plans or in the governing specifications.The various classes of sealant described herein shall be in accordance with Departmental Material Specification D-9-6310.Copies of specification D-9-6310 are available from the Texas Department of Transportation, Director of Materials and Tests, 125 E. 11th Street, Austin, TX 78701-2483.

(2) Storage. Class 1 and 2 sealants shall be stored at temperatures between 5° C and40° C.Class 4 and 5 sealants shall be stored in sealed containers at a temperature of 40° C or below and the material must be used within two (2) months of receipt on the project.

(3) Classes of Joint Sealants.

(a) Class 1. Two Component, Synthetic Polymer, Non-sag. The components shall be proportioned and mixed in accordance with the manufacturer's recommendations.

(b) Class 2.Two Component, Synthetic Polymer, Self-leveling. The components shall be proportioned and mixed in accordance with the manufacturer's recommendations.

(c) Class 3. Hot Poured Rubber. This sealant shall be a rubber asphalt compound which when heated shall melt to the proper consistency for pouring and shall solidify on cooling to the ambient temperatures.

(d) Class 4. Non-sag Low Modulus Silicone. The material shall be a single component formulation not requiring addition of a catalyst.

(e) Class 5. Self-leveling Low Modulus Silicone. The materialshall be a single component formulation not requiring addition of a catalyst.

(f) Class 6. Preformed Joint Sealant (PJS). The preformed joint sealant shall be an extruded elastomeric material having a multi-channeled shape.

The size shown on the plans shall be the nominal width of the sealant.The uncompressed depth of the seal shall be equal to or greater than the width.

All preformed joint sealants installed by the Contractor shall have been prequalified for compliance with the requirements.Each size and configuration of seal produced by a manufacturer must be approved by the Engineer prior to use on Department projects.For a sealant manufacturer to prequalify and obtain approval of a sealant, detailed dimensions and configuration of each size of sealant and certified test results indicating compliance with Departmental Materials Specification D-9-6310 and any requirements shown on the plans and specifications shall be submitted to the Engineer.

Submission shall be done sufficiently in advance of work to allow for testing and evaluation of the material.

The Engineer will confirm by visual inspection that the sealant proposed for installation is the same size, configuration and manufacture as shown on the plans.The Engineer will examine the sealant for any undue distortions, such as dissymmetry, warping, thick webs or uneven width which are likely to impair the performance of the joint.If the magnitude of the distortions are sufficient to create doubts as to the performance of the sealant, the Engineer may direct that the sealant be replaced or that samples representing the worst of the lot be subjected to further testing to verify their performance.

(g) Class 7. Self-leveling, Rapid Curing, Low modulus Silicone. This material shall be a two component, rapid curing, self-leveling, low modulus formulation.The

components shall be proportioned and mixed in accordance with the manufacturer's recommendations.

(4) Backer Rods and Backing Materials. These materials shall be capable of holding the fluid sealant in open joints in place.In all cases, these materials shall be of such a type that will not bond to the sealant and shall not react or bond together.The backing materials shall meet the requirements of the sealant manufacturer.They shall be compressible type materials, such as closed-cell, resilient foam or sponge rubber stock of vinyl, butyl or neoprene, or expanded polyethylene or polyurethane.

The diameter of the backer rod shall be at least 25 percent larger than the joint reservoir width.

(5) Joint Fillers. Joint fillers shall be of such size, shape and type indicated on the plans and shall conform to the following requirements.

(a) Timber Boards. Timber boards shall be obtained from redwood, cypress, gum, southern yellow pine or Douglas fir timber.They shall be sound heartwood and shall be free from sapwood, knots, clustered bird's-eye, checks and splits.Occasional sound or hollow bird's-eye, when not in clusters, will be permitted provided the board is free from any other defects that will impair its usefulness as a joint filler.All boards, except redwood and cypress, shall have a creosote or pentachlorophenol treatment conforming to Item 492, "Timber Preservative and Treatment", Table 1.When oven dried at 110° C to a constant mass, the mass of the board per cubic meter (minus treatment) shall not be less than 320 kilograms nor more than 560 kilograms.

(b) Asphalt Boards. Asphalt boards shall consist of two (2) suitable asphalt-impregnated liners filled with a mastic mixture of asphalt and vegetable fiber and/or mineral fiber.Asphalt boards shall be smooth, flat and sufficiently rigid to permit installation.When tested in accordance with Test Method Tex-524-C, the horizontal deflection shall not be more than 25 millimeters in 90 millimeters.

(c) Preformed Fiber Material.

(c.1) Preformed Bituminous FiberMaterial. Preformed bituminous fiber material shall meet the requirements of ASTM D 1751.

(c.2) Preformed Nonbituminous Fiber Material. Preformed nonbituminous fiber material shall meet the requirements of ASTM D-1751, except that the requirements pertaining to bitumen content, density and water absorption shall be voided.

(d) Rebonded Neoprene Filler. Rebonded neoprene filler shall consist of ground closed-cell neoprene particles, rebonded and molded into sheets of uniform thickness of the dimensions shown on the plans, meeting the requirements of ASTM D-1752, Type I.Certification that the material meets these requirements shall be furnished to the Engineer.

(6) Lubricant. Lubricant for installation of preformed joint seal shall be a one component polychloroprene compound containing only soluble phenolic resins blended together with antioxidants and acid acceptors in aromatic hydrocarbon solvent mixture and shall meet therequirements recommended by the manufacturer of the seal.

Each shipment of lubricant shall be delivered to the job site in the manufacturer's original sealed container. Each container shall be marked with the manufacturer's name, batch or lot number, and the date of manufacture and shall be accompanied by the manufacturer's certification stating that the lubricant meets the requirements of the specification. This lubricant shall be stored at a temperature between 10 °C and 30 °C and shall be used within 270 days of its manufacture.

433X.3. Equipment. All equipment shall be in accordance with the sealant manufacturer's recommendations.

Air compressors shall be equipped with appropriate filters for removing oil and water from the air.

433X.4. Construction Methods. Prior to beginning operations, the Contractor shall submit a statement from the sealant manufacturer showing the recommended equipment and installation procedures to be used.All equipment and procedures will be subject to approval by the Engineer.

The use of any material which damages dowels, reinforcing steel, concrete, base subbase or subgrade shall be discontinued, and the joint and/or crack shall be cleaned by other methods which do not cause such damage.

Joints shall be sealed as soon as feasible and, if possible,before the pavement is opened to traffic, including construction equipment. The pavement temperature shall be above 4 °C at the time of installation of the preformed joint seal and 10 °C for poured joint sealing material.

If the pavement must be opened to traffic prior to placement of the sealant, this paragraph should be modified to require the Contractor to temporarily fill the joint with a jute or nylon rope immediately after the joint is sawed. The rope should be slightly larger than the joint and should be forced into the joint so that the top of the rope is 3 mm below the pavement surface. The rope shall be removed immediately prior to cleaning.

(1) Joint and Crack Preparation. Immediately before sealing, the joints shall be thoroughly cleaned and free of all laitance, curing compound, debris, dirt, saw cuttings or other foreign material.

(a) Joint Preparation. The joints shall be cleaned by a method approved by the Engineer.Unless otherwise shown on the plans, hand tools, air guns, power routes, abrasive blasting equipment or other equipment may be used to clean the joints.Where shown on the plans, the joint sealant space shall be reissued by sawing to the width and depth shown on the plans to accommodate the type of sealant specified.

(b) Crack Preparation. Unless otherwise required, the crack shall first be grooved at the surface so that a reservoir of rectangular cross section is provided for the sealant.Grooves shall be cut to the dimensions shown on the plans.Devices used for grooving, such as diamond blade random cut saws, random-crack grinders, etc., shall be capable of following the path of the crack without causing excessive spalling or other damage to the concrete.

(2) Joint and Crack Sealing. Joints shall be inspected for proper width, depth, alignment, and preparation, and shall be approved by the Engineer before sealing is allowed.

The Contractor shall install the sealant in accordance with the manufacturer's recommended procedure.Joint and crack surfaces shall be dry unless otherwise recommended by the manufacturer of the sealant.The surface temperature at the time of sealing shall not be less than 5° C.The top of the sealant shall be three (3) millimeters to six (6) millimeters below the pavement surface.The minimum depth of sealant shall be 13 millimeters or as recommended by the sealant manufacturer.

(a) Primer. Primer, if required, shall be applied as soon as possible after cleaning.Primer shall be applied uniformly at the approximate rate recommended by the sealant manufacturer.The primer shall be applied to metal surfaces before new corrosion begins and shall be allowed to cure a minimum of 30 minutes but not more than eight (8) hours before applying the sealant, unless otherwise recommended by the sealant manufacturer.

(b) Backer Rods. Backing material shall be used to prevent fluid type sealant from flowing through the joint or crack and to hold the sealant at its required elevation.The use of such material shall be as recommended by the sealant manufacturer and approved by the Engineer.

(c) Hot Poured Sealants. The joint sealant shall be applied uniformly solid from bottom to top and shall be filled without formation of entrapped air or voids. A backing material shall be placed as shown on the plans and shall be nonadhesive to the concrete or the sealant material. The heating kettle shall be an indirect heating type, constructed as a double boiler. A positive temperature control and mechanical agitation shall be provided. The sealant shall not be heated to more than 11 °C below the safe heating temperature recommended by the manufacturer. Any sealant spilled on the surface of the pavement shall be removed immediately.

(d) Cold Applied Sealants. Cold applied joint sealing compound shall be applied by means of pressure equipment that will force the sealing material to the bottom of the joint and completely fill the joint without spilling the material on the surface of the pavement. A backing material shall be placed as shown on the plans and shall be nonadhesive to the concrete or the sealant material. Sealant which does not bond to the concrete surface of the joint walls, contains voids, or fails to set to a tack-free condition will be rejected and replaced by the Contractor at no additional cost.

(e) Preformed Elastomeric Joint Seals. Preformed joint sealer shall be placed using equipment capable of installing the sealer in the upright position, without cutting, nicking, distorting, or otherwise damaging the seal. Lubricant shall be applied to the concrete or the preformed seal, or both, and the seal shall be installed in a substantially compressed condition and at the depth below the surface of the pavement as shown in the plans. The method of installation shall be such that the joint sealer will not be stretched more than 5 percent of the minimum theoretical length, or compressed more than 2 percent.

433X.5. Measurement. When specified on the plans to be a pay item, "Cleaning and/or Sealing Joints and Cracks" will be measured by the meter of sealant complete in place.

433X.6. Payment. The work performed and materials furnished as required by this Item will not be paid for directly but will be considered subsidiary to the various bid items of the contract, unless specified as a pay item in the contract.

When shown as a pay item, the work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Cleaning Existing Joints", "Cleaning and Sealing of Existing Joints", and "Cleaning and Sealing Cracks".This price will be full compensation for furnishing all materials; for all sawing, routing, and cleaning and installing; and for all manipulations, labor, equipment, tools and incidentals necessary to complete the work.

APPENDIX G

SPECIAL SPECIFICATION

ITEM 30XX A/P

COAL TAR SEALER/REJUVENATOR

DRAFT

SPECIAL SPECIFICATION

ITEM 30XX A/P

COAL-TAR SEALER/REJUVENATOR

30XX.1. Description. This item shall govern for the application of a coal-tar sealer/rejuvenator to an existing asphalt paved surface.The purpose of this application is to rejuvenate an oxidized or otherwise aged asphalt binder and/or provide a protective fuel resistant surface when applied to airport runways, taxiways and fueling areas.

The material shall be applied in accordance with these specifications to the areas shown on the plans, or as designated by the Engineer.

30XX.2. Materials.

(1) Bituminous Materials. The bituminous materials shall be ASTM D 490, "Tars (For Use in Road Construction)" and meet100% of the following materials requirements within the ranges specified below.

Materials	Minimum	Maximum
Coal-Tar Pitch	35%	50%
Maltenous type petroleum distillate	32%	42%
Coal-tar Oils/Rejuvenator	15%	40%

The coal-tar pitch shall conform to the requirements of ASTM D 490, Grade RT-12, and the maltenous type petroleum distillate shall be compatible with the tar components. The bituminous materials shall meet the above requirements.Coal-tar solvent components will not be deemed to meet the coal-tar oil requirements as specified above. Coal-tar solvent naphtha will not be allowed. The rejuvenator content shall be in addition to the indigenous oils contained in the coal-tar pitch.

TABLE 1. BITUMINOUS MATERIAL PROPERTY REQUIREMENTS

Test Property	Test Method	Requirements
Specific Gravity @ 25/25°C	ASTM D 70	1.04 min.
Viscosity Engler 50cc @ 50C	ASTM D 1665	8.0 max.
Water % by Volume	ASTM D 95	2.0 max.
Distillation % by weight to.	ASTM D 20	
170° C		20 min.
270° C		25-45
300° C		30-55
Softening Point of Residue From 300°C Distillation Test	ASTM D 36	40-55° C

(2) Product Verification. It shall be the responsibility of the Contractor to verify that the bituminous materials meet the requirements set forth in Section 2.(1) by submitting a sample of the product to the Engineer along with the results of an independent commercial materials testing laboratory that confirms full compliance of the product. In addition, a statementfrom the manufacturer shall be furnished to the Engineer that the tests on the sample are an accurate representation of the materials to be furnished on the project.

In addition, the Contractor shall provide a written warranty that states.

The Manufacturer of the sealer/rejuvenator and/or its authorized representative will warrant that from the date the product is applied and for a period of three years thereafter, the material will not flake, peel, chip or spall or the Manufacturer (and/or its authorized representative) will reapply the coal-tar sealer/rejuvenator, as necessary, at no cost to the airport owner. Further, the Manufacturer's authorized representative will warrant the treated surface to be fuel resistant for a period of three years after the date of application.This warranty shall remain in effect only if spills are cleaned up as per local EPA regulations.

30XX.3. Application Rates.

(1) Test Section. Prior to full production the Contractor shall construct a series of test sections at the specific rates specified by the Engineer (between 0.23- 0.45 liters per square meter)The area to be tested will be designated by the Engineer and will be located on the existing pavement to be treated.The Engineer shall examine the test sections 24 hours after treatment and advise the Contractor of the application rate for the project.

(2) Application Rate. The coal-tar sealer/rejuvenator shall be uniformly applied at the rate determined as specified above.This rate shall not be varied without the approval of the Engineer.The application temperature of the coal-tar sealer/rejuvenator shall be between 21 and 49° C.

30XX.4. Construction Methods.

(1) Weather Limitations. The sealer/rejuvenator shall be applied only when the existing is dry and the air temperature is at least 10° C or higher and rising.

(2) Equipment. The pressure distributor shall be designed, equipped and operated with a hooded spray bar so that. a) the coal-tar sealer/ rejuvenator can be applied uniformly on variable widths of pavement at the specified rate, adjustable in increments of 0.02 liters per square meter, and . b) the applicator shall maintain proper nozzle height.

(3) Cleaning Existing Surface. Prior to placing the sealer/rejuvenator, the Contractor, utilizing a power broom or approved equal, shall clean the surfaces of the pavement to be treated and assure that they are free of all debris, dust, dirt and other loose matter.The pavement shall be properly cleaned by the Contractor to the satisfaction of the Engineer.

(4) Application of Material. The coal-tar sealer/rejuvenator shall be applied at the rate as approved above to the prepared surface.Following application, the surface shall be allowed to cure without being disturbed until the sealer has thoroughly dried.This period shall be coordinated between the Contractor and the Engineer.Suitable precautions shall be taken by the Contractor during this period to protect the applied product, including the proper application of any sand necessary used to blot up any excess material.

30XX.5. Measurement. The coal-tar sealer/rejuvenator shall be measured in place by the square meter of surface area treated.

The Contractor shall furnish the Engineer with the receipted bills when railroad shipments are made, and certified weigh bills when materials are received in any other manner, for the coal-tar sealer/rejuvenator used in the construction under this Item.The Contractor's shall not remove material from the tank car or storage tank until initial outage and temperature measurements have been verified.

30XX.6. Payment. The work performed and materials furnished in accordance with this Item and measured as provided under "MEASUREMENT"will be paid for at the unit bid price per square meter. This price shall be full compensation for allcleaning of existing surfaces; for furnishing, preparing, hauling, and placing all materials; for all freight and heating involved; and for all manipulations, labor, tools, equipment and incidentals necessary to complete the work.

APPENDIX H

SPECIAL SPECIFICATION

ITEM 3042 A/P

MICRO-SURFACING (POLYMER MODIFIED)

FOR AIRPORT CONSTRUCTION

SPECIAL SPECIFICATION

ITEM 3042 A/P

MICRO-SURFACING (POLYMER MODIFIED)

FOR AIRPORT CONSTRUCTION

3042.1. Description. This item shall consist of a micro-surfacing system specifically for use on airport paving and which shall be a mixture of cationic polymer modified asphalt emulsion, mineral aggregate, mineral filler, water and other additives mixed and placed on a paved surface in accordance with these specifications and to the dimensions as shown on the plans.

3042.2. Materials.

(1) Asphaltic Material. The asphalt material, designated as CSS-1P shall be a cationic slow setting emulsion modified with an approved polymer. The polymer shall be incorporated by blending with the base asphalt prior to emulsification or it shall be co-milled with the asphalt to produce the finished emulsion.The distillation residue of the modified emulsion shall contain a minimum of 3.0 percent polymer by weight, as determined by an analytical method approved by the Department.The emulsion supplier shall furnish the Department samples of the base asphalt and polymer used in the finished emulsion.

In addition, the emulsion shall be homogeneous, shall show no separation of polymer and shall comply with the following requirements.

	Min	Max
Polymer content distillation residue, % by weight	3.0	
Viscosity, Saybolt Furol at 25 C, s	20	100
Storage stability test, one day, %	--	1
Particle charge test	Positive	
Sieve test, %	--	0.1

*Distillation.

Oil distillate, by volume of emulsion, %		0.5
Residue, %	62	--

Tests on Residue from Distillation.

Penetration, 25 C, 100 g, 5 s	55	90
Ductility, 25 C, 5 cm/min, cm	70	--
Solubility in trichlorethylene, %	97	--
Softening Point, R. & B., C	60	--

*The standard distillation procedure shall be modified as follows.

The temperature on the lower thermometer shall be brought slowly to 177¡C ± 5¡C and maintained at this point for 20 minutes.Complete the total distillation in 60 plus or minus five (5) minutes from the first application of heat.

(2) Mineral Aggregate.

(a) Description. The mineral aggregate shall be all generatedby crushing operations from a single source and shall be composed of clean, tough and durable particles of crushed traprock, crushed granite, crushed sandstone or other material approved by the Engineer.A sand equivalent value of 70 or higher is required unless otherwise shown on the plans.The aggregate shall show a maximum weighted loss of 30 percent when subjected to five (5) cycles of conditioning using magnesium sulfate solution in accordance with Test Method Tex-411-A.The test shall be performed on the gradation to be used on the project.

The polish value for the aggregate shall not be less than the value shown the plans when tested in accordance with Test Method Tex-438-A.The polish value test shall be performed on the parent rock.The Engineer may waive the polish value requirement for aggregates with known satisfactory performance historybased on Department skid values.

(b) Grades. When tested by Test Method Tex-200-F, Part II, Washed Sieve Analysis, the gradation requirements shall be as follows.

Retained on Sieve	Percent Aggregate By Weight
Grade 1 (Fine Graded Surface Course)	
9.5mm	0
.75mm	0-2
.36mm	10-25
1.18mm	25-50
600µm	50-70
300µm	65-82
150µm	79-90
75µm	85-95
Grade 2(Coarse Graded Surface Course)	
12.5mm	0
9.5mm	0-1
4.75mm	6-14
2.36mm	35-55
1.18mm	54-75
600µm	65-85
300µm	75-90
150µm	82-93
75µm	85-95

(c) Mineral Filler. Mineral filler shall be non-air-entrained Portland cement which is free lumps and foreign matter.

(d) Water. The water shall be potable and shall be free of harmful soluble salts.

(e) Other Additives. With the approval of the Engineer, additives approved by the emulsion manufacturer may be added to the emulsion mix or to any of the component materials to provide control of the time of set in the field.

(3) Paving Mixture.

(a) Mixture Design. The mixture design, or job mix formula shall be supplied by the Contractor and subject to approval by the Engineer.Laboratory mixing and curing procedures shall be as outlined in Test Method Tex-230-F.The emulsified asphalt content will be selected to provide an optimum laboratory compacted density within the range of 92 to 95 percent when evaluated in accordance with Test Method Tex-204-F in conjunction with Test Method Tex-227-F.Hveem stability will required only when a minimum value is shown on the plans.These mix design requirements are subject to verification by testing of laboratory produced mixes or trial batch material prior to placement of project material.

(b) Composition of Mixture. The polymer modified micro-surfacing shall consist of a uniform mixture of aggregate and CSS-1P emulsion and mineral filler, water and field control additive as required.The emulsion and aggregate must be compatible so that a complete, uniform coating of the aggregate will be obtained in the mixing process.The mixture must have sufficient working life to allow for proper placement at the existing ambient temperature and humidity.When the paving mixture is placed with the relative humidity at not more than 50 percent and ambient air temperature of at least 24 C, it must be cure sufficiently that uniformly moving traffic can be allowed onto the surface in one hour with no damage to the surface.Locations subject to sharp turning or stopping and starting traffic may require additional curing.

The approved job mix formula shall have proportions within the following limits.

Residual Asphalt	6.0 to 9.0 percent by weight of dry aggregate
Mineral Filler	0.5 to 3.0 percent by weight of dry aggregate (Portland Cement)
Field Control Additive	As required to provide control of the break and cure of the emulsion
Water	As required to provide proper consistency

The mixture shall be designed so that the mineral aggregate will produce a gradation which conforms to the limitations for the master grading for the type specified herein.The gradation will be determined in accordance with Test Method Tex-200-F (Washed Sieve Analysis) and shall be based upon aggregate and mineral filler.

(c) Determination of Mixture Composition and Tolerances. Determination of aggregate gradation may be based on sieve analysis of representative samples taken from the stockpile at the job site.The amount of mineral filler added to the mix shall be included in determining the total minus 75μm aggregate fraction.The asphalt content may be determined in accordance with Test Method Tex-228-F.Alternately, aggregate gradation and asphalt content may be determined by Test Method Tex-210-F.If Test Method Tex-210-F is used, an asphalt retention factor must be established.

Mix Samples will be taken from the mixing unit discharge in a manner such that the complete discharge stream is included in the sample.Mix samples shall be dried to constant weight at 110 C plus or minus 5 C prior to determination of asphalt content and aggregate gradation.The aggregate portion of the paving mixture produced shall not vary from the design gradation by more than the following tolerances.The material passing the 75μm sieve is further restricted to conform to the limitations for the master grading for the type specified.The residual asphalt content of the paving mixture shall not vary from the design amount by more than the allowed tolerance and is also restricted to conform to the master limits.

	Percent by Weight or Volume as Applicable
Passing 9.5mm sieve, retained on 4.75mm sieve	Plus or Minus5
Passing 4.75mm sieve, retained on 2.36mm sieve	Plus or Minus5
Total Retained on 2.36mm	Plus or Minus5
Passing 2.36mm sieve, retained on 1.18mm sieve	Plus or minus3
Passing 1.18mm sieve, retained on 600μm sieve	Plus or Minus3
Passing 600μm sieve, retained on 300μm sieve	Plus or Minus3
Passing 300μm sieve, retained on 150μm sieve	Plus or Minus3
Passing 150μm sieve, retained 75μm sieve	Plus or Minus3
Passing 75μm sieve	Plus or Minus3
Residual Asphalt Content	Plus or Minus 0.5 by wt.

(4) Equipment. All equipment for the handling of all materials and mixing and placing of the mixture shall be maintained in good repair and operating condition and is subject to the approval of the Engineer.Any equipment found to be defective and potentially affecting the quality of the paving mixture shall be replaced.All scales used in weighing aggregate and emulsion shall conform to the requirements of Item 520, "Weighing and Measuring Equipment".

The material shall be mixed by a self-propelled micro-surfacing mixing machine which shall be a continuous flow mixing unit able to accurately deliver and proportion the aggregate, emulsified asphalt, mineral filler, field control additive and water to a revolving multi-blade mixer and discharge the mixed product on a continuous flow basis.Themachine shall have sufficient storage capacity for aggregate, emulsified asphalt, mineral filler, field control additive and water to maintain an adequate supply to the proportioning controls.The machine shall be equipped with self loading devices which provide for the loading of all materials while continuing to lay the micro-surfacing, thereby minimizing construction joints.The machine shall be equipped with opposite side driving stations to optimize longitudinal alignment.The machine shall be equipped to allow the mix operator to have full hydrostatic control of the forward and reverse speed during application of the micro-surfacing material.

Individual volume or weight controls for proportioning each material to be added to the mix shall be provided.Each material control device shall be calibrated and properly marked.The aggregate feed to the mixer shall be equipped with a revolution counter or similar device so the amount of aggregate used may be determined at any time.The emulsion pump shall be a positive displacement type and shall be equipped with a revolution counter or similar device so that the amount of emulsion used may be determined at any time.

The mixing machine shall be equipped with a water pressure system and nozzle type spray bar to provide a water spray immediately ahead of and outside the spreader box.It also shall be equipped with an approved fines feeder that shall provide a uniform, positive, accurately metered, predetermined amount of the specified mineral filler.

(5) Stockpiling and Storage.

(a) Aggregate Storage. If the mineral aggregates are stored or stockpiled, they shall be handled in such a manner as to prevent segregation, mixing of the various materials or sizes, and contamination with foreign materials.The grading of aggregates proposed for use and as supplied to the mixing plant shall be uniform.Suitable equipment of acceptable size shall be furnished by the

contractor to work the stockpiles and prevent segregation of the aggregates.The aggregate shall be passed over a scalping screen prior to transfer to the micro-surfacing mixing machine to remove oversize material.

(b) Storage of Asphaltic Materials.The asphaltic material storage shall be ample to meet the requirements of the plant.All equipment used in the storage and handling of asphaltic material shall be kept in a clean condition at all times and shall be operated in such manner that there will be no contamination with foreign matter.

(6) Construction Methods.

(a) General. It shall be the responsibility of the Contractor to produce, transport, and place the specified paving mixture in accordance with these specifications and as approved by the Engineer.The finished micro-surfacing shall have a uniform texture free from excessive scratch marks, tears or other surface irregularities.The cured mixture shall adhere fully to the underlying pavement.

(b) Weather Limitations. The material shall be placed only when the ambient temperature is at least 10 C and rising and the weather is not foggy or rainy and there is no forecast of temperatures below 0 C within 24 hours after mix placement.

(c) Surface Preparation. Prior to placing a tack coat or the micro-surfacing mixture, unsatisfactory areas shall be repaired and the surface of the pavement shall be clean and free from any vegetation, dust, dirt, or other loose foreign matter, grease oil, or any type of objectionable surface film.The pavement shall be swept with hand brooms or power sweepers or cleaned with a power blower.When required, the pavement surface shall be flushed with pressure streams of water; provided, however, that flushing with pressure streams of water shall not be permitted in areas having significant amounts of surface cracking.Grates, manholes, tie downs, or other such appurtenances shall be protected from the surfacing material.

Unless otherwise directed by the Engineer, any painted stripes or markings on the surface to be paved shall be removed prior to the application of a tack coat and/or micro-surfacing.

Unless otherwise directed by the Engineer, all cracks exceeding 9.55mm in width shall be cleaned and sealed with a compatible joint sealer as directed by the Engineer prior to the placement of the micro-surfacing mixture.

When required by note on the plans, following the preparation of the surface for paving, The Contractor shall apply a diluted asphalt emulsion tack coat to the existing surface.The tack coat shall consist of one part emulsified asphalt of the same type used in the micro-surfacing mixture mixed with three parts water and shall be applied with a pressure distributor of an approved type.Tack coat shall be applied at a rate of 0.2 to 0.6 liter residual asphalt per square meter as directed by the Engineer.The tack coat, if required, shall be applied at least 2 hours before the placement of the micro-surfacing mixture.

(d) Spreading Equipment. The paving mixture shall be spread uniformly by means of a mechanical type spreader box attached to the mixer, equipped with paddles or other devices to agitate and spread the materials throughout the box.The spreader box used must be capable of obtaining the desired lines and grade as shown on the plans.A front seal shall be provided to insure no loss of the mixture at the road contact surface.The rear seal shall act as a strike off and shall be adjustable.A secondary strike off shall be provided to improve surface texture.The second strike off shall have the same adjustments as the rear seal.The mixture shall be spread to fill cracks and minor surface irregularities and leave a uniform skid resistant application of aggregate and asphalt on the surface.The spreader box and rear strike off shall be so designed and operated that a uniform consistency is achieved to produce a free flow of material to the rear strike off.The seam where two spreads join shall be neat appearing and uniform.

(e) Ruts. When required on theplans, before the final surface course is placed, preliminary micro-surfacing material shall be required to fill ruts, utility cuts, depressions in the existing surface, etc.Ruts of 12.5mm or greater shall be filled independently with a rut filling spreader box either 1.5 or 2.0 meters in width.For irregular or shallow rutting less than 12.5mm in depth, a full-width scratch coat pass may used as directed by the Engineer.Ruts that are in excess of 37.5mm depth may require multiple placements with the rut filling spreader box to restore the original cross section.

(f) Workmanship. No excessive buildup, uncovered areas or unsightly appearance will be permitted on longitudinal or transverse joints.Longitudinal joints shall be placed on lane lines.Excessive overlap will not be permitted.Care shall be taken to insure straight lines along the roadway centerline, lane lines or shoulder lines.Lines at intersections will be kept straight to provide a good appearance.

(7) Measurement. This Item will be measured by the megagram of the composite "micro-surfacing (polymer modified")The composite micro-surfacing (polymer modified) mixture is hereby defined as the asphalt emulsion, aggregate and additives.

(a) Aggregate. The quantity of aggregate used in the accepted portions of the work shall be measured by net ticket weight of each individual load of aggregate shipped to the project based on dry weight of aggregate.The aggregate will be weighed at the Contractor's stockpile site.The weighing equipment can be either a suspended hopper or a beltscale meeting the requirements of Item 520.The weight of mineral filler used shall be calculated and included in the total aggregate weight.

(b) Polymer Modified Asphalt Emulsion. The quantity of polymer modified asphalt emulsion in the accepted portion of the work shall be measured by tons of material based on the accepted load tickets issued from the manufacturer.At the completion of the project any unused emulsion shall be weighed back and that quantity deducted from the accepted asphalt emulsion quantity delivered.

(8) Payment. The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Micro-surfacing (Polymer Modified)", of the grade specified.This price shall be full compensation for furnishing all materials and performing all operations necessary to complete the work.

APPENDIX I

SPECIAL SPECIFICATION

ITEM 31XX A/P

EMULSIEFIED ASPALT SLURRY SEAL SURFACE TREATMENT

DRAFT

SPECIAL SPECIFICATION

ITEM 31XX

EMULSIFIED ASPHALT SLURRY SEAL SURFACE TREATMENT

31XX.1. Description.This item shall govern for the construction of a slurry seal surface treatment for airport runways, taxiways and support pavements and shall consist of a mixture of emulsified asphalt, mineral aggregate, and water; properly proportioned, mixed, and spread evenly on a prepared underlying course or existing wearing course in accordance with these specifications and shall conform to the dimensions shown on the plans or as directed by the Engineer.This Item shall also govern for the furnishing of Aggregates (Stockpiled)Quantities for the materials will be as shown on the Basis of Estimate in the Plans.

31XX.2. Materials. All materials shall be of the type(s) and grades shown herein or on the plans and shall conform to the pertinent material of this specification and the following Items as applicable.

Item 300, "Asphalts, Oils and Emulsions"

Item 302, "Aggregate for Surface Treatments"

(1) Aggregate.The aggregate material shall meet the quality requirements of Item 302, "Aggregate for Surface Treatments".The aggregate shall consist of sound and durable natural or manufactured sand, slag, crusher fines, crushed stone, or crushed stone and rock dust, or a combination thereof.Smooth textured sand of less than 1.25 percent water absorption, as tested by Test Method Tex-433-A, shall not exceed 50 percent of the total combined aggregate. The aggregate shall be clean and free from vegetable matter, dirt, dust, and other deleterious substances. The aggregate blend shall have a sand equivalent of not less than 45 when tested in accordance with Test Method Tex-203-F. Aggregate retained on the 300 μm shall be 100 percent crushed.

The combined aggregate shall conform to the gradation shown in Table 1 when tested in accordance with Test Method Tex-200-F for the type and purpose intended. The aggregate, as

finally selected, shall have a gradation within the limits designated in Table 1, and should not vary from the low limit on one sieve to the high limit on the adjacent sieve and vice versa.

The definition and use for each type are as follows:

The Type I gradation is used for maximum crack penetration and is usually used in low density traffic areas where the primary objective is sealing.

The Type II gradation is used to seal and improve skid resistance.

The Type III gradation is used to correct surface conditions and provide skid resistance.

GRADATION OF AGGREGATES

Sieve Size Percentage by Weight Passing Sieves

Type I Type IIType III

9.5 mm--- 100100

4.75 mm10098 - 10070 - 90

2.36 mm 90 - 10075 - 9045 - 70

1.18 mm 65 - 90 50 - 7528 - 50

600 µm 40 - 60 30 - 5019 - 34

300 µm 25 - 42 18 - 3512 - 25

150 µm 15 - 30 10 - 21 7 - 18

75 µm 10 - 205 - 15 5 - 15

Recommended rates of Application

Residual asphalt content

Percent dry aggregate10 - 167.5 - 13.5 6.5 - 12

Kilograms of aggregate per square meter3.2 - 5.45.4 - 8.18.1 - 10.8

Precautions shall be taken to prevent segregation of the aggregate in storing and handling. The stockpile shall be kept in areas that drain readily.

(2) Mineral Filler. If mineral filler is necessary, it shall be used in the minimum amounts required.Mineral filler shall consist of thoroughly dried stone dust, portland cement, or other mineral dust approved by the Engineer.Mineral filler shall only be used if needed to improve the workability of the mix or to improve the gradation of the aggregate. The filler shall be considered as part of the blended aggregate.

(3) Emulsified Asphalt. The emulsified asphalt shall conform to the requirements of Item 300, "Asphalts, Oils and Emulsions".The Engineer shall specify the type of emulsion.Cationic emulsions Type CSS-1 or CSS-1h are preferred for use in moderate or hot climates andAnionic emulsions Type SS-1 or SS-1h may be used for colder climatic areas.

Samples of the emulsion that the Contractor proposes to use, together with a statement as to its source, must be submitted, and approval must be obtained before using such material. The Contractor shall furnish the Engineer a manufacturer's certified report for each consignment of the emulsion. The manufacturer's certified report shall not be interpreted as a basis for final acceptance. All such reports shall be subject to verification by testing samples of the emulsion as received for use on the project.

(4) Water. All water used in making the slurry shall be potable, clean and free from industrial wastes and other objectionable matter.

(5) Tack Coat.The tack coat shall be a diluted asphalt emulsion of the same type specified for the slurry mix. The ratio of asphalt emulsion to water shall be 1 to 3.

31XX.3. Construction Methods.

(1) Weather Limitations. The slurry seal shall not be applied if either the pavement or the air temperature is 13 °C or below or when rain is imminent.

(2) Equipment. All equipment, tools, and machines used in the performance of this work shall be maintained in satisfactory working order at all times. Descriptive information on the slurry mixing and applying equipment to be used shall be submitted to the Engineer for approval not less than 10 days before work starts.

(a) Pressure Distributors. Pressure distributors used for application of the diluted asphalt emulsion tack coat shall be self-propelled, equipped with pneumatic tires, and capable of uniformly applying 0.23 to 0.68 liter per square meter of the diluted emulsion over the required width of application. Distributors shall be equipped with tachometers, pressure gauges, and volume measuring devices.

(b) Slurry Mixing Equipment. The slurry mixing machine shall be a continuous flow mixing unit capable of accurately delivering a predetermined proportion of aggregate, water, and asphalt emulsion to the mixing chamber and of discharging the thoroughly mixed product on a continuous basis. The aggregate shall be preweted immediately prior to mixing with the emulsion. The mixing unit of the mixing chamber shall be capable of thoroughly blending all ingredients together. No excessive mixing shall be permitted. The mixing machine shall be equipped with an approved fines feeder that provides an accurate metering device or method to introduce a predetermined proportion of mineral filler into the mixer at the same time and location that the aggregate is fed into the mixer. The fines feeder shall be used whenever added mineral filler is part of the aggregate blend.

The mixing machine shall be equipped with a water pressure system and fog type spray bar adequate for complete fogging of the surface with an application of 0.23 to 0.45 liter per square meter preceding the spreading equipment.

Sufficient machine storage capacity to mix properly and apply a minimum of 4,500 kg of the slurry shall be provided. Proportioning devices shall be calibrated prior to placing the slurry seal.

(c) Slurry Spreading Equipment. Attached to the mixing machine shall be a mechanical type squeegee distributor equipped with flexible material in contact with the surface to prevent loss of slurry from the distributor. It shall be maintained to prevent loss of slurry on varying grades and crown by adjustments to assure uniform spread. There shall be a lateral control device and a flexible strike-off capable of being adjusted to lay the slurry at the specified rate of application. The spreader box shall have an adjustable width. The box shall be kept clean, and

builtup asphalt and aggregate on the box shall not be permitted. The use of burlap drags or other drags shall be approved by the Engineer.

(d) Roller. The roller shall be a pneumatic tired roller capable of exerting a contact pressure during rolling of 350 000 newtons per square meter.

(e) Auxiliary Equipment. Other tools or equipment such as brushes, hand squeegees, hose equipment, tank trucks, water distributors and flushers, power blowers, barricades, etc., shall be provided as required.

(3) Equipment Calibration. Each slurry mixing unit to be used on the project shall be calibrated in the presence of the Engineer prior to construction. Previous calibration documentation covering the exact materials to be used may be accepted by the Engineer provided they were made during the calendar year. The documentation shall include an individual calibration of each material at various settings, which can be related to the machines metering devices. No machine will be allowed to work on the project until the calibration has been completed and/or accepted.

(4) Surface Preparation. Prior to placing the tack coat and slurry seal coat, unsatisfactory areas shall be repaired and the surface shall be cleaned of dust, dirt, or other loose foreign matter, grease, oil, or any type of objectionable surface film. Any standard cleaning method will be acceptable except that water flushing will not be permitted in areas where considerable cracks are present in the pavement surface.

Any painted stripes or markers on the surface to be treated shall be removed before applying the tack coat.

When the surface of the existing pavement or base is irregular or broken, it shall be repaired or brought to uniform grade and cross-section as directed by the Engineer. Cracks wider than 9 mm shall be sealed with compatible joint sealer prior to applying the slurry seal.

(5) Application of Tack Coat. Following the preparation for sealing, application of the diluted emulsion tack coat shall be made by means of a pressure distributor in amounts between 0.23 to 0.68 liter per square meter as directed by the Engineer. The tack coat shall be applied, at least, 2 hours before the slurry seal, but within the same day.

(6) Composition of Slurry Mix. No slurry seal for payment shall be placed until a mix design has been approved by the Engineer. The mix design shall be developed by a laboratory

with experience in designing slurry seal mixes and a signed copy submitted in writing by the Contractor to the Engineer at least 10 days prior to the start of operations.

The laboratory report must indicate the proportions of aggregates, mineral filler (minimum and maximum), water (minimum and maximum) and asphalt based on the dry aggregate weight. It shall also report the quantitative effects of moisture content on the unit weight of the aggregate (bulking effects) The mix design shall be in effect until modified in writing by the Engineer. Should a change in sources of materials be made, a new design mix shall be established before the new material is used.

The percent of aggregate passing each sieve shall not vary more than ±14.0 percent from the mix design formula. The residual asphalt content shall not vary more than ±1.0 percent from the mix design quantity.

The main items of design in emulsified asphalt slurry seals are aggregate gradation, emulsified asphalt content, and consistency of the mixture. The aggregates, emulsified asphalt, and water should form a creamy textured slurry that, when spread, will flow in a wave ahead of the strike-off squeegee. This will allow the slurry to flow down into the cracks in the pavement and fill them before the strike-off passes over. Technical Bulletin No. 111, "Outline Guide Design Procedure for Slurry Seal," published by the International Slurry Seal Association contains information to aid designers of slurry mixes.

(7) Test Sections. Test sections shall be placed prior to the start of the slurry seal work in the presence of the Engineer. The test area will be designated by the Engineer and will be located on the existing pavement.

Test strips shall be made by each machine after calibration. Samples of the slurry seal shall be taken and the mix consistency and proportions verified. The rate of application will also be verified. If any test does not meet specification requirements, additional tests shall be made at the Contractor's cost until an acceptable test strip is placed.

(8) Application of Slurry Seal Coat. The surface shall be prewet by fogging ahead of the slurry spreader box. Water used in prewetting the surface shall be applied at such a rate that the entire surface is damp with no apparent flowing water in front of the slurry spreader box. The slurry mixture shall be of the desired consistency when deposited on the surface, and no additional elements shall be added. Total time of mixing shall not exceed 5 minutes. A sufficient amount of

slurry shall be carried in all parts of the spreader box at all times so that complete coverage of all surface voids and cracks is obtained. Care shall be taken not to overload the spreader box which shall be towed at a slow and uniform rate not to exceed 8 kilometers per hour. No lumping, balling, or unmixed aggregate shall be permitted. No segregation of the emulsion and aggregate fines from the coarse aggregate will be permitted. If the coarse aggregate settles to the bottom of the mix, the slurry will be removed from the pavement surface. A sufficient amount of slurry shall be fed in the box to keep a full supply against the full width of the squeegee. The mixture shall not be permitted to overflow the front sides of the spreader box. No excessive breaking of the emulsion will be allowed in the spreader box. No streaks such as caused by oversized aggregate will be left in the finished pavement.

Adjacent lanes shall be lapped at the edges a minimum of 100 mm to provide complete sealing at the overlap. All edges shall be feathered with hand squeegees.

After application of the slurry seal, the surface shall be rolled with a pneumatic tired roller a minimum of 4 coverages. The roller should be operated at a tire pressure of 350 000 kPa.

Generally, where normal traffic will iron out the slurry and close any hairline cracks of dehydration, it is not necessary to roll a normal thickness (6 mm or less) of slurry seal.

However, in some instances the somewhat latticelike structure of the slurry should probably be densified by pneumatic tire rolling to improve durability, such as areas subjected to severe braking or acceleration. Rolling of the slurry seal is at the option of the Engineer.

The fresh slurry seal application shall be protected by barricades and markers and permitted to dry for 4 to 24 hours, depending on weather conditions. Any damage to uncured slurry will be repaired at the Contractor's expense.

In areas where the spreader box cannot be used, the slurry shall be applied by means of a hand squeegee. Any joints or cracks that are not filled by the slurry mixture shall be filled by using hand squeegees. No excessive buildup or unsightly appearance shall be permitted on longitudinal or transverse joints. Upon completion of the work, the seal coat shall have no holes, bare spots, or cracks through which liquids or foreign matter could penetrate to the underlying pavement. The finished surface shall present a uniform and skid resistant texture satisfactory to the Engineer. All wasted and unused material and all debris shall be removed from the site prior to final acceptance.

The cured slurry shall have a homogeneous appearance, fill all cracks, adhere firmly to the surface, and have skid resistant texture.

31XX.4.Measurement.

(1) Asphaltic Material. The Asphaltic Material for emulsified asphalt shall be measured by the liter or kg.The volume shall be corrected to the value at 15 °C. Only the actual quantity of undiluted emulsified asphalt will be measured for payment.

(2) Aggregate. The Aggregate shall be measured by the kg.

31XX.5. Payment. The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit prices bid for "Asphalt", "Aggregate" and "Aggregate (Stockpiled)", if required, of the type and grade specified. These prices shall be full compensation for furnishing all materials, for preparing, mixing, and applying these materials, and for all labor, equipment, tools, and incidentals necessary to complete the item.

APPENDIX J

SPECIAL SPECIFICATION

ITEM 3116 A/P (ENGLISH)

QUALITY CONTROL/QUALITY ASSURANCE OF HOT MIX ASPHALT FOR AIRFIELD PAVEMENTS

A/P DRAFT,1993 ENGLISH

SPECIAL SPECIFICATION

ITEM 3116 A/P

QUALITY CONTROL/QUALITY ASSURANCE OF HOT MIX ASPHALT FOR AIRFIELD PAVEMENTS

3116.1. Description. This item shall govern the construction of a base course, a level-up course, a surface course or any combination of these courses as shown on the plans for airport runways, taxiways and any other designated airdrome pavements. Each course must be composed of a compacted mixture of aggregate and asphalt material mixed hot in a mixing plant, in accordance with the typical sections and details shown on the plans and the requirements herein.

It is the intent of this specification that the Contractor be responsible for all quality control to include mix design and testing with certified specialists. TxDOT shall be responsible for all quality assurance, verification of the mix design and testing and any required referee testing.

The Texas Department of Transportation is the owner's agent and shall as such determine compliance with this specification. At the option of the Department, consulting engineering firms may be used in the design and oversight for TxDOT.

(1) Quality Control. Contractor sampling, testing and inspection for operational control.

(2) Quality Assurance. Engineer sampling, testing and inspection activities to determine payment and to make acceptance decisions.

(3) Verification Tests. Tests to verify accuracy of quality control, quality assurance and mixture design testing.

(4) Referee Tests. Tests used to resolve differences between Contractor and Engineer test results. The Materials and Tests Division of TxDOT is designated as the referee laboratory.

(5) Independent Assurance Program. An unbiased and independent evaluation of all the sampling and testing techniques used in the acceptance program. These activities are performed by the Engineer. The test results are not used for acceptance.

3116.2. Certification and Reporting Requirements. All sampling and testing (Contractor and Engineer) will be conducted by personnel certified by the TxDOT-approved program. The certification level required for performance of each test shall comply with requirements shown in Table 7. The Contractor shall provide a list of certified personnel to be used on the project prior to the beginning of production. An updated list shall be provided when personnel changes are made. The Contractor's certified Level IA HMA specialist shall be at the plant prior to the beginning of and during plant production operations.

TxDOT's automated hot mix program will be used by the Engineer and the Contractor to record all test data and calculate all pay factors. The Engineer will provide the automated program to the contractor. A diskette copy of the automated hot mix program shall be used by the Contractor to submit test results to the Engineer on a daily basis. The results of all quality control testing shall be plotted by the Contractor, and the results of all quality assurance testing will be plotted by the Engineer in accordance with Test Method Tex-233-F. The control chart shall be updated as soon as test results for each sublot becomes available.

3116.3. Materials. Before mixing begins, the Contractor shall furnish to the project materials meeting the following requirements. Additional test requirements affecting the quality of individual materials or the paving mixture shall be required when indicated on the plans.

(1) Aggregate. The aggregate shall be composed of a coarse aggregate and a fine aggregate, and may include reclaimed asphalt pavement (RAP) The contractor may use a mineral filler when necessary to meet the mixture design requirements. Samples of each aggregate shall be submitted to the Department for testing and approval. Approval must be completed prior to submission of the mixture design. Additional aggregate testing may be performed by the Engineer at any time during production.

Aggregate from each source shall meet the quality requirements of Table 1 and other requirements as specified herein. Aggregate quality testing will be performed by the Engineer. Aggregate may be sampled either before or after delivery to the plant or both as determined by the Engineer. The aggregate contained in RAP will not be required to meet Table 1 requirements.

(a) Coarse Aggregate. Coarse aggregate is defined as that part of the aggregate retained on a No. 10 sieve. The aggregate shall be natural or slag and shall be of uniform quality throughout. When specified on the plans, certain coarse aggregate material may be allowed, required or prohibited.

Slag shall be air-cooled, blast furnace slag and shall have a compacted weight of not less than 70 pounds per cubic foot when tested in accordance with test method TEX-404-A.

The aggregate shall not contain more than seventeen (17) percent by weight of flat or elongated particles when tested in accordance with test method TEX-224-F.

Aggregate from each source, including the gravel aggregate from RAP, shall be so crushed as to have a minimum of 85 percent of the particles retained on the No. 4 sieve with two (2) or more mechanically induced crushed faces, as determined by test method TEX-460-A (Part I) The material passing the No. 4 sieve and retained on the No. 10 sieve must be the product of crushing aggregate that was originally retained on the No. 4 sieve.

If a polish value is required by note on the plans, the polish value for the virgin coarse aggregate used in the surface or finish course, when tested in accordance with test method TEX-438-A, shall not be less than the value shown on the plans. For rated sources, the Materials and Tests Division's *Rated Source Quality Catalog* (RSQC) will be used to determine polish value compliance. Blending of coarse aggregates to meet the polish value requirements will be allowed unless otherwise shown on the plans. When blending is allowed, the blended coarse aggregates shall contain non-polishing aggregates of at least 50 percent by volume retained on the No. 4 sieve for Types C, D, and coarse matrix high binder (CMHB) mixes, and at least 50 percent by volume retained on the No. 10 sieve for Type F mixes. Blending of coarse aggregates to meet polish value requirements shall be in accordance with test method TEX-438-A, Part II, Method B.

Aggregates with a satisfactory skid history that do not meet the minimum polish value or RSQC requirement may be used. A list of aggregate sources with an acceptable skid history is available from the engineer.

(b) Reclaimed Asphalt Pavement (RAP). RAP is defined as a salvaged, milled, pulverized, broken or crushed asphalt pavement. The RAP to be used in the mix shall be crushed or broken to the extent that 100 percent will pass the 2 inch sieve with the additional requirement that it will be further broken down to the proper gradation when incorporated into the mixture. The

Contractor has the option to use up to 20 percent RAP in surfacing mixtures and level-ups and up to 30 percent RAP in base course mixtures. Only RAP from designated state-owned sources may be used in surface mixtures.

The stockpiled RAP shall not be contaminated by dirt or other objectionable materials. Unless otherwise shown on the plans, stockpiled, crushed RAP shall have either a decantation of five (5) percent or less or a plasticity index of eight (8) or less, when tested in accordance with test method TEX-406-A, Part I, or test method TEX-106-E, respectively. This requirement applies to stockpiled RAP from which the asphalt has not been removed by extraction.

The polish value of RAP aggregate will not be used in any determination of polish value specification compliance.

When shown on the plans or when designated in a special provision, state-owned RAP sources are available to the Contractor. The approximate asphalt material content and asphalt cement properties will be shown on the plans. If the source is an existing stockpile material, the decantation or plasticity index will also be shown on the plans.

Any contractor-owned RAP that is allowed to be used on the project shall remain the property of the Contractor, while stockpiled, and shall not be intermingled with state-owned RAP stockpiles. Any unused contractor-owned RAP material shall be removed from the project site upon completion of the project. Any unused state owned RAP shall be returned to the stockpile as directed by the Engineer.

(c) Fine Aggregate. The fine aggregate is defined as that part of the aggregate passing the No. 10 sieve. It shall be of uniform quality throughout. A maximum of 15 percent of the total virgin aggregate may be field sand or other uncrushed fine aggregate, unless a value less than 15 percent is shown on the plans. When specified on the plans, certain fine aggregate material may be allowed, required or prohibited.

Unless otherwise shown on the plans, gravel screenings shall not be allowed. Crushed gravel screenings, when allowed, shall be the result of crushing aggregate that was originally retained on the No. 4 sieve.

When screenings are used, they shall meet the following gradation requirements when tested in accordance with test method TEX-200-F, Part II.

	PERCENT BY MASS
PASSING THE 3/8" SIEVE	100
PASSING THE NO. 10 SIEVE	70.0 – 100.0
PASSING THE NO. 200 SIEVE	0.0 – 30.0

Except in CMHB mixtures, screenings shall be supplied from sources whose coarse aggregate meet the Los Angeles Abrasion and magnesium sulfate soundness loss requirements.

(d) Mineral Filler. Mineral filler shall consist of thoroughly dried stone dust. The use of fly ash will not be permitted. If other mineral filler is used, it must be approved by the engineer. The mineral filler shall be free from foreign matter and meet the following gradation requirements when tested in accordance with test method TEX-200-F, Part II.

	PERCENT BY MASS
PASSING THE NO. 10 SIEVE	100
PASSING THE NO. 200 SIEVE	more than 30.0

(e) Baghouse Fines. The addition of fines collected by the baghouse or other air-cleaning or dust-collecting equipment is permitted.

(2) Asphalt Material.

(a) Asphalt Material. Asphalt material for the paving mixture shall be of the grade shown on the plans or designated by the Engineer and shall meet the requirements of Item 300, "Asphalts, Oils And Emulsions."

(b) Tack Coat. Asphalt materials shown on the plans or approved by the Engineer shall meet the requirements of Item 300, "Asphalts, Oils And Emulsions."

3116.4. Job Mix Formula. A job mix formula (JMF) identifies the combined aggregate gradation and lists the percentage of each material component to be used in the mix. The JMFs are described in the following sections.

For runways and taxiways, the target density for all mixes is 97.0 percent. On all other support pavements, for mixture Types A, B, C, D and F, the target laboratory molded density may be set at 96.0 percent and for mixture Types CMHB-C or CMHB-F, the target laboratory density may be set at 96.5 percent. When shown on the plans, the target laboratory molded density for any type of mixture may be set at any value within the range of 96.0 to 97.0. These target lab densities apply to all JMFs.

(1) Development Of Laboratory Mixture Design (JMF 1). JMF 1 is the laboratory mixture design developed by the contractor's Level II certified specialist in accordance with test method TEX-204-F. JMF 1 shall use the project aggregates, asphalt material, and any additives that are allowed or required.

Creep, Hveem stability, gradation and VMA properties shall conform to the requirements specified in Table 2 as determined in accordance with the test methods in Table 7.

The mixture proposed for use shall be evaluated for moisture susceptibility in the mixture design stage by test method TEX-531-C, unless otherwise shown on the plans. Mixture approval criteria shall be in accordance with Item 301, "Asphalt Antistripping Agents."

The Contractor may select either lime or a liquid antistripping agent to reduce the moisture susceptibility of the aggregate. The addition of these antistripping agents shall be in accordance with Item 301, "Asphalt Antistripping Agents." The Engineer may waive testing for moisture susceptibility if a similar design using the same materials has proven satisfactory. When the antistripping additive type and rate are shown on the plans, then all moisture susceptibility testing requirements for mixture design will be waived. However, production testing, when required, will remain in effect.

When it is suspected that there is a significant difference between the specific gravities for the individual aggregates, then the specific gravity shall be determined for all aggregates. If the specific gravity values differ by 0.300 or more, the mixture design shall be by the volumetric method, test method TEX-204-F, Part II.

The Contractor's and Engineer's responsibilities in development and approval of JMF 1 are as follows.

(a) Contractor Responsibilities. The Contractor shall develop JMF 1 in accordance with test method TEX 204-F and submit all required worksheets and laboratory molded specimens for Hveem stability or creep testing.

When the nuclear gauge is used for determining the asphalt content, then calibration samples prepared by the Contractor during the laboratory mixture design shall be retained by the Contractor for later use as necessary.

The Contractor shall notify the Engineer of any changes in material sources. If a source changes at any point, a new laboratory mixture design shall be required unless otherwise approved by the Engineer. The Engineer may request a new laboratory mixture design if the asphalt material grade is changed.

(b) Engineer Responsibilities. The Engineer will review the contractor's mix design report and verify conformance with all aggregates, asphalt, and additives and mixture specifications. The Engineer will verify the mixture design using material samples collected by either the Engineer or the Contractor. The samples may be obtained at the plant or quarry as determined by the Engineer. Quarry samples shall be from materials produced for the project. The Engineer may elect to sample at both locations. Using these materials, the Engineer will determine lab density, VMA, moisture susceptibility and Hveem stability or creep at the optimum asphalt content using the test methods in Table 7. The Engineer will approve the Contractor's JMF 1 in 10 working days provided that the Engineer's test results for lab molded bulk specific gravity, theoretical maximum specific gravity, VMA, moisture susceptibility and Hveem stability or creep and the Contractor's mix design report are in conformance with the requirements of this specification. In addition, lab density from the Engineer's tests must be within 0.5 percent of specified target for JMF1 to be approved. When prior experience with the submitted mixture design makes it unnecessary to perform verification testing, the Engineer may waive JMF1 verification testing.

Referee testing will be used to resolve differences between the Engineer and the Contractor in determinations of lab density, VMA and, when required, moisture susceptibility. Referee test results will be provided within 10 working days from receipt of samples at the referee laboratory.

(2) Development of JMF 2. The Contractor shall use JMF 1 to provide a plant-produced trial mixture and to develop JMF 2 prior to the construction of the test section/s/. The trial mixture should be of sufficient quantity to ensure that a representative mixture is produced. At the request of the Contractor, the Engineer may waive the requirement for a trial mixture if a similar design using the same materials has proven satisfactory. All materials, labor and equipment furnished by the Contractor for the production of the trial mixtures are subsidiary to the bid item for hot mix and will not be paid for directly. The Engineer and the Contractor will sample and test the trial mixture. Correlation of Engineer and Contractor presses to be used for the project, and tests for laboratory molded density, asphalt content, Hveem stability, and aggregate gradation shall be performed. The Engineer will approve the trial mixture within 24 hours of producing the trial batch if the Engineer's test results meet the following requirements.

(a) Laboratory Molded Density. Target laboratory molded density (as specified in Article 4) shall be plus or minus 1.0 percent.

(b) Combined Aggregate Gradation. The gradation shall be within the limits of the master grading shown in Table 2 and the operational tolerances of JMF 1 shown in Table 3. When aggregate blending is allowed and is used to achieve polish value, the bin percentage and stockpile gradation must be such that the polish value requirements are met.

(c) Hveem Stability. A minimum stability of 35 is required, unless otherwise shown on the plans. Hveem stability is not required for mixture types CMHB-F and CMHB-C.

(d) Asphalt. The asphalt content shall be within plus or minus 0.5 percent of the JMF 1 target asphalt content.

When the Engineer's test results do not meet the above requirements, additional plant-produced trial mixes shall be produced and tested prior to approval of the plant-produced trial mix. If an acceptable plant-produced mixture cannot be produced from JMF 1, a new laboratory mixture design will be required.

After evaluation of test results on the trial batch, the Contractor shall determine the optimum mixture ingredients for JMF 2. The Engineer will approve JMF 2 provided that it meets the master grading limits shown in Table 2 , the operational tolerance of JMF 1 for gradation listed in Table 3 and the asphalt content is within +/- 0.5 % of JMF 1.

(3) Development of JMF 3. JMF 2 will be used to produce the test section/s/ and to develop JMF 3. Plant adjustments within the operational tolerances may be made as necessary during production of material for the test section/s/ in order to develop JMF 3. Acceptance of the material will be in accordance with Article 8.

The Contractor and the Engineer will perform sufficient tests to insure that the mixture meets the requirements of Article 8. The difference between the Contractor's and the Engineer's test results must be within the tolerances listed in Table 4. If the difference exceeds the tolerances listed in Table 4, the Contractor and the Engineer must resolve the differences prior to beginning Lot 1.

The test section production mix shall be the basis for the Contractor to establish the job-mix formula which will be the job-mix formula (JMF 3) for the project unless the JMF 3 is adjusted as provided in Subarticle 4.4. At the end of production of the test sections, the Contractor shall submit the JMF 3 to the Engineer. The Engineer will approve the JMF 3 provided that it meets the master grading limits shown in Table 2, meets the operational tolerance of JMF 1 for gradation listed in Table 3, and that the asphalt content is within +/- 0.5 % of JMF 1. JMF 3 must be such that the target lab density can be achieved.

The pay adjustment factor for the test section/s/ production mixture will be 1.00 except as set forth is Subarticle 4.3.1. However, the Contractor. with the approval of the Engineer, may elect to waive the 1.00 pay factor for the test section and begin acceptance testing in accordance with Article 8. This notification must be made in writing to the Engineer prior to production of the test section.

(a) Test Sections. Prior to full production, the Contractor shall prepare and place a quantity of the asphalt mixture according to the job-mix formula. The amount of the mixture should be sufficient to construct a test section approximately 300 feet long and 20 to 30 wide, placed in a minimum of two lanes, with a longitudinal cold joint, and shall be of the same depth specified for the construction of the course which it represents. The underlying grade or pavement structure upon which the test section is to be constructed shall be the same as the remainder of the course represented by the test section. The equipment used in the construction of the test section shall be the same type and weight to be used on the remainder of the course represented by the test section.

Random samples of the mixture shall be taken at the plant and tested and evaluated. A minimum of three random cores shall be taken from the finished test section pavement mat and

three from adjacent to the longitudinal joint and tested in accordance with the procedures specified herein.

The mixture shall be considered acceptable if the test values are within the limits specified for the JMF.

If the initial test section should prove to be unacceptable, the necessary adjustments to the job mix formula, plant operation, placing procedures, and/or rolling patterns shall be made. A second test section shall then be placed. If the second test section also does not meet specification requirements, both sections shall be removed at the Contractor's expense. If the second test section does meet the specification requirements, both sections may remain in place unless the first section would require removal according to the requirements of this specification. Under these conditions, the first test section must be removed at the Contractor's expense. Any additional test sections failing to meet the specification requirements shall be removed at the Contractor's expense. Full production shall not begin until an acceptable section has been constructed and accepted by the Engineer.

(4) Job Mix Formula Adjustment. At any time during the project, the Contractor may submit for the engineer's approval, a new laboratory mixture design as detailed in Article 4.1. Unless otherwise approved by the Engineer, plant-produced trial mixes will be required to verify the new laboratory mixture design as described in Article 4.2.

The Contractor may adjust the job mix formula prior to beginning a new lot provided that it meets the master gradation limits shown in Table 2 and the operational tolerance of JMF 1 for the gradation listed in Table 3. Also, the asphalt content must be within plus or minus 0.5 percent of JMF 1. The new job mix formula must be such that the target lab density shown in Article 4, can be achieved.

3116.5. Equipment.

(1) General. All equipment for the handling of all materials, mixing, placing and compacting of the mixture shall be maintained in good repair and operating condition. In case of equipment malfunction, the Contractor shall cease production until defective equipment is repaired or replaced.

(2) Mixing Plants. Automatic proportioning devices shall be required for all plants and documentation as to their accuracy may be required by the Engineer.

If a liquid or emulsified additive is to be introduced into the asphaltic material at the mix plant, it shall be added to the asphalt line at the required rate by means of an in-line metering device. The Contractor shall demonstrate that the meter meets the requirements of Item 520, "Weighing And Measuring Equipment." An in-line blending device is required to disperse the additive into the asphaltic material. A sampling port shall be provided on the asphalt line near the outlet of the additive blending device so that the modified asphaltic material may be sampled. The measuring, blending, and sampling equipment and its location must be approved by the Engineer.

(3) Fuel. When using fuel oil heavier than grade No. 2 or when using waste oil, the contractor shall ensure that the fuel delivered to the burner is at a viscosity of 100 SSU or less, when tested in accordance with test method TEX-534-C. This viscosity ensures complete burning of the fuel. Higher viscosities may be allowed by the Engineer if recommended by the burner manufacturer. If necessary, the contractor shall preheat the oil to maintain the required viscosity.

The Contractor shall provide means for obtaining a sample of the fuel just prior to entry into the burner in order to perform the viscosity test. The Contractor shall perform this test or provide a laboratory test report that will establish the temperature of the fuel necessary to meet the viscosity requirements. There shall be an in-line thermometer to check the temperature of the fuel delivered to the burner.

Regardless of the burner fuel used, the burner or combination of burners and types of fuel used shall provide a complete burn of the fuel and shall not leave any fuel residue adhering to the heated aggregate.

(4) Surge-Storage System and Scales. A surge-storage system may be used to minimize the production interruptions during the normal day's operations. A device such as a gob hopper or other device designed to prevent segregation in the surge-storage bin shall be used. The mixture shall be weighed upon discharge from the surge-storage system.

When a surge-storage system is used, scales shall be standard platform truck scales or other equipment such as weigh hopper (suspended) scales and shall conform to Item 520, "Weighing And Measuring Equipment." If truck scales are used, they shall be placed at a location

approved by the Engineer. If other weighing equipment is used, the Engineer may require mass checks by truck scales for the basis of approval of the equipment.

Temporary storing or holding of the hot mix asphalt by the surge-storage system will be required for drum-mix plants during the normal day's operation. Overnight storage will not be permitted unless authorized on the plans or in writing by the Engineer.

(5) Recording Device and Record Printer. The mixture shall be weighed for payment. If a surge-storage system is used, an automatic recording device and a digital record printer shall be provided to indicate the date, project identification number, vehicle identification, total mass of the load, tare mass of the vehicle, the mass of asphaltic mixture in each load and the number of loads for the day, unless otherwise indicated on the plans. When surge-storage is not used, batch weights will be used as the basis for payment and automatic recording devices and automatic digital record printers in accordance with Item 520, "Weighing And Measuring Equipment," shall be required.

(6) Laboratory. The Contractor shall establish, maintain and operate a laboratory. The laboratory shall be equipped to perform the tests indicated in this specification. All quality control testing shall be performed at the Contractor's on-site laboratory, unless otherwise approved by the Engineer. All test equipment at the laboratory shall be calibrated and certified in accordance with test method Tex-237-F or the manufacturer's recommendations. The Engineer will verify that all the necessary equipment, materials and current test procedures are present and that all equipment meets these requirements prior to the production of hot mix asphalt.

3116.6. Stockpiling, Storage and Feeding of Materials.

(1) Storage And Heating of Asphalt Materials. The asphalt material storage capacity shall be ample to meet the requirements of the plant. Asphalt shall not be heated to a temperature in excess of that specified in Item 300, "Asphalts, Oils And Emulsions." All equipment used in the storage and handling of asphalt material shall be kept in a clean condition at all times and shall be operated in such a manner that there will be no contamination with foreign matter. The heating apparatus shall be equipped with a continuously recording thermometer and a 24-hour chart that will record the temperature of the asphalt material at the location of the highest temperature.

Continuous recordings shall be made for asphalt material and hot mix asphalt temperatures. These recordings shall be made available to the Engineer on a daily basis.

(2) Scalping Screen. A scalping screen shall be required after the cold feeds and ahead of the combined aggregate belt scales for all plants.

(3) Plants Using RAP. If RAP is used, a separate cold bin shall be required. The RAP feed system shall be equipped to remove particles over 2 inches in size prior to the weighing device. There shall be adequate cold bin controls to provide a uniform amount of RAP to the mixture.

Positive mass measurement of RAP shall be provided by the use of belt scales or other approved devices or methods. RAP shall be mixed and blended so that there is no evidence of unseparated particles in the mixture as it leaves the mixer.

3116.7. Construction Methods.

(1) General. It shall be the responsibility of the Contractor to produce, transport, place and compact the specified paving mixture in accordance with the requirements herein.

If at any time prior to placement on the roadway surface the temperature of the mixture falls below 212 F, the quantity of that mixture shall be determined to the satisfaction of the Engineer and removed from the project at the expense of the Contractor . No payment will be made for the mixture that is removed.

(2) Adverse Weather Conditions. Unless otherwise approved by the engineer, asphaltic mixture, when placed with a spreading and finishing machine, or tack coat shall not be placed when air temperature is below 50 F and is falling, but it may be placed when the air temperature is above 40 F and is rising. If a mixture produced prior to production cessation is placed on a wet or damp or cold surface and it does not bond to the existing pavement, ravels, or has other surface irregularities, the mixture shall be removed or repaired to the satisfaction of the Engineer. Removal or repair shall be at the expense of the Contractor.

(3) Tack Coat. Tack coat shall be used at the direction of the Engineer. The surface upon which the tack coat is to be placed shall be cleaned thoroughly to the satisfaction of the Engineer. A uniform application of tack coat shall be applied at a rate not to exceed 0.05 gallon residual asphalt material per square yard of surface area. In CMHB mixtures, the rate shall not exceed 0.07 gallon

residual asphalt material per square yard of surface area. All cold joints shall be painted with a thin, uniform application of tack coat. During the application of tack coat, care shall be taken to prevent splattering of adjacent pavement and structures. The tack coat shall be rolled with a pneumatic tire roller when directed by the Engineer.

(4) Transporting Hot Mix. The hot mix shall be hauled to the work site in tight vehicles previously cleaned of all foreign material. Diesel shall not be used as a truck bed release agent. Any transporting operation that results in contamination of hot mix with foreign materials or excessive loss of temperature will not be allowed.

(5) Windrow Pick-Up Equipment. Windrow pick-up equipment shall be such that substantially all the mixture deposited on the roadbed is picked up and loaded into the spreading and finishing machine. The mixture shall not be contaminated with foreign material. The loading equipment shall be designed so that, without resorting to hand finishing, it does not interfere with the spreading and finishing machine in obtaining the required line, grade and surface.

(6) Placing. The hot mix shall be placed on the approved prepared surface with a spreading and finishing machine. When properly compacted, the finished pavement shall be smooth, of uniform texture and density and shall meet the requirements of the typical cross sections, grades and the surface tests. In addition, the placing of the hot mix shall be done without tearing, shoving, gouging or segregating the mixture and without producing streaks in the mat.

Construction joints of successive courses of asphaltic material shall be offset at least twelve (12) inches. Construction joints on surface courses shall coincide with lane lines or shall be as directed by the Engineer.

(7) Compacting. The pavement shall be compacted thoroughly and uniformly with the necessary rollers to obtain the air voids and cross section of the finished paving mixture meeting the requirements of the plans and specifications.

All places not accessible to the roller, or in such positions as will not allow thorough compaction with the rollers, shall be thoroughly compacted with lightly oiled tamps. Rolling with a trench roller may be required by the Engineer on widened areas, in trenches and in other limited areas.

With the exception of the above requirements, and when specific air void requirements have not been voided by plan note, the type and size of compaction equipment and the rolling patterns used will be entirely at the discretion of the Contractor.

Where specific air void requirements are voided, one (1) three-wheel roller, one (1) pneumatic-tire roller, and one (1) tandem roller shall be furnished for each compaction operation except as provided below or as approved by the Engineer. The use of a tandem roller may be waived by the Engineer when the surface is already adequately smooth and further steel-wheel rolling is shown to be ineffective. With approval of the Engineer, the Contractor may substitute a vibratory roller for the three-wheel roller and/or the tandem roller. Use of at least one (1) pneumatic-tire roller is required. Use of pneumatic tire rollers will not be allowed for CMHB mixtures if excessive pickup of fines by roller tires occurs. Additional or heavier rollers shall be furnished if required by the Engineer. Rolling patterns that achieve maximum compaction shall be established by the contractor as outlined in test method TEX-207-F, Part IV. For these conditions there will be no pay adjustment factor calculated for in-place air voids.

(8) Opening To Traffic. The compacted pavement shall be opened to traffic when directed by the Engineer.

3116.8. Acceptance Plan.

(1) General. Acceptance of the hot mix will be based on the acceptance plan described herein. Random sampling of the hot mix shall be performed on a lot and sublot basis.

(2) Production Lot. The Contractor shall select the sublot size for each lot based upon the anticipated daily production. Sublot size can only be changed prior to the beginning of a lot. It is the intent that this sampling plan produce approximately 4 sublots per day. If the sublot size selected results in less than 4 sublots per day for 2 consecutive production days, then the Engineer may reduce the sublot size.

(a) Small Production Quantities. When the anticipated daily production is less than 1000 tons the requirement for 4 sublots per day is waived and the sublot size shall be 250 tons. If this results in less than four 4 sublots for the project, pay adjustment will be in accordance with Subarticle 8.2.2, "Incomplete Lots."

(b) Incomplete Lots. If a lot is begun but cannot be completed such as on the last day of production or in other circumstances deemed appropriate by the Engineer, the lot may be closed out by the Engineer. Payment for the lot will be adjusted in accordance with Subarticle 10.2.

(3) Production Sampling. All sampling locations shall be determined by the random sampling procedure defined in test method TEX-225-F. The Engineer is responsible for establishing the random sample locations before lot production begins. Only the locations of the samples that will be taken by the Contractor will be disclosed to the Contractor.

Hot mix shall be obtained from trucks at the plant in accordance with test method TEX-222-F. For each sublot, the Contractor shall take one sample at the location randomly selected by the Engineer. In addition, for each lot the Engineer will randomly select at least two sublots and take one random sample from each selected sublot. Each sample will be split by the sampler into three equal portions in accordance with test method TEX-200-F. These portions will be labeled as contractor, engineer and referee and will be delivered to the appropriate party's laboratory. Referee samples will be delivered to the Engineer. Unused samples will be discarded after the Contractor accepts pay adjustment factors for that lot. For the purposes of independent assurance, at least one (1) engineer sample out of every ten (10) lots or a minimum of one per project will be split into four (4) equal portions.

A sampling platform approved by the Engineer shall be provided by the Contractor.

(4) Production Testing. Production testing responsibility is divided between the Engineer and the Contractor. The Engineer will determine lab density for each sublot, and the Contractor has the option to verify Engineer's test results on split samples provided by the Engineer. The Contractor shall determine compliance with operational tolerance using Contractor's samples on all sublots, and the Engineer will verify contractor's test results.

The Contractor can request referee testing should the difference between the Contractor's and the Engineer's test results exceed the values shown in Table 4.

Both the Engineer and the Contractor will make the completed test results available to each other upon completing the test. All production testing must be completed within one working day of completion of the lot.

(a) Lab Density. Density is a mixture design and pay factor parameter. The lab density is determined by the Engineer for each sublot. It is determined in accordance with test methods TEX-207-F and TEX-227-F. When the Engineer obtains a sample from a sublot in accordance with Subarticle 8.3, that sample will be used by the Engineer to determine the laboratory bulk specific gravity and the maximum theoretical specific gravity and to calculate the lab density. For sublots not sampled by the Engineer, the Contractor's split sample will be used by the engineer to determine laboratory bulk specific gravity and maximum theoretical specific gravity and to calculate lab density.

(b) Gradation Test. Gradations shall be determined in accordance with test method TEX-200-F. Aggregates for gradation determination are obtained from one of the following three methods.

- extraction (TEX-210-F)
- cold feed/hot bin samples (TEX-229-F)
- ignition oven (TEX-236-F)

When cold feed samples are used for gradation testing, the contractor shall supply a correlation as outlined in Tex-229-F. Correlation factors shall be verified by the Contractor and approved by the Engineer once every five production days.

Gradation testing shall be conducted by the Contractor for each sublot on samples taken by the Contractor. The Engineer will verify that the operational tolerances for gradation shown in Table 3 have been met . The minimum verification frequency will be one (1) Engineer's sample for every twelve (12) sublots.

(c) Asphalt Content. The asphalt material content shall be determined in accordance with test method TEX-228-F or TEX-236-F.

Asphalt content testing shall be conducted by the Contractor for each sublot on samples taken by the Contractor. The Engineer will conduct asphalt content testing on Engineer's samples on a minimum of one (1) for every four (4) sublots.

If the asphalt content exceeds the operational tolerance shown in Table 3 on two consecutive sublots per lot, based on the Engineer's test results or two consecutive sublots per lot based on the Contractor's test results no production or placement bonus will be paid for that lot.

(d) Hveem Stability. Hveem stability will be determined in accordance with test method TEX-208-F. Hveem stability testing is conducted by the Engineer a minimum of once per lot on specimens molded by the Engineer.

(e) Moisture Susceptibility. Production verification testing after final approval of JMF 1 will use test method TEX-530-C and is required only when shown on the plans. In such cases, the Engineer will determine the location and frequency of sampling and will perform the test.

(f) Operational Tolerances. The hot mix shall meet operational tolerances shown in Table 3 for each sublot. When either the Contractor's or the Engineer's test results exceed the operational tolerances shown in Table 3 for three (3) consecutive tests for a single property, then the Contractor shall cease production until test results or other information indicate, to the satisfaction of the Engineer, that the next material to be produced will meet the specified values.

The Contractor shall select the target discharge temperature of the mixture between 250 F and 350 F. The mixture, when discharged from the mixer, shall not vary from this selected temperature more than 25 F, but in no case shall the temperature exceed 360 F.

(g) Individual Loads of Hot Mix. Individual loads of hot mix in the truck can be rejected by the Engineer. When a load of hot mix is rejected for reasons other than temperature as stated in Subarticle 7.1 and Subarticle 8.4.6, the rejected load will be tested at the request of the Contractor. This request must be made within four (4) hours of rejection. If tests are within operational tolerances, payment will be made for the load. If test results are not within operational tolerances as shown in Table 3, no payment will be made for the load. The Engineer will perform sampling and testing.

(5) Placement Lot. A placement lot shall consist of the area placed in a production lot, excluding miscellaneous areas. A placement sublot shall consist of one fourth of the area of the placement lot.

(a) Incomplete Placement Lots. An incomplete placement lot shall consist of the area placed in an incomplete production lot as described in Subarticle 8.2.2 excluding miscellaneous

areas. For these lots, one placement sample location will be selected for each production sublot placed.

(b) Miscellaneous Areas. Miscellaneous areas are the only areas that are not eligible for random placement sampling locations, and will be assigned placement pay factor 1.000.

(c) Level-Ups and Thin Overlays. For the purpose of calculating placement pay adjustment factors, level-ups and thin overlays will be considered as miscellaneous areas. The placement pay adjustment factor shall be 1.000 for layer thicknesses designated on the plans less than one and one-half (1-1/2) inches or for level-up areas. The Contractor will establish a rolling pattern that will achieve in-place air voids in accordance with Subarticle 7.7. Total adjusted pay (TAP) will be based on TAP 2 as shown in Subarticle 10.4.

(d) Shoulders and Ramps. Shoulders and ramps are subject to in-place air voids determination unless otherwise shown on the plans. When shoulders and ramps are not subject to in-place air voids determination, then compaction shall be in accordance with Subarticle 7.7.

(6) Placement Sampling. The Engineer is responsible for determining the random sampling plan. The Contractor will be responsible for obtaining two (2) cores side-by-side from each placement sublot. Immediately after obtaining the cores, the Contractor shall repair core holes in a manner approved by the Engineer.

For Type A and Type B hot mix, six (6) inch diameter cores shall be obtained. For all other types of hot mix, four (4) inch diameter or six (6) inch diameter cores shall be obtained.

The Contractor is responsible for trimming and delivering all cores to the Engineer within one working day following placement operations.

(a) Sample Locations. One random sample location shall be determined for each placement sublot. The random sample location shall be determined in accordance with test method TEX-225-F. No random sample location shall be located within two (2) feet of a joint or pavement edge. The sample shall be taken within one (1) foot of the random location provided.

(b) Placement Testing. The Engineer will determine placement pay adjustment factors by measuring in-place air voids in accordance with test method TEX-207-F and TEX-227-F.

The theoretical maximum specific gravity used for in-place air voids determination will be the average of the values obtained for all sublots in the production lot tested by the Engineer.

The average air void content of the two (2) cores shall be used to calculate a placement pay adjustment factor for each sublot tested. Placement pay adjustment factors shall be determined in accordance with Article 10.

Paraffin coating will be used if required by test method TEX-207-F. If a paraffin-coated sample yields a higher specific gravity than the uncoated sample, then the test results from nonparaffin-coated cores will be used for placement pay factor determination.

After determining air voids contents, the Engineer will return tested cores to the Contractor.

The Contractor can request referee testing should the difference between the Contractor's and the Engineer's test results exceed the values shown in Table 4.

(c) **Smoothness.** The finished surface of the pavement shall not vary more than inch for the surface course. Each lot shall be measured with a 16-foot straightedge. Measurements will be perpendicular and parallel to the centerline.

The finished surfaces of the pavement shall not vary from the gradelines, elevations and cross sections shown on the plans by more than _ inch. The Contractor shall correct at his cost pavement areas varying in excess of this amount by removing and replacing the defective work. Skin patching shall not be permitted for correction of low areas nor shall planning be permitted for correction of high areas.

(7) **Irregularities or Segregation**. If a pattern of surface irregularities including, but not limited to, rutting, segregation, raveling, mat slippage, color, texture, roller marks, tears or uncoated aggregate particles is detected by the Contractor or the Engineer, the Contractor shall make an investigation into the causes and immediately take the appropriate corrective action. If no immediate appropriate corrective action is or can be taken, paving shall cease until the Contractor further investigates the causes and the Engineer approves further production to determine effectiveness of corrective action.

Segregated and/or severely damaged areas shall be corrected at the Contractor's expense as directed by the Engineer. Correction may include removal and replacement. Disputes will be resolved by the TxDOT Construction and Maintenance Division.

(8) Referee Tests. The TxDOT Materials and Tests Division will perform the referee tests. Either the Engineer or the Contractor may request referee tests; however, all referee samples must be submitted to the Materials and Tests Division by the Engineer. Referee tests will be performed on every sublot for the lot (s) in question. These tests are final and will establish pay adjustment factors for the lot(s) in question.

The Contractor shall pay only for referee tests the Contractor requests and for which the Engineer's test result is closer to the referee test result than that of the Contractor.

(9) Independent Assurance Tests. Independent assurance tests as defined in Subarticle 1.5 will be performed by the Engineer on all tests used for acceptance of the hot mix.

3116.9. Measurement. The quantity of hot mix will be measured by the composite mass or composite volumetric method.

(1) Composite Mass Method. Hot mix will be measured by the ton of 2000 pounds of the composite hot mix of the type actually used in the completed and accepted work in accordance with the plans and specifications for the project. The composite hot mix is hereby defined as the asphalt, aggregate, RAP and additives as noted on the plans and/or approved by the Engineer.

If mixing is done by a drum-mix plant, measurement will be made on scales as specified herein.

If mixing is done by a weigh-batch plant or modified weigh-batch plant, measurement will be determined on the batch scales unless surge-storage is used. Records of the number of batches, batch design and the mass of the composite hot mix shall be kept. Where surge-storage is used, measurement of the material taken from the surge-storage bin will be made on truck scales or suspended hopper scales.

(2) Composite Volumetric Method. Hot mix will be measured by the cubic yard of compacted hot mix of the type actually used in the completed and accepted work in accordance with the plans and specifications for the project. The composite hot mix is hereby defined as the asphalt, aggregate, RAP and additives as noted on the plans and/or approved by the Engineer. The volume of the composite hot mix shall be calculated by the following formula.

$$V = \frac{W}{62.4\,(27)\,GA}$$

V = Cubic yard of compacted hot mix

W = Total mass of hot mix in pounds

GA = Average actual specific gravity of three (3) molded specimens as prepared by test method TEX- 206-F and determined in accordance with test method TEX-207-F, using samples collected by the Engineer.

If mixing is done by a drum-mix plant, the mass "W" will be determined by scales as specified herein.

If mixing is done by a weigh-batch plant or modified weigh-batch and surge-storage is not used, the mass "W" will be determined by batch scales. Records of the number of batches, batch designs and mass of asphalt and aggregate shall be kept. Where surge-storage is used, measurement of the material taken from the surge-storage bin will be made on truck scales or suspended hopper scales.

3116.10. Payment And Pay Adjustment Factors.

(1) General. The work performed and materials furnished in accordance with this item and measured as provided under Article 9, "Measurement" will be paid for at the unit price bid for the "hot mix" of the type specified and as determined in Article 10, "Payment and Pay Adjustment Factors."

MEASUREMENT METHOD	BID ITEM	UNIT OF MEASURE
Composite Mass	Hot mix	Ton
Composite Volumetric	Hot mix	Cubic Yard

The payment based on the unit bid price shall be full compensation for quarrying, for furnishing all materials and additives, for freight involved, for sampling and testing, for all hot mix design(s), for all quality control, for all heating, for mixing, for hauling, for cleaning the existing base course or pavement, for tack coat, for placing, rolling and finishing hot mix, for transporting RAP, for transporting any excess RAP to locations shown on the plans, and for all manipulations, labor, tools, equipment and incidentals necessary to complete the work.

All templates, straightedges, core drilling equipment, scales and other weighing and measuring devices necessary for the proper construction, measuring and checking of the work shall be furnished, operated and maintained by the Contractor at his expense.

The Contractor's laboratory building and equipment shall be furnished, maintained, and operated by certified specialists at the Contractor's own expense.

If the production or placement pay factor for 3 consecutive lots is below 1.000, then the Contractor shall cease production until test results, or other information, indicate to the satisfaction of the Engineer that the next material to be produced will meet the specified values.

(2) Production Pay Adjustment Factors. The pay adjustment factor for production is based on the laboratory density and will be determined using the Engineer's test results. A pay adjustment factor will be determined from Table 5 for each sublot using the deviation from target lab density defined in Article 4. The pay adjustment factor for the production lot will be the average of the pay adjustment factors for the sublots within that lot.

Pay adjustments for incomplete production lots described under Subarticle 8.2.2 will be calculated in accordance with Subarticle 10.2 using the average of the production pay factors from all sublots sampled.

If the total pay adjustment factor for production for any lot is less than 1.000, the Contractor has the option to remove and replace the lot or agree to accept the lot at an adjusted unit price determined by the total pay adjustment calculation. If the pay adjustment factor for production for any lot is less than 0.700, the material will not be paid for by the Engineer, and the material shall be removed at the expense of the Contractor. Replacement material shall meet the requirements of this specification with payment made accordingly.

(3) Placement Pay Adjustment Factors. The pay adjustment factor for a placement sublot shall be determined from Table 6 for the sublots that require air void measurement. For sublots that do not require air void measurement, the pay adjustment factor shall be 1.000. The pay adjustment factor for a placement lot shall be the average of the four (4) pay adjustment factors for the sublots within that lot.

Pay adjustments for incomplete placement lots described under Subarticle 8.5.1 will be calculated in accordance with this Subarticle using the average of the placement pay factors from all sublots sampled.

If the total pay adjustment factor for placement for any lot is less than 1.000, the Contractor has the option to remove and replace the lot or agree to accept the lot at an adjusted unit price determined by the total pay adjustment calculation. If the pay adjustment factor for placement for any lot is less than 0.700, the material will not be paid for by the Engineer, and the material shall be removed at the expense of the Contractor. Replacement material shall meet the requirements of this specification with payment made accordingly.

(d) Total Adjusted Pay Calculation. Total adjusted pay (TAP) shall be based on the applicable pay adjustment factors for production and placement.

For production only * TAP1 = A

For production and placement TAP2 = $\frac{A+B}{2}$

A = Bid price x production lot quantity x pay adjustment factor for production

B = Bid price x placement lot quantity x pay adjustment factor for placement

* Applies only when placement of the mixture is not part of the contract.

Pay adjustment factors shall be rounded to the thousandth place (e.g., 0.000)

TABLE 1. AGGREGATE QUALITY REQUIREMENTS

REQUIREMENT	TEST METHOD	SLAG OR NATURAL AGGREGATE
COARSE AGGREGATE		
DRY, LOOSE UNIT WEIGHT, LB/CF, MIN.	TEX-404-A	-
DELETERIOUS MATERIAL, PERCENT, MAXIMUM	TEX-217-F PART I	1.5
DECANTATION, PERCENT, MAXIMUM	TEX-217-F PART II	1.5
LOS ANGELES ABRASION, PERCENT, MAXIMUM FOR MIXTURE OTHER THAN CMHB FOR CMHB MIXTURES	TEX-410-A TEX-410-A	40 35
MAGNESIUM SULFATE SOUNDNESS LOSS, 5 CYCLE, PERCENT, MAXIMUM	TEX-411-A	30 or as shown on plan
POLISH VALUE	TEX-438-A	SHOWN ON PLANS
FINE AGGREGATE		
LINEAR SHRINKAGE, PERCENT, MAXIMUM	TEX-107-E PART II	3
COMBINED COARSE AND FINE AGGREGATES AND MINERAL FILLER		
SAND EQUIVALENT VALUE, PERCENT, MINIMUM	TEX-203-F	45

TABLE 2. MIXTURE REQUIREMENTS MASTER GRADING (PERCENT PASSING BY MASS OR VOLUME)

	TYPE						
SIEVE SIZE	A COARSE BASE	B FINE BASE	C COARSE SURFACE	D FINE SURFACE	F FINE MIXTURE	CMHB-F FINE SURFACE	MHB-C COARSE SURFACE
1-1/2"	98.0-100.0						
1"		98.0-100.0					
7/8"	70.0-90.0		98.0-100.0				98.0-100.0
5/8"		75.0-95.0					
1/2"	50.0-70.0			98.0-100.0		98.0-100.0	
3/8"		60.0-80.0	70.0-85.0	85.0-100.0	98.0-100.0	85.0-100.0	50.0-70.0
1/4"							
No. 4	30.0-50.0	40.0-60.0	43.0-63.0	50.0-70.0		40.0-60.0	30.0-45.0
No. 10	20.0-34.0	27.0-40.0	30.0-40.0	32.0-42.0	32.0-42.0	15.0-25.0	15.0-25.0
No. 40	5.0-20.0	10.0-25.0	10.0-25.0	11.0-26.0	9.0-24.0	6.0-20.0	6.0-20.0
No. 80	2.0-12.0	3.0-13.0	3.0-13.0	4.0-14.0	3.0-13.0	6.0-18.0	6.0-18.0
No. 200	1.0-6.0	1.0-6.0	1.0-6.0	1.0-6.0	1.0-6.0	5.0-8.0	5.0-8.0
MIXTURE PROPERTIES							
VMA,% MINIMUM	13.0	14.0	15.0	16.0	17.0	16.0	15.0
HVEEM STABILIY MINIMUM	35*	35*	35*	35*	35*		
CREEP SLOPE			IN/IN/SEC MAXIMUM			4.0X10-8	4.0X10-8
CREEP STIFFNESS			PSI MINIMUM			6,000	6,000
PERMANENT STRAIN			IN/IN MAXIMUM			6X10-4	6X10-4

* OR AS SHOWN ON PLANS.

TABLE 3. OPERATIONAL TOLERANCES OF CURRENT FORMULA

ITEM	TOLERANCE (MASS OR VOLUME)
INDIVIDUAL PERCENT RETAINED ON EACH SIEVE NO. 10 AND LARGER	PLUS OR MINUS 5*
INDIVIDUAL PERCENT RETAINED ON EACH SIEVE SMALLER THAN NO. 10	PLUS OR MINUS 3*
ASPHALT CONTENT	±0.3 **
HVEEM STABILITY (EXCEPT FOR CMHB)	MINIMUM 35 - NO MAXIMUM
MOISTURE SUSCEPTIBILITY, TEX-530-C (WHEN SHOWN ON PLANS)	ITEM 301

*when within these tolerances, the gradation of the mixture may fall outside the master grading limits for all sieves except passing no. 200. For the passing no. 200, any test result which is not within the master grading limit will be considered as exceeding the operational tolerance.

**production shall cease if the asphalt content deviates from the current job mix formula by more than 0.5 percent for any sublot.

TABLE 4. MAXIMUM ALLOWABLE DIFFERENCE BETWEEN CONTRACTOR AND ENGINEER TESTS

TEST METHOD NO.	TEST DESCRIPTION	MAX. DIFFERENCE
TEX-210-F TEX-200-FOR TEX-236-F	SIEVE ANALYSIS.INDIVIDUAL PERCENT RETAINED FOR 5/8" SIEVES & LARGERINDIVIDUAL PERCENT RETAINED FOR SIEVES SMALLER THAN 5/8" AND LARGER THAN NO. 200PERCENT PASSING NO. 200 SIEVE	PLUS OR MINUS 5.0PLUS OR MINUS 3.0PLUS OR MINUS 1.6
TEX-228-F OR TEX-236-F	ASPHALT MATERIAL CONTENT	PLUS OR MINUS 0.3
TEX-207-F	IN-PLACE AIR VOIDS	PLUS OR MINUS 1.0
TEX-207-F	LABORATORY MOLDED AIR VOIDS	PLUS OR MINUS 1.4
TEX-227-F	THEORETICAL MAXIMUM(RICE) GRAVITY	PLUS OR MINUS 0.020
TEX-207-F	LABORATORY MOLDED BULKSPECIFIC GRAVITY	PLUS OR MINUS 0.020

TABLE 5. PRODUCTION PAY ADJUSTMENT FACTORS FOR LAB DENSITY

ABSOLUTE DEVIATION FROM TARGET LAB MOLDED DENSITY	PAY FACTOR
0.0	1.050
0.1	1.050
0.2	1.050
0.3	1.044
0.4	1.038
0.5	1.031
0.6	1.025
0.7	1.019
0.8	1.013
0.9	1.006
1.0	1.000
1.1	0.980
1.2	0.960
1.3	0.940
1.4	0.920
1.5	0.900
1.6	0.850
1.7	0.800
1.8	0.700
>1.8	No Pay

TABLE 6. PLACEMENT PAY ADJUSTMENT FACTORS FOR IN-PLACE DENSITY

In-Place Air Voids	Pay Adjustment Factor	In-Place Air Voids	Pay Adjustment Factor	In-Place Air Voids	Pay Adjustment Factor	In-Place Air Voids	Pay Adjustment Factor	In-Place Air Voids	Pay Adjustment Factor
<2.6	No Pay	5.0	1.050	7.5	1.025	10.0	0.950	12.6	0.820
2.6	0.700	5.1	1.050	7.6	1.023	10.1	0.945	12.7	0.815
2.7	0.738	5.2	1.050	7.7	1.022	10.2	0.940	12.8	0.810
2.8	0.775	5..3	1.050	7.8	1.020	10.3	0.935	12.9	0.805
2.9	0.813	5.4	1.050	7.9	1.018	10.4	0.930	13.0	0.800
3.0	0.850	5.5	1.050	8.0	1.017	10.5	0.925	13.1	0.795
3.1	0.860	5.6	1.050	8.1	1.015	10.6	0.920	13.2	0.790
3.2	0.870	5.7	1.050	8.2	1.013	10.7	0.915	13.3	0.785
3.3	0.880	5.8	1.050	8.3	1.012	10.8	0.910	13.4	0.780
3.4	0.890	5.9	1.050	8.4	1.010	10.9	0.905	13.5	0.775
3.5	0.900	6.0	1.050	8.5	1.008	11.0	0.900	13.6	0.770
3.6	0.910	6.1	1.048	8.6	1.007	11.1	0.895	13.7	0.765
3.7	0.920	6.2	1.047	8.7	1.005	11.2	0.890	13.8	0.760
3.8	0.930	6.3	1.045	8.8	1.003	11.3	0.885	13.9	0.755
3.9	0.940	6.4	1.043	8.9	1.002	11.4	0.880	14.0	0.750
4.0	0.950	6.5	1.042	9.0	1.000	11.5	0.875	14.1	0.745
4.1	0.960	6.6	1.040	9.1	0.995	11.6	0.870	14.2	0.740
4.2	0.970	6.7	1.038	9.2	0.990	11.7	0.865	14.3	0.735
4.3	0.980	6.8	1.037	9.3	0.985	11.8	0.860	14.4	0.730
4.4	0.990	6.9	1.035	9.4	0.980	11.9	0.855	14.5	0.725
4.5	1.000	7.0	1.033	9.5	0.975	12.0	0.850	14.6	0.720
4.6	1.010	7.1	1.032	9.6	0.970	12.1	0.845	14.7	0.715
4.7	1.020	7.2	1.030	9.7	0.965	12.2	0.840	14.8	0.710
4.8	1.030	7.3	1.028	9.8	0.960	12.3	0.835	14.9	0.705
4.9	1.040	7.4	1.027	9.9	0.955	12.4	0.830	15.0	0.700
						12.5	0.825	>15.0	No Pay

TABLE 7. TEST METHODS, TEST RESPONSIBILITY AND MINIMUM CERTIFICATION LEVELS

		CERTIFICATION			
	TEST	CONTRACTOR	TXDOT	LEVEL	
1.	AGGREGATE TESTING				
	SAMPLING	TEX-400-A	TEX-400-A	IA	
	WASHED SIEVE	TEX-200-F, PART II		IA	
	UNIT WEIGHT		TEX-404-A		
	L.A. ABRASION		TEX-410-A		
	SOUNDNESS		TEX-411-A		
	PRESSURE SLAKE		TEX-431-A		
	POLISH VALUE		TEX-438-A		
	CRUSHED FACE COUNT		TEX-460-A		
	LINEAR SHRINKAGE		TEX-107-E		
	SAND EQUIVALENT		TEX-203-F		
2.	LABORATORY MIX DESIGN AND VERIFICATION				
	DESIGN	TEX-204-F	TEX-204-F	II	
	MIXING	TEX-205-F	TEX-205-F	II	
	MOLDING	TEX-206-F	TEX-206-F	IA	
	DENSITY AND VMA	TEX-207-F	TEX-207-F	II	
	TENSILE STRENGTH	TEX-226-F	TEX-226-F	II	
	RICE GRAVITY	TEX-227-F	TEX-227-F	IA	
	NUCLEAR GAUGE CALIBRATION		TEX-228-F	TEX-228-F	II
	IGNITION OVEN CALIBRATION		TEX-236-F	TEX-236-F	II
	BOIL TEST	TEX-530-C	TEX-530-C	II	
	TENSILE RATIO	TEX-531-C	TEX-531-C II		
	STABILITY		TEX-208-F		
	CREEP		TEX-231-F		

TABLE 7. TEST METHODS, TEST RESPONSIBILITY AND MINIMUM CERTIFICATION LEVELS (CONT.)

		CERTIFICATION			
	TEST	CONTRACTOR	TXDOT	LEVEL	
3.	TRIAL MIX VERIFICATION				
	APPROVED GYRATORY PRESS CORRELATION			IA	
	SAMPLING	TEX-222-F	TEX-222-F	IA	
	MOLDING	TEX-206-F	TEX-206-F	IA	
	DENSITY	TEX-207-F	TEX-207-F	IA	
	STABILITY		TEX-208-F		
	EXTRACTION	TEX-210-F	TEX-210-F	IA	
	MOISTURE		TEX-212-F	IA	
	RICE GRAVITY	TEX-227-F	TEX-227-F	IA	
	ASPHALT CONTENT(NUCLEAR)		TEX-228-F	TEX-228-F	IA
	ASPHALT CONTENT (IGNITION)		TEX-236-F	TEX-236-F	
	BOIL TEST		TEX-530-C	II	
4.	PRODUCTION OPERATIONS				
	RANDOM SAMPLING		TEX-225-F	IA	
	SAMPLING	TEX-222-F	TEX-222-F	IA	
	ASPHALT CONTENT(NUCLEAR)		TEX-228-F	TEX-228-F	IA
	ASPHALT CONTENT(IGNITION)		TEX-236-F	TEX-236-F	
	EXTRACTION OR COLD FEED		TEX-229-F	TEX-229-F	IA
	MOLDING	TEX-206-F	TEX-206-F	IA	
	LAB DENSITY	TEX-207-F	TEX-207-F	IA	
	RICE GRAVITY	TEX-227-F	TEX-227-F	IA	
	STABILITY		TEX-208-F		
5.	ROADWAY OPERATIONS				
	RANDOM SAMPLING		TEX-225-F	IB or IA	
	AIR VOIDS	TEX-207-F	TEX-207-F	IB or IA	
	ESTABLISH ROLLING PATTERN		TEX-207-F	TEX-207-F	IB

APPENDIX K

SPECIAL SPECIFICATION

ITEM 3022 A/P (METRIC)

QUALITY CONTROL/QUALITY ASSURANCE OF HOT MIX ASPHALT FOR AIRFIELD PAVEMENTS

A/P DRAFT,1995 METRIC

SPECIAL SPECIFICATION

ITEM 3022 A/P

QUALITY CONTROL/QUALITY ASSURANCE OF HOT MIX ASPHALT FOR AIRFIELD PAVEMENTS

3022.1. Description.This item shall govern the construction of a base course, a level-up course, a surface course or any combination of these courses for airport runways, taxiways and any other designated airdrome pavements.Each course must be composed of a compacted mixture of aggregate and asphalt material mixed hot in a mixing plant, in accordance with the typical sections and details shown on the plans and the requirements herein.

It is the intent of this specification that the Contractor be responsible for all quality control to include mix design and testing with certified specialists.TxDOT shall be responsible for all quality assurance, verification of the mix design and testing and any required referee testing.

The Texas Department of Transportation is the owner's agent and shall as such determine compliance with this specification.At the option of the Department, consulting engineering firms may be used in the design and oversight for TxDOT.

(1) Quality Control. Contractor sampling, testing and inspection for operational control.

(2) Quality Assurance. Engineer sampling, testing and inspection activities to determine payment and to make acceptance decisions.

(3) Verification Tests. Tests to verify accuracy of quality control, quality assurance and mixture design testing.

(4) Referee Tests. Tests used to resolve differences between Contractor and Engineer test results.The Materials and Tests Division of TxDOT is designated as the referee laboratory.

(5) Independent Assurance Program. An unbiased and independent evaluation of all the sampling and testing techniques used in the acceptance program.These activities are performed by the Engineer.The test results are not used for acceptance.

3022.2. Certification and Reporting Requirements. All sampling and testing (Contractor and Engineer) will be conducted by personnel certified by the TxDOT-approved program.The certification level required for performance of each test shall comply with requirements shown in Table 7.The Contractor shall provide a list of certified personnel to be used on the project prior to the beginning of production.An updated list shall be provided when personnel changes are made.The Contractor's certified Level IA HMA specialist shall be at the plant prior to the beginning of and during plant production operations.

TxDOT's automated hot mix program will be used by the Engineer and the Contractor to record all test data and calculate all pay factors.The Engineer will provide the automated program to the Contractor.A diskette copy of the automated hot mix program shall be used by the Contractor to submit test results to the Engineer on a daily basis.The results of all quality control testing shall be plotted by the Contractor, and the results of all quality assurance testing will be plotted by the Engineer in accordance with Test Method Tex-233-F.The control chart shall be updated as soon as test results for each sublot becomes available.

3022.3. Materials. Before mixing begins, the Contractor shall furnish to the project materials meeting the following requirements.Additional test requirements affecting the quality of individual materials or the paving mixture shall be required when indicated on the plans.

(1) Aggregate.The aggregate shall be composed of a coarse aggregate and a fine aggregate, and may include reclaimed asphalt pavement (RAP).The Contractor may use a mineral filler when necessary to meet the mixture design requirements.Samples of each aggregate shall be submitted for testing and approval.Approval must be completed prior to submission of the mixture design.Additional aggregate testing may be performed by the Engineer at any time during production.

Aggregate from each source shall meet the quality requirements of Table 1 and other requirements as specified herein. Aggregate quality testing will be performed by the Engineer.Aggregate may be sampled either before or after delivery to the plant or both as determined by the Engineer.The aggregate contained in RAP will not be required to meet Table 1 requirements.

(a) Coarse Aggregate. Coarse aggregate is defined as that part of the aggregate retained on a 2.00 millimeter sieve.The aggregate shall be natural or slag, and shall be of uniform quality throughout.When specified on the plans, certain coarse aggregate material may be allowed, required or prohibited.

Slag shall be air-cooled, blast furnace slag and shall have a compacted weight of not less than 1120 kilograms per cubic meter when tested in accordance with test method TEX-404-A.

The aggregate shall not contain more than seventeen (17) percent by weight of flat or elongated particles when tested in accordance with test method TEX-224-F.

Aggregate from each source, including the gravel aggregate from RAP,shall be so crushed as to have a minimum of 85 percent of the particles retained on the 4.75 millimeter sieve with two (2) or more mechanically induced crushed faces, as determined by test method TEX-460-A (Part I).The material passing the 4.75 millimeter sieve and retained on the 2.00 millimeter sieve must be the product of crushing aggregate that was originally retained on the 4.75 millimeter sieve.

If a polish value is required by note on the plans, the polish value for the virgin coarse aggregate used in the surface or finish course, when tested in accordance with test method TEX-438-A, shall not be less than the value shown on the plans.For rated sources, the Materials and Tests Division's *Rated Source Quality Catalog* (RSQC) will be used to determine polish value compliance.Blending of coarse aggregates to meet the polish value requirements will be allowed unless otherwise shown on the plans.When blending is allowed, the blended coarse aggregates shall contain non-polishing aggregates of at least 50 percent by volume retained on the 4.75 millimeter sieve for Types C, D, and coarse matrix high binder (CMHB) mixes, and at least 50 percent by volume retained on the 2.00 millimeter sieve for Type F mixes.Blending of coarse aggregates to meet polish value requirements shall be in accordance with test method TEX-438-A, Part II, Method B.

Aggregates with a satisfactory skid history that do not meet the minimum polish value or RSQC requirement may be used.A list of aggregate sources with an acceptable skid history is available from the Engineer.

(b) Reclaimed Asphalt Pavement (RAP). RAP is defined as a salvaged, milled, pulverized, broken or crushed asphalt pavement.The RAP to be used in the mix shall be crushed or broken to the extent that 100 percent will pass the 50 millimeter sieve.The Contractor has the

option to use up to 20 percent RAP in surfacing mixtures and level-ups and up to 30 percent RAP in base course mixtures.Only RAP from designated state-owned sources may be used in surface mixtures.

The stockpiled RAP shall not be contaminated by dirt or other objectionable materials.Unless otherwise shown on the plans, stockpiled, crushed RAP shall have either a decantation of five (5) percent or less or a plasticity index of eight (8) or less, when tested in accordance with test method TEX-406-A, Part I, or test method TEX-106-E, respectively.This requirement applies to stockpiled RAP from which the asphalt has not been removed by extraction.

The polish value of RAP aggregate will not be used in any determination of polish value specification compliance.

When shown on the plans or when designated in a special provision, state-owned RAP sources are available to the Contractor.The approximate asphalt material content and asphalt cement properties will be shown on the plans.If the source is an existing stockpile material, the decantation or plasticity index will also be shown on the plans.

Any contractor-owned RAP that is allowed to be used on the project shall remain the property of the Contractor, while stockpiled, and shall not be intermingled with state-owned RAP stockpiles.Any unused contractor-owned RAP material shall be removed from the project site upon completion of the project. Any unused state owned RAP shall be returned to the stockpile as directed by the Engineer.

(c) Fine Aggregate. The fine aggregate is defined as that part of the aggregate passing the 2.00 millimeter sieve.It shall be of uniform quality throughout.A maximum of 15 percent of the total virgin aggregate may be field sand or other uncrushed fine aggregate, unless a value less than 15 percent is shown on the plans.When specified on the plans, certain fine aggregate material may be allowed, required or prohibited.

Unless otherwise shown on the plans, gravel screenings shall not be allowed.Crushed gravel screenings, when allowed, shall be the result of crushing aggregate that was originally retained on the 4.75 millimeter sieve.

When screenings are used, they shall meet the following gradation requirements when tested in accordance with test method TEX-200-F, Part II.

	PERCENT BY MASS
PASSING THE 9.5 MM SIEVE	100
PASSING THE 2.00 MM SIEVE	70.0 – 100.0
PASSING THE 0.075 MM SIEVE	0.0 – 30.0

Except in CMHB mixtures, screenings shall be supplied from sources whose coarse aggregate meet the Los Angeles Abrasion and magnesium sulfate soundness loss requirements.

(d) Mineral Filler. Mineral filler shall consist of thoroughly dried stone dust.The use of fly ash will not be permitted.If other mineral filler is used, it must be approved by the Engineer.The mineral filler shall be free from foreign matter and meet the following gradation requirements when tested in accordance with test method TEX-200-F, Part II.

	PERCENT BY MASS
PASSING THE 2.00 MM SIEVE	100
PASSING THE 0.075 MM SIEVE	more than 30.0

(e) Baghouse Fines. The addition of fines collected by the baghouse or other air-cleaning or dust-collecting equipment is permitted.

(2) Asphalt Material.

(a) Asphalt Material. Asphalt material for the paving mixture shall be of the grade shown on the plans or designated by the Engineer and shall meet the requirements of Item 300, "Asphalts, Oils And Emulsions."

(b) Tack Coat. Asphalt materials shown on the plans or approved by the Engineer shall meet the requirements of Item 300, "Asphalts, Oils And Emulsions."

3022.4. Job Mix Formula. A job mix formula (JMF) identifies the combined aggregate gradation and lists the percentage of each material component to be used in the mix.The JMFs are described in the following sections.

For runways and taxiways, the target density for all mixes is 97.0 percent.On all other support pavements, for mixture Types A, B, C, D and F, the target laboratory molded density may be set at 96.0 percent and for mixture Types CMHB-C or CMHB-F, the target laboratory density may be set at 96.5 percent. When shown on the plans, the target laboratory molded density for any type of mixture may be set at any value within the range of96.0 to 97.0.These target lab densities apply to all JMFs.

(1) Development of Laboratory Mixture Design (JMF 1). JMF 1 is the laboratory mixture design developed by the Contractor's Level II certified specialist in accordance with test method TEX-204-F.JMF 1 shall use the project aggregates, asphalt material, and any additives that are allowed or required.

Creep, Hveem stability, gradation and VMA properties shall conform to the requirements specified in Table 2 as determined in accordance with the test methods in Table 7.

The mixture proposed for use shall be evaluated for moisture susceptibility in the mixture design stage by test method TEX-531-C, unless otherwise shown on the plans. Mixture approval criteria shall be in accordance with Item 301, "Asphalt Antistripping Agents."

The Contractor may select either lime or a liquid antistripping agent to reduce the moisture susceptibility of the aggregate.The addition of these antistripping agents shall be in accordance with Item 301, "Asphalt Antistripping Agents."The Engineer may waive testing for moisture susceptibility if a similar design using the same materials has proven satisfactory.When the antistripping additive type and rate are shown on the plans, then all moisture susceptibility testingrequirements for mixture design will be waived, however, production testing, when required, will remain in effect.

When it is suspected that there is a significant difference between the specific gravities for the individual aggregates, then the specific gravity shall be determined for all aggregates.If the specific gravity values differ by 0.300 or more, the mixture design shall be by the volumetric method, test method TEX-204-F, Part II.

The Contractor's and Engineer's responsibilities in development and approval of JMF 1 are as follows.

(a) Contractor Responsibilities. The Contractor shall develop JMF 1 in accordance with test method TEX 204-F and submit all required worksheets andlaboratory molded specimens for Hveem stability or creep testing.

When the nuclear gauge is used for determining the asphalt content, then calibration samples prepared by the Contractor during the laboratory mixture design shall be retained by the Contractor for later use as necessary.

The Contractor shall notify the Engineer of any changes in material sources.If a source changes at any point, a new laboratory mixture design shall be required unless otherwise approved by the Engineer.The Engineer may request a new laboratory mixture design if the asphalt material grade is changed.

(b) Engineer Responsibilities. The Engineer will review the Contractor's mix design report and verify conformance with all aggregates, asphalt and additives and mixture specifications. The Engineer will verify the mixture design using material samples collected by either the Engineer or the Contractor. The samples may be obtained at the plant or quarry as determined by the Engineer.Quarry samples shall be from materials produced for the project.The Engineer may elect to sample at both locations.Using these materials, the Engineer will determine lab density, VMA, moisture susceptibility and Hveem stability or creep at the optimum asphalt content using the test methods in Table 7.The Engineer will approve the contractor's JMF 1 in 10 working days provided that the engineer's test results for lab molded bulk specific gravity, theoretical maximum specific gravity,VMA, moisture susceptibility and Hveem stability or creepand the Contractor's mix design report are in conformance with the requirements of this specification.In addition, lab density from the Engineer's tests must be within 0.5 percent of specified target for JMF1 to be approved.When prior experience with the submitted mixture design makes it unnecessary to perform verification testing, the Engineer may waive JMF1 verification testing.

Referee testing will be used to resolve differences between the engineer and the contractor in determinations oflab density, VMA and, when required, moisture susceptibility. Referee test results will be provided within 10 working days from receipt of samples at the referee laboratory.

(2) Development of JMF 2. The Contractor shall use JMF 1 to provide a plant-produced trial mixture and to develop JMF 2 prior to the construction of the test section/s/.The trial mixture should be of sufficient quantity to ensure that a representative mixture is produced.At the request of the Contractor, the Engineer may waive the requirement for a trial mixture if a similar design using the same materials has proven satisfactory.All materials, labor and equipment furnished by the Contractor for the production of the trial mixtures are subsidiary to the bid item for hot mix and will not be paid for directly.The Engineer and the Contractor will sample and test the trial mixture.Correlation of Engineer and Contractor presses to be used for the project, and tests for laboratory molded density, asphalt content, Hveem stability, and aggregate gradation shall be performed.The Engineer will approvethe trial mixture within 24 hours of producing the trial batchif the Engineer's test results meet the following requirements.

(a) Laboratory Molded Density. Target laboratory molded density (as specified in Article 4) shall be plus or minus 1.0 percent.

(b) Combined Aggregate Gradation. The gradation shall be within the limits of the master grading shown in Table 2 and the operational tolerances of JMF 1 shown in Table 3.

(c) Hveem Stability. A minimum stability of 35 is required, unless otherwise shown on the plans.Hveem stability is not required for mixture types CMHB-F and CMHB-C.

(d) Asphalt. The asphalt content shall be within plus or minus 0.5 percent of the JMF 1 target asphalt content.

When the Engineer's test results do not meet the aboverequirements, additional plant-produced trial mixes shall be produced andtested prior to approval of the plant-produced trial mix.If an acceptable plant-produced mixture cannot be produced from JMF 1, a new laboratory mixture design will be required.

After evaluation of test results on the trial batch, the Contractor shall determine the optimum mixture ingredients for JMF 2.The Engineer will approve JMF 2 provided that it meets the master grading limits shown in Table 2, the operational tolerance of JMF 1 for gradation listed in Table 3, and the asphalt content iswithin +/- 0.5 % of JMF 1.

(3) Development of JMF 3. JMF 2 will be used to produce the test section/s/ and to develop JMF 3.Plant adjustments within the operational tolerances may be made as necessary

during production of material for the test section/s/ in order to develop JMF 3.Acceptance of the material will be in accordance with Article 8.

The Contractor and the Engineer will test every sublot in Lot 1 in accordance with Article 8.The difference between the Contractor's and the Engineer's test results must be within the tolerances listed in Table 4.If the difference exceeds the tolerances listed in Table 4, the Contractor and the Engineer must resolve the differences prior to beginning Lot 1.

The test section production mix shall be the basis for the Contractor to establish the job-mix formula which will be the job-mix formula (JMF 3) for the project unless the JMF 3 is adjusted as provided in Subarticle 4.4. At the end of production of the test sections, the Contractor shall submit the JMF 3 to the Engineer.The Engineer will approve the JMF 3 provided that it meets the master grading limits shown in Table 2, meets the operational tolerance of JMF 1 for gradation listed in Table 3, and that the asphalt content is within+/- 0.5 % of JMF 1.JMF 3 must be such that the target lab density can be achieved.

The pay adjustment factor for the test section/s/ production mixture will be 1.00 except as set forth is Subarticle 4.3.1.However, the Contractor. with the approval of the Engineer, may elect to waive the 1.00 pay factor for the test section and begin acceptance testing in accordance with Article 8.This notification must be made in writing to the Engineer prior to production of the test section.

(4) Test Sections. Prior to full production, the Contractor shall prepare and place a quantity of the asphalt mixture according to the job-mix formula.The amount of the mixture should be sufficient to construct a test section approximately 92 meters long and 6 to 9 meters wide, placed in a minimum of two lanes, with a longitudinal cold joint, and shall be of the same depth specified for the construction of the course which it represents.The underlying grade or pavement structure upon which the test section is to be constructed shall be the same as the remainder of the course represented by the test section.The equipment used in the construction of the test section shall be the same type and weight to be used onthe remainder of the course represented by the test section.

Random samples of the mixture shall be taken at the plant and tested and evaluated.A minimum of three random cores shall be taken from the finished test section pavement mat and three from adjacent to the longitudinal joint and tested in accordance with the procedures specified herein.

The mixture shall be considered acceptable if the test values are within the limits specified for the JMF.

If the initial test section should prove to be unacceptable, the necessary adjustments to the job mix formula, plant operation, placing procedures, and/or rolling patterns shall be made.A second test section shall then be placed.If the second test section also does not meet specification requirements, both sections shall be removed at the Contractor's expense.If the second test section does meet the specification requirements, both sections may remain in place unless the first section would require removal according to the requirements of this specification.Under these conditions, the first test section must be removed at the Contractor's expense.Any additional test sections failing to meet the specification requirements shall be removed at the Contractor's expense.Full production shall not begin until an acceptable section has been constructed and accepted by the Engineer.

(5) Job Mix Formula Adjustment. At any time during the project, the contractor may submit for the engineer's approval, a new laboratory mixture design as detailed in Article 4.1.Unless otherwise approved by the engineer,plant-produced trial mixes will be required to verify the new laboratory mixture design as described in Article 4.2.

The contractor may adjust the job mix formula prior to beginning a new lot provided that it meets the master gradation limits shown in Table 2 and the operational tolerance of JMF 1 for the gradation listed in Table 3. Also, the asphalt content must be within plus or minus 0.5 percentof JMF 1.The new job mix formula must be such that the target lab density shown in Article 4, can be achieved.

3022.5. Equipment.

(1) General. All equipment for the handling of all materials, mixing, placing and compacting of the mixture shall be maintained in good repair and operating condition.In case of equipment malfunction, the Contractor shall cease production until defective equipment is repaired or replaced.

(2) Mixing Plants. Automatic proportioning devices shall be required for all plants and documentation as to their accuracy may be required by the Engineer.

If a liquid or emulsified additive is to be introduced into the asphaltic material at the mix plant, it shall be added to the asphalt line at the required rate by means of an in-line metering device.The Contractor shall demonstrate that the meter meets the requirements of Item 520, "Weighing And Measuring Equipment."An in-line blending device is required to disperse the additive into the asphaltic material.A sampling port shall be provided on the asphalt line near the outlet of the additive blending device so that the modified asphaltic material may be sampled.The measuring, blending, and sampling equipment and its location must be approved by the engineer.

(3) Fuel. When using fuel oil heavier than grade No. 2 or when using waste oil, the Contractor shall ensure that the fuel delivered to the burner is at a viscosity of 100 SSU or less, when tested in accordance with test method TEX-534-C. This viscosity ensures complete burning of the fuel.Higher viscosities may be allowed by the engineer if recommended by the burner manufacturer.If necessary, the Contractor shall preheat the oil to maintain the required viscosity.

The contractor shall provide means for obtaining a sample of the fuel just prior to entry into the burner in order to perform the viscosity test.The Contractor shall perform this test or provide a laboratory test report that will establish the temperature of the fuel necessary to meet the viscosity requirements.There shall be an in-line thermometer to check the temperature of the fuel delivered to the burner.

Regardless of the burner fuel used, the burner or combination of burners and types of fuel used shall provide a complete burn of the fuel and shall not leave any fuel residue adhering to the heated aggregate.

(4) Surge-Storage System and Scales. A surge-storage system may be used to minimize the production interruptions during the normal day's operations.A device such as a gob hopper or other device designed to prevent segregation in the surge-storage bin shall be used.The mixture shall be weighed upon discharge from the surge-storage system.

When a surge-storage system is used, scales shall be standard platform truck scales or other equipment such as weigh hopper (suspended) scales and shall conform to Item 520, "Weighing And Measuring Equipment."If truck scales are used, they shall be placed at a location approved by the Engineer.If other weighing equipment is used, the Engineer may require mass checks by truck scales for the basis of approval of the equipment.

Temporary storing or holding of the hot mix asphalt by the surge-storage system will be required for drum-mix plants during the normal day's operation.Overnight storage will not be permitted unless authorized on the plans or in writing by the Engineer.

(5) Recording Device and Record Printer. The mixture shall be weighed for payment.If a surge-storage system is used, an automatic recording device and a digital record printer shall be provided to indicate the date, project identification number, vehicle identification, total mass of the load, tare mass of the vehicle, the mass of asphaltic mixture in each load and the number of loads for the day, unless otherwise indicated on the plans.When surge-storage is not used, batch weights will be used as the basis for payment and automatic recording devices and automatic digital record printers in accordance with Item 520, "Weighing And Measuring Equipment," shall be required.

(6) Laboratory. The Contractor shall establish, maintain and operate a laboratory.The laboratory shall be equipped to perform the tests indicated in this specification.All quality control testing shall be performed at the Contractor's on-site laboratory, unless otherwise approved by the Engineer.All test equipment at the laboratory shall be calibrated and certified in accordance with test methodTex-237-F or the manufacturer's recommendations.The Engineer will verify that all the necessary equipment, materials and current test procedures are present and that all equipment meets these requirements prior to the production of hot mix asphalt.

3022.6. Stockpiling, Storage and Feeding of Materials.

(1) Storage and Heating of Asphalt Materials.The asphalt material storage capacity shall be ample to meet the requirements of the plant.Asphalt shall not be heated to a temperature in excess of that specified in Item 300, "Asphalts, Oils And Emulsions."All equipment used in the storage and handling of asphalt material shall be kept in a clean condition at all times and shall be operated in such a manner that there will be no contamination with foreign matter.The heating apparatus shall be equipped with a continuously recording thermometer and a 24-hour chart that will record the temperature of the asphalt material at the location of the highest temperature.

Continuous recordings shall be made for asphalt material and hot mix asphalt temperatures. These recordings shall be made available to the Engineer on a daily basis.

(2) Scalping Screen. A scalping screen shall be required after the cold feeds and ahead of the combined aggregate belt scales for all plants.

(3) Plants Using RAP. If RAP is used, a separate cold bin shall be required.The RAP feed system shall be equipped to remove particles over 50 millimeters in size prior to the weighing device.There shall be adequate cold bin controls to provide a uniform amount of RAP to the mixture.

Positive mass measurement of RAP shall be provided by the use of belt scales or other approved devices or methods.RAP shall be mixed and blended so that there is no evidence of unseparated particles in the mixture as it leaves the mixer.

3022.7. Construction Methods.

(1) General. It shall be the responsibility of the Contractor to produce, transport, place and compact the specified paving mixture in accordance with the requirements herein.

If at any time prior to placement on the roadway surface the temperature of the mixture falls below 100 C, the quantity of that mixture shall be determined to the satisfaction of the Engineer and removed from the project at the expense of the Contractor.No payment will be made for the mixture that is removed.

(2) Adverse Weather Conditions. Unless otherwise approved by the Engineer, asphaltic mixture, when placed with a spreading and finishing machine, or tack coat shall not be placed when air temperature is below 10 C and is falling, but it may be placed when the air temperature is above 5 C and is rising.If a mixtureis placed on a wet or damp surface and it does not bond to the existing pavement, ravels, or has other surface irregularities, the mixture shall be removed or repaired to the satisfaction of the Engineer.Removal or repair shall be at the expense of the Contractor.

(3) Tack Coat. Tack coat shall be used at the direction of the Engineer.The surface upon which the tack coat is to be placed shall be cleaned thoroughly to the satisfaction of the Engineer.A uniform application of tack coat shall be applied at a rate not to exceed 0.2 liter residual asphalt material per square meter of surface area.In CMHB mixtures, the rate shall not exceed 0.3 liter residual asphalt material per square meter of surface area.All joints shall be painted with a thin, uniform application of tack coat.During the application of tack coat, care shall be taken to prevent splattering of adjacent pavement, curb and gutter and structures.The tack coat shall be rolled with a pneumatic tire roller when directed by the Engineer.

(4) Transporting Hot Mix. The hot mix shall be hauled to the work site in tight vehicles previously cleaned of all foreign material.Diesel shall not be used as a truck bed release agent.Any transporting operation that results in contamination of hot mix with foreign materials will not be allowed.

(5) Windrow Pick-Up Equipment. Windrow pick-up equipment shall be such that substantially all the mixture deposited on the roadbed is picked up and loaded into the spreading and finishing machine.The mixture shall not be contaminated with foreign material.The loading equipment shall be designed so that, without resorting to hand finishing, it does not interfere with the spreading and finishing machine in obtaining the required line, grade and surface.

(6) Placing. The hot mix shall be placed on the approved prepared surface with a spreading and finishing machine.When properly compacted, the finished pavement shall be smooth, of uniform texture and density and shall meet the requirements of the typical cross sections and the surface tests.In addition, the placing of the hot mix shall be done without tearing, shoving, gouging or segregating the mixture and without producing streaks in the mat.

Construction joints of successive courses of asphaltic material shall be offset at least 150 millimeters.Construction joints on surface courses shall coincide with lane lines or shall be as directed by the Engineer.

(7) Compacting.The pavement shall be compacted thoroughly and uniformly with the necessary rollers to obtain the air voids and cross section of the finished paving mixture meeting the requirements of the plans and specifications.

All places not accessible to the roller, or in such positions as will not allow thorough compaction with the rollers, shall be thoroughly compacted with lightly oiled tamps.Rolling with a trench roller may be required by the Engineer on widened areas, in trenches and in other limited areas.

With the exception of the above requirements, and when specific air void requirements have not been voided by plan note, the type and size of compaction equipment and the rolling patterns used will be entirely at the discretion of the contractor.

Where specific air void requirements are voided, one (1) three-wheel roller, one (1) pneumatic-tire roller, and one (1) tandem roller shall be furnished for each compaction operation

except as provided below or as approved by the engineer.The use of a tandem roller may be waived by the Engineer when the surface is already adequately smooth and further steel-wheel rolling is shown to be ineffective.With approval of the Engineer, the Contractor may substitute a vibratory roller for the three-wheel roller and/or the tandem roller.Use of at least one (1) pneumatic-tire roller is required.Use of pneumatic tire rollers will not be allowed for CMHB mixtures if excessive pickup of fines by roller tires occurs.Additional or heavier rollers shall be furnished if required by the Engineer.Rolling patterns that achieve maximum compaction shall be established by the contractor as outlined in test method TEX-207-F, Part IV.For these conditions there will be no pay adjustment factor calculated for in-place air voids.

(8) Opening to Traffic. The compacted pavement shall be opened to traffic when directed by the Engineer.

3022.8. Acceptance Plan.

(1) General. Acceptance of the hot mix will be based on the acceptance plan described herein.Random sampling of the hot mix shall be performed on a lot and sublot basis.

(2) Production Lot. The Contractor shall select the sublot size for each lot based upon the anticipated daily production.Sublot size can only be changed prior to the beginning of a lot.It is the intent that this sampling plan produce approximately 4 sublots per day.If the sublot size selected results in less than 4 sublots per day for 2 consecutive production days, then the engineer may reduce the sublot size.

The first 200 Megagrams of the first day production will be assigned a production pay factor of 1.000 to allow the contractor to adjust the hot mix plant.

(a) Small Production Quantities. When the anticipated daily production is less than 800 megagrams the requirement for 4 sublots per day is waived and the sublot size shall be 200 megagrams.If this results in less than four 4 sublots for the project, pay adjustment will be in accordance with Subarticle 8.2.2, "Incomplete Lots."

(b) Incomplete Lots. If a lot is begun but cannot be completed such as on the last day of production or in other circumstances deemed appropriate by the Engineer, the lot maybe closed out by the Engineer.Payment for the lot will be adjusted in accordance with Subarticle 10.2.

(3) Production Sampling. All sampling locations shall be determined by the random sampling procedure defined in test method TEX-225-F.The Engineer is responsible for establishing the random sample locations before lot production begins.Only the locations of the samples that will be taken by the Contractor will be disclosed to the Contractor.

Hot mix shall be obtained from trucks at the plant in accordance with test method TEX-222-F.For each sublot, the Contractor shall take one sample at the location randomly selected by the Engineer. In addition, for each lot the Engineer will randomly select at least two sublots and take one random sample from each selected sublot.Each sample will be split by the sampler into three equal portions in accordance with test method TEX-200-F.These portions will be labeled as Contractor, Engineer and referee and will be delivered to the appropriate party's laboratory.Referee samples will be delivered to the Engineer.Unused samples will be discarded after the Contractor accepts pay adjustment factors for that lot.For the purposes of independent assurance, at least one (1) Engineer sample out of every ten (10) lots or a minimum of one per project will be split into four (4) equal portions.

A sampling platform approved by the Engineer shall be provided by the Contractor.

(4) Production Testing. Production testing responsibility is divided between the Engineer and the Contractor.The Engineer will determine lab density for each sublot, and the Contractor has the option to verify Engineer's test results on split samples provided by the Engineer.The Contractor shall determine compliance with operational tolerance using Contractor's samples on all sublots, and the Engineer will verify Contractor's test results.

The Contractor can request referee testing should the difference between the Contractor's and the Engineer's test results exceed the values shown in Table 4.

Both the Engineer and the Contractor will make the completed test results available to each other upon completing the test.All production testing must be completed within one working day of completion of the lot.

(a) Lab Density. Density is a mixture design and pay factor parameter.The lab density is determined by the engineer for each sublot.It is determined in accordance with test methods TEX-207-F and TEX-227-F.When the Engineer obtains a sample from a sublot in accordance with Subarticle 8.3, that sample will be used by the Engineer to determine the laboratory bulk specific gravity and the maximum theoretical specific gravity and to calculate the lab density.For sublots not

sampled by the Engineer, the Contractor's split sample will be used by the Engineer to determine laboratory bulk specific gravity and maximum theoretical specific gravity and to calculate lab density.

(b) Gradation Test. Gradations shall be determined in accordance with test method TEX-200-F.Aggregates for gradation determination are obtained from one of the following three methods.

- extraction (TEX-210-F)
- cold feed/hot bin samples (TEX-229-F)
- ignition oven (TEX-236-F)

When cold feed samples are used for gradation testing, the Contractor shall supply a correlation as outlined in Tex-229-F.Correlation factors shall be verified by the Contractor and approved by the Engineer once every five production days.

Gradation testing shall be conducted by the Contractor for each sublot on samples taken by the Contractor.The Engineer will verify that the operational tolerances for gradation shown in Table 3 have been met.The minimumverification frequency will be one (1) Engineer's sample for every twelve (12) sublots.

(c) Asphalt Content. The asphalt material content shall be determined in accordance with test method TEX-228-F or TEX-236-F.

Asphalt content testing shall be conducted by the Contractor for each sublot on samples taken by the contractor.The Engineer will conduct asphalt content testing on Engineer's samples on a minimum of one (1) for every four (4) sublots.

If the asphalt content exceeds the operational tolerance shown in Table 3 ontwo consecutive sublots per lot, based on the Engineer's test results ortwoconsecutive sublots per lot based onthe Contractor's test results no production or placement bonus will be paid for that lot.

(d) Hveem Stability. Hveem stability will be determined in accordance with test method TEX-208-F.Hveem stability testing is conducted by the Engineer a minimum of once per lot on specimens molded by the Engineer.

(e) Moisture Susceptibility. Production verification testing after final approval of JMF 1 will use test method TEX-530-C and is required only when shown on the plans.In such cases, the Engineer will determine the location and frequency of sampling and will perform the test.

(f) Operational Tolerances. The hot mix shall meet operational tolerances shown in Table 3 for each sublot.When either the Contractor's or the Engineer's test results exceed the operational tolerances shown in Table 3 for three (3) consecutive tests for a single property, then the Contractor shall cease production until test results or other information indicate, to the satisfaction of the Engineer, that the next material to be produced will meet the specified values.

The Contractor shall select the target discharge temperature of the mixture between 120 C and 175 C.The mixture, when discharged from the mixer, shall not vary from this selected temperature more than 15 C, but in no case shall the temperature exceed 18 C.

(g) Individual Loads of Hot Mix. Individual loads of hot mix in the truck can be rejected by the engineer.When a load of hot mix is rejected for reasons other than temperature as stated in Subarticle 7.1 and Subarticle 8.4.6, the rejected load will be tested at the request of the Contractor. This request must be made within four (4) hours of rejection.If tests are within operational tolerances, payment will be made for the load.If test results are not within operational tolerances as shown in Table 3, no payment will be made for the load.The Engineer will perform sampling and testing.

(5) Placement Lot. A placement lot shall consist of the area placed in a production lot, excluding miscellaneous areas.A placement sublot shall consist of one fourth of the area of the placement lot.

(a) Incomplete Placement Lots. An incomplete placement lot shall consist of the area placed in an incomplete production lot as described in Subarticle 8.2.2 excluding miscellaneous areas.For these lots, one placement sample location will be selected for each production sublot placed.

(b) Miscellaneous Areas. Miscellaneous areas are the only areas that are not eligible for random placement sampling locations, and will be assigned placement pay factor 1.000.

(c) Level-Ups and Thin Overlays. For the purpose of calculating placement pay adjustment factors, level-ups and thin overlays will be considered as miscellaneous areas. The

placement pay adjustment factor shall be 1.000 for layer thicknesses designated on the plans less than 40 millimeters or for level-up areas.The Contractor willestablish a rolling pattern that will achieve in-place air voids in accordance with Subarticle 7.7.Total adjusted pay (TAP) will be based on TAP 2 as shown in Subarticle 10.4.

(d) Shoulders and Ramps. Shoulders and ramps are subject to in-place air voids determination unless otherwise shown on the plans.When shoulders and ramps are not subject to in-place air voids determination, then compaction shall be in accordance with Subarticle 7.7.

(6) Placement Sampling. The Engineer is responsible for determining the random sampling plan.The Contractor will be responsible for obtaining two (2) cores side-by-side from each placement sublot.Immediately after obtaining the cores, the Contractor shall repair core holes in a manner approved by the engineer.

For Type A and Type B hot mix, 150 mm diameter cores shall be obtained. For all other types of hot mix, 100 mm diameter or 150 mm diameter cores shall be obtained.

The Contractor is responsible for trimming and delivering all cores to the Engineer withinone workingday following placement operations.

(a) Sample Locations.One random sample location shall be determined for each placement sublot.The random sample location shall be determined in accordance with test method TEX-225-F.No random sample location shall be located within 0.6 meters of a joint or pavement edge.The sample shall be taken within 0.3 meters of the random location provided.

(b) Placement Testing.The Engineer will determine placement pay adjustment factors by measuring in-place air voids in accordance with test method TEX-207-F and TEX-227-F.

The theoretical maximum specific gravity used for in-place air voids determination will be the average of the values obtainedfor all sublots in the production lot tested by the Engineer.

The average air void content of the two (2) cores shall be used to calculate a placement pay adjustment factor for each sublot tested.Placement pay adjustment factors shall be determined in accordance with Article 10.

Paraffin coating will be used if required by test method TEX-207-F.If a paraffin-coated sample yields a higher specific gravity than the uncoated sample, then the test results from nonparaffin-coated cores will be used for placement pay factor determination.

After determining air voids contents, the Engineer will return tested cores to the contractor.

The Contractor can request referee testing should the difference between the contractor's and the Engineer's test results exceed the values shown in Table 4.

(c) **Smoothness**.The finished surface of the pavement shall not vary more than 6.35 millimeters for the surface course.Each lot shall be measured with a 5.0 meter straightedge.Measurements will be perpendicular and parallel to the centerline.

The finished surfaces of the pavement shall not vary from the gradelines, elevations and cross sections shown on the plans by more than 12.70 millimeters.The Contractor shall correct at his cost pavement areas varying in excess of this amount by removing and replacing the defective work.Skin patchingshall not be permitted for correction of low areas nor shall planning be permitted for correction of high areas.

(7) **Irregularities or Segregation**. If a pattern of surface irregularities including, but not limited to, rutting, segregation, raveling, mat slippage, color, texture, roller marks, tears or uncoated aggregate particles is detected by the Contractor or the Engineer, the Contractor shall make an investigation into the causes and immediately take the appropriate corrective action.Placement may continue for no more than one (1) day of production only if appropriate action is being taken.If no appropriate corrective action is taken or if the problem exists after one (1) day, paving shall cease until the contractor further investigates the causes and the engineer approves further production to determine effectiveness of corrective action.

Segregated areas shall be corrected at the Contractor's expense as directed by the Engineer. Correction may include removal and replacement. Disputes will be resolved by the TxDOT Construction and Maintenance Division.

(8) **Referee Tests**. The TxDOT Materials and Tests Division will perform the referee tests. Either the Engineer or the Contractor may request referee tests; however, all referee samples must be submitted to the Materials and Tests Division by the Engineer.Referee tests will be

performed on every sublot for the lot(s) in question. These tests are final and will establish pay adjustment factors for the lot(s) in question.

The Contractor shall pay only for referee tests the Contractor requests and for which the Engineer's test result is closer to the referee test result than that of the Contractor.

(9) Independent Assurance Tests. Independent assurance tests as defined in Subarticle 1.5 will be performed by the Engineer on all tests used for acceptance of the hot mix.

3022.9. Measurement. The quantity of hot mix will be measured by the composite mass or composite volumetric method.

(1) Composite Mass Method. Hot mix will be measured by the megagrams of the composite hot mix of the type actually used in the completed and accepted work in accordance with the plans and specifications for the project.The composite hot mixis hereby defined as the asphalt, aggregate, RAP and additives as noted on the plans and/or approved by the Engineer.

If mixing is done by a drum-mix plant, measurement will be made on scales as specified herein.

If mixing is done by a weigh-batch plant or modified weigh-batch plant, measurement will be determined on the batch scales unless surge-storage is used.Records of the number of batches, batch design and the mass of the composite hot mix shall be kept.Where surge-storage is used, measurement of the material taken from the surge-storage bin will be made on truck scales or suspended hopper scales.

(2) Composite Volumetric Method. Hot mix will be measured by the cubic meter of compacted hot mix of the type actually used in the completed and accepted work in accordance with the plans and specifications for the project.The composite hot mix is hereby defined as the asphalt, aggregate, RAP and additives as noted on the plans and/or approved by the Engineer.The volume of the composite hot mix shall be calculated by the following formula.

$$V = \frac{W}{1000\,GA}$$

V = Cubic meter of compacted hot mix

W = Total mass of hot mix in kilograms

GA = Average actual specific gravity of three (3) molded specimens as prepared by test method TEX-206-F and determined in accordance with test method TEX-207-F, using samples collected by the Engineer.

If mixing is done by a drum-mix plant, the mass "W" will be determined by scales as specified herein.

If mixing is done by a weigh-batch plant or modified weigh-batch and surge-storage is not used, the mass "W" will be determined by batch scales.Records of the number of batches, batch designs and mass of asphalt and aggregate shall be kept.Where surge-storage is used, measurement of the material taken from the surge-storage bin will be made on truck scales or suspended hopper scales.

3022.10. Payment and Pay Adjustment Factors.

(1) **General.**The work performed and materials furnished in accordance with this item and measured as provided under Article 9, "Measurement" will be paid for at the unit price bid for the "hot mix" of the type specified and as determined in Article 10, "Payment and Pay Adjustment Factors."

MEASUREMENT METHOD	BID ITEM	UNIT OF MEASURE
Composite Mass	Hot mix	Megagrams
Composite Volumetric	Hot mix	Cubic Meter

The payment based on the unit bid price shall be full compensation for quarrying, for furnishing all materials and additives, for freight involved, for sampling and testing, for all hot mix design(s), for all quality control, for all heating, for mixing, for hauling, for cleaning the existing base course or pavement, for tack coat, for placing, rolling and finishing hot mix, for transporting RAP, for transporting any excess RAP to locations shown on the plans, and for all manipulations, labor, tools, equipment and incidentals necessary to complete the work.

All templates, straightedges, core drilling equipment, scales and other weighing and measuring devices necessary for the proper construction, measuring and checking of the work shall be furnished, operated and maintained by the Contractor at his expense.

The Contractor's laboratory building and equipment shall be furnished, maintained, and operated by certified specialists at the Contractor's own expense.

If the production or placement pay factor for 3 consecutive lots is below 1.000, then the Contractor shall cease production until test results, or other information, indicate to the satisfaction of the Engineer that the next material to be produced will meet the specified values.

(2) Production Pay Adjustment Factors. The pay adjustment factor for production is based on the lab density and will be determined using the Engineer's test results.A pay adjustment factor will be determined from Table 5 for each sublot using the deviation from target lab density defined in Article 4. The pay adjustment factor for the production lot will be the average of thepay adjustment factors for the sublots within that lot.

Pay adjustments for incomplete production lots described under Subarticle 8.2.2 will be calculated in accordance with Subarticle 10.2 using the average of the production pay factors from all sublots sampled.

If the total pay adjustment factor for production for any lot is less than 1.000, the Contractor has the option to remove and replace the lot or agree to accept the lot at an adjusted unit price determined by the total pay adjustment calculation.If the pay adjustment factor for production for any lot is less than 0.700, the material will not be paid for by the Engineer, and the material shall be removed at the expense of the Contractor.Replacement material shall meet the requirements of this specification with payment made accordingly.

(3) Placement Pay Adjustment Factors. The pay adjustment factor for a placement sublot shall be determined from Table 6 for the sublots that require air void measurement.For sublots that do not require air void measurement, the pay adjustment factor shall be 1.000.The pay adjustment factor for a placement lot shall be the average of the four (4) pay adjustment factors for the sublots within that lot.

Pay adjustments for incomplete placement lots described under Subarticle 8.5.1 will be calculated in accordance with this Subarticle using the average of the placement pay factors from all sublots sampled.

If the total pay adjustment factor for placement for any lot is less than 1.000, the Contractor has the option to remove and replace the lot or agree to accept the lot at an adjusted unit price determined by the total pay adjustment calculation.If the pay adjustment factor for placement for any lot is less than 0.700, the material will not be paid for by the Engineer, and the material shall be removed at the expense of the Contractor.Replacement material shall meet the requirements of this specification with payment made accordingly.

(4) Total Adjusted Pay Calculation.Total adjusted pay (TAP) shall be based on the applicable pay adjustment factors for production and placement.

For production only * $TAP1 = A$

For production and placement $TAP2 = \frac{A+B}{2}$

A = Bid price x production lot quantity x pay adjustment factor for production

B = Bid price x placement lot quantity x pay adjustment factor for placement

* Applies only when placement of the mixture is not part of the contract.

Pay adjustment factors shall be rounded to the thousandth place (e.g., 0.000).

TABLE 1. AGGREGATE QUALITY REQUIREMENTS

REQUIREMENT	TEST METHOD	SLAG OR NATURAL AGGREGATE
COARSE AGGREGATE		
DRY, LOOSE UNIT WEIGHT, KG/M3, MINIMUM	TEX-404-A	-
DELETERIOUS MATERIAL, PERCENT, MAXIMUM	TEX-217-F PART I	1.5
DECANTATION, PERCENT, MAXIMUM	TEX-217-F PART II	1.5
LOS ANGELES ABRASION, PERCENT,	TEX-410-A	40
MAXIMUM FOR MIXTURE OTHER THAN CMHB	TEX-410-A	35
FOR CMHB MIXTURES		
MAGNESIUM SULFATE SOUNDNESS LOSS, 5 CYCLE, PERCENT, MAXIMUM	TEX-411-A	30 or as shown on plan
POLISH VALUE	TEX-438-A	SHOWN ON PLANS
FINE AGGREGATE		
LINEAR SHRINKAGE, PERCENT, MAXIMUM	TEX-107-EPART II	3
COMBINED COARSE AND FINE AGGREGATES AND MINERAL FILLER		
SAND EQUIVALENT VALUE, PERCENT, MINIMUM	TEX-203-F	45

TABLE 2.MIXTURE REQUIREMENTS MASTER GRADING (PERCENT PASSING BY MASS OR VOLUME)

	TYPE						
	A	B	C	D	F	CMHB-F	MHB-C
SIEVE SIZE (MM)	COARSE BASE	FINE BASE	COARSE SURFACE	FINE SURFACE	FINE MIXTURE	FINE SURFACE	COARSE SURFACE
37.5	98.0-100.0						
25.0		98.0-100.0					
22.4	70.0-90.0		98.0-100.0				98.0-100.0
16.0		75.0-95.0					
12.5	50.0-70.0			98.0-100.0		98.0-100.0	
9.5		60.0-80.0	70.0-85.0	85.0-100.0	98.0-100.0	85.0-100.0	50.0-70.0
6.3							
4.75	30.0-50.0	40.0-60.0	43.0-63.0	50.0-70.0		40.0-60.0	30.0-45.0
2.00	20.0-34.0	27.0-40.0	30.0-40.0	32.0-42.0	32.0-42.0	15.0-25.0	15.0-25.0
0.425	5.0-20.0	10.0-25.0	10.0-25.0	11.0-26.0	9.0-24.0	6.0-20.0	6.0-20.0
0.180 M	2.0-12.0	3.0-13.0	3.0-13.0	4.0-14.0	3.0-13.0	6.0-18.0	6.0-18.0
0.075	1.0-6.0	1.0-6.0	1.0-6.0	1.0-6.0	1.0-6.0	5.0-8.0	5.0-8.0
MIXTURE PROPERTIES							
VMA,% MINIMUM	13.0	14.0	15.0	16.0	17.0	16.0	15.0
HVEEM STABILITY, MINIMUM	35*	35*	35*	35*	35*		
CREEP SLOPE MM/MM/SEC MAXIMUM						4.0X10-8	4.0X10-8
CREEP STIFFNESS KPA MINIMUM						41,400	41,400
PERMANENT STRAIN MM/MM MAXIMUM						6X10-4	6X10-4

* OR AS SHOWN ON PLANS.

TABLE 3.OPERATIONAL TOLERANCES OF CURRENT JOB MIX FORMULA

ITEM	TOLERANCE (MASS OR VOLUME)
INDIVIDUAL PERCENT RETAINED ON EACH SIEVE 2.00 MM AND LARGER	PLUS OR MINUS 5*
INDIVIDUAL PERCENT RETAINED ON EACH SIEVE SMALLER THAN 2.00 MM	PLUS OR MINUS 3*
ASPHALT CONTENT	±0.3 **
HVEEM STABILITY (EXCEPT FOR CMHB)	MINIMUM 35 - NO MAXIMUM
MOISTURE SUSCEPTIBILITY, TEX-530-C (WHEN SHOWN ON PLANS)	ITEM 301

*When within these tolerances, the gradation of the mixture may fall outside the master grading limits for all sieves except passing 0.075 mm.for the passing 0.075 mm, any test result which is not within the master grading limit will be considered as exceeding the operational tolerance.

**production shall cease if the asphalt content deviates from the current job mix formula by more than 0.5 percent for any sublot.

TABLE 4.MAXIMUM ALLOWABLE DIFFERENCE BETWEEN CONTRACTOR AND ENGINEER TESTS

TEST METHOD NO.	TEST DESCRIPTION	MAX. DIFFERENCE
TEX-210-F	SIEVE ANALYSIS.	
TEX-200-F	INDIVIDUAL PERCENT RETAINED FOR	PLUS OR MINUS 5.0
OR TEX-236-F	16.0 MM SIEVES & LARGER	PLUS OR MINUS 3.0
	INDIVIDUAL PERCENT RETAINED FOR SIEVES SMALLER THAN 16.0 MM AND LARGER THAN 0.075 MM	PLUS OR MINUS 1.6
	PERCENT PASSING 0.075 MM SIEVE	
TEX-228-F OR TEX-236-F	ASPHALT MATERIAL CONTENT	PLUS OR MINUS 0.3
TEX-207-F	IN-PLACE AIR VOIDS	PLUS OR MINUS 1.0
TEX-207-F	LABORATORY MOLDED AIR VOIDS	PLUS OR MINUS 1.4
TEX-227-F	THEORETICAL MAXIMUM (RICE) GRAVITY	PLUS OR MINUS 0.020
TEX-207-F	LABORATORY MOLDED BULK SPECIFIC GRAVITY	PLUS OR MINUS 0.020

TABLE 5.PRODUCTION PAY ADJUSTMENT FACTORS FOR LAB DENSITY

ABSOLUTE DEVIATION FROM TARGET LAB MOLDED DENSITY	PAY FACTOR
0.0	1.050
0.1	1.050
0.2	1.050
0.3	1.044
0.4	1.038
0.5	1.031
0.6	1.025
0.7	1.019
0.8	1.013
0.9	1.006
1.0	1.000
1.1	0.980
1.2	0.960
1.3	0.940
1.4	0.920
1.5	0.900
1.6	0.850
1.7	0.800
1.8	0.700
>1.8	No Pay

TABLE 6.PLACEMENT PAY ADJUSTMENT FACTORS FOR IN-PLACE DENSITY

In-Place Air Voids	Pay Adjustment Factor	In-Place Air Voids	Pay Adjustment Factor	In-Place Air Voids	Pay Adjustment Factor	In-Place Air Voids	Pay Adjustment Factor	In-Place Air Voids	Pay Adjustment Factor
<2.6	No Pay	5.0	1.050	7.5	1.025	10.0	0.950	12.6	0.820
2.6	0.700	5.1	1.050	7.6	1.023	10.1	0.945	12.7	0.815
2.7	0.738	5.2	1.050	7.7	1.022	10.2	0.940	12.8	0.810
2.8	0.775	5..3	1.050	7.8	1.020	10.3	0.935	12.9	0.805
2.9	0.813	5.4	1.050	7.9	1.018	10.4	0.930	13.0	0.800
3.0	0.850	5.5	1.050	8.0	1.017	10.5	0.925	13.1	0.795
3.1	0.860	5.6	1.050	8.1	1.015	10.6	0.920	13.2	0.790
3.2	0.870	5.7	1.050	8.2	1.013	10.7	0.915	13.3	0.785
3.3	0.880	5.8	1.050	8.3	1.012	10.8	0.910	13.4	0.780
3.4	0.890	5.9	1.050	8.4	1.010	10.9	0.905	13.5	0.775
3.5	0.900	6.0	1.050	8.5	1.008	11.0	0.900	13.6	0.770
3.6	0.910	6.1	1.048	8.6	1.007	11.1	0.895	13.7	0.765
3.7	0.920	6.2	1.047	8.7	1.005	11.2	0.890	13.8	0.760
3.8	0.930	6.3	1.045	8.8	1.003	11.3	0.885	13.9	0.755
3.9	0.940	6.4	1.043	8.9	1.002	11.4	0.880	14.0	0.750
4.0	0.950	6.5	1.042	9.0	1.000	11.5	0.875	14.1	0.745
4.1	0.960	6.6	1.040	9.1	0.995	11.6	0.870	14.2	0.740
4.2	0.970	6.7	1.038	9.2	0.990	11.7	0.865	14.3	0.735
4.3	0.980	6.8	1.037	9.3	0.985	11.8	0.860	14.4	0.730
4.4	0.990	6.9	1.035	9.4	0.980	11.9	0.855	14.5	0.725
4.5	1.000	7.0	1.033	9.5	0.975	12.0	0.850	14.6	0.720
4.6	1.010	7.1	1.032	9.6	0.970	12.1	0.845	14.7	0.715
4.7	1.020	7.2	1.030	9.7	0.965	12.2	0.840	14.8	0.710
4.8	1.030	7.3	1.028	9.8	0.960	12.3	0.835	14.9	0.705
4.9	1.040	7.4	1.027	9.9	0.955	12.4	0.830	15.0	0.700
						12.5	0.825	>15.0	No Pay

TABLE 7.TEST METHODS, TEST RESPONSIBILITY AND MINIMUM CERTIFICATION LEVELS

		CERTIFICATION			
	TEST	CONTRACTOR	TXDOT	LEVEL	
1.	AGGREGATE TESTING				
	SAMPLING	TEX-400-A	TEX-400-A	IA	
	WASHED SIEVE	TEX-200-F, PART II		IA	
	UNIT WEIGHT		TEX-404-A		
	L.A. ABRASION		TEX-410-A		
	SOUNDNESS		TEX-411-A		
	PRESSURE SLAKE		TEX-431-A		
	POLISH VALUE		TEX-438-A		
	CRUSHED FACE COUNT			TEX-460-A	
	LINEAR SHRINKAGE		TEX-107-E		
	SAND EQUIVALENT		TEX-203-F		
2.	LABORATORY MIX DESIGN AND VERIFICATION				
	DESIGN	TEX-204-F	TEX-204-F	II	
	MIXING	TEX-205-F	TEX-205-F	II	
	MOLDING	TEX-206-F	TEX-206-F	IA	
	DENSITY AND VMA	TEX-207-F	TEX-207-F	II	
	TENSILE STRENGTH	TEX-226-F	TEX-226-F	II	
	RICE GRAVITY	TEX-227-F	TEX-227-F	IA	
	NUCLEAR GAUGE CALIBRATION		TEX-228-F	TEX-228-F	II
	IGNITION OVEN CALIBRATION		TEX-236-F	TEX-236-F	II
	BOIL TEST	TEX-530-C	TEX-530-C	II	
	TENSILE RATIO	TEX-531-C	TEX-531-C	II	
	STABILITY		TEX-208-F		
	CREEP		TEX-231-F		

TABLE 7. TEST METHODS, TEST RESPONSIBILITY AND MINIMUM CERTIFICATION LEVELS (CONT.)

	TEST	CONTRACTOR	TXDOT	CERTIFICATION LEVEL	
3.	TRIAL MIX VERIFICATION				
	APPROVED GYRATORY PRESS CORRELATION			IA	
	SAMPLING	TEX-222-F	TEX-222-F	IA	
	MOLDING	TEX-206-F	TEX-206-F	IA	
	DENSITY	TEX-207-F	TEX-207-F	IA	
	STABILITY		TEX-208-F		
	EXTRACTION	TEX-210-F	TEX-210-F	IA	
	MOISTURE		TEX-212-F	IA	
	RICE GRAVITY	TEX-227-F	TEX-227-F	IA	
	ASPHALT CONTENT(NUCLEAR)		TEX-228-F	TEX-228-F	IA
	ASPHALT CONTENT (IGNITION)		TEX-236-F	TEX-236-F	
	BOIL TEST		TEX-530-C	II	
4.	PRODUCTION OPERATIONS				
	RANDOM SAMPLING		TEX-225-F	IA	
	SAMPLING	TEX-222-F	TEX-222-F	IA	
	ASPHALT CONTENT(NUCLEAR)		TEX-228-F	TEX-228-F	IA
	ASPHALT CONTENT(IGNITION)		TEX-236-F	TEX-236-F	
	EXTRACTION OR COLD FEED		TEX-229-F	TEX-229-F	IA
	MOLDING	TEX-206-F	TEX-206-F	IA	
	LAB DENSITY	TEX-207-F	TEX-207-F	IA	
	RICE GRAVITY	TEX-227-F	TEX-227-F	IA	
	STABILITY		TEX-208-F		
5.	ROADWAY OPERATIONS				
	RANDOM SAMPLING		TEX-225-F	IB or IA	
	AIR VOIDS	TEX-207-F	TEX-207-F	IB or IA	
	ESTABLISH ROLLING PATTERN		TEX-207-F	TEX-207-F	IB

APPENDIX L

SPECIAL SPECIFICATION

ITEM P-503

INTERLOCKING CONCRETE PAVER BLOCK CONSTRUCTION

ITEM P-503

INTERLOCKING CONCRETE PAVER BLOCK CONSTRUCTION

503-1.0 DESCRIPTION

503 – 1.1 This item shall consist of a surface course composed of interlocking concrete blocks set in bedding sand on an approved base course constructed in accordance with the Plans and Specifications. All paver blocks shall be manufactured for the construction of paved surfaces to be trafficked by automobiles, trucks, and aircraft. This item is suitable for taxiways and aprons for jet and propeller aircraft This item is not recommended for runways or areas where full aircraft power or reverse jet thrust are used (e.g. areas gate areas where "powerback" operations are conducted) This item shall include paver blocks, bedding sand, joint sand, edge restraints, geotextile, and sealer manufactured and installed in accordance with these specifications. This item shall be required for construction of concrete paver pavements in the manner and at the locations shown on the Plans, or as directed by the Engineer.

503-2.0 MATERIALS

503 – 2.1 Concrete Pavers

A. General. Concrete pavers shall be manufactured in accordance with ASTM C 936, except as modified by Section 503-4.1 and 503–4.2 of this Specification. Solid concrete interlocking paving units shall be made from normal weight aggregates in sizes and shapes indicated on Plans. Color shall be natural Gray except where otherwise indicated on the Plans. Hard face or coated pavers with special finishes shall not be used. Pavers shall be chamfered with a beveled edge around the top of the paver unit and shall be constructed with spacer bars; (Small protrusions on each side of the paver to keep the pavers uniformly spaced so that sand can fill the joints) Chamfers shall have a nominal size of 1 / 8 inch to 1 / 4 inch (3mm to 6mm) and the spacers shall have a nominal size of 1/16" (2mm) in thickness.

B. Paver Type and Dimensions. All aircraft trafficked pavers shall be a block shape that provides a fully interlockingherringbone or similar pattern with no clustering or grouping of pavers without a continuous interlocking pattern. All pavers shall have round spacer bars, not exceeding 2mm in thickness. Pavers shall be 3.025 in. (80 mm) thick. Length and width dimensions shall be approved by the engineer.

C. Color. Color shall be natural Gray, except where indicated on the Plans. Colored pavers shall use synthetic iron oxide pigments conforming to ASTM C 979.

D. Freeze –Thaw Durability. The Contractor shall submit test results and certification that the concrete pavers meet the durability requirements. Resistance to 50 freeze – thaw cycles shall be tested in accordance with ASTM C 936 and ASTM C 67. Three units shall be sampled and tested for every 500,000 units produced for this job.

Report weight loss at 10, 20, and 50 cycles. The average weight loss shall not be more than 1% after 50 cycles.

Where freeze – thaw conditions are mild or not anticipated, paragraph 503-2.1. D can be deleted.

E. Efflorescence. Concrete pavers shall be manufactured with additives to reduce efflorescence.

F. Abrasion Resistance. Abrasion resistance of concrete pavers shall conform to the weight loss requirements of ASTM C 936 when tested in accordance with ASTM C 418.

G. Acceptance. Concrete pavers shall be accepted by the Engineer at the source of manufacture in accordance with the acceptance requirements contained in Sections 503 – 4.1 and 503 – 4.2.

H. Average Compressive Strength. Minimum average compressive strength shall be 8,000 psi (55Mpa) Units shall be tested according to ASTM C 140, as whole units and capped with gypsum plaster. No individual unit shall have a compressive strength below 7, 200 psi (50 Mpa)

I. Average Absorption. Maximum average absorption shall be 5% when tested in accordance with ASTM C 140. Maximum absorption of any individual units shall not exceed 7%.

503 2.2 Bedding Sand

A. Bedding Sand. Bedding sand shall be coarse, naturally occurring or manufactured hard sand. Grading shall not vary from the high limit on one sieve to the low limit on the next larger sieve. Bedding sand shall conform to the requirements of ASTM C 33, except for gradation requirements, which are contained in Table 1 of this specification. Locally available manufactured sand is acceptable, provided the sand is manufactured from rock having a Los Angeles (LA) Abrasion of 20 or less, when tested in accordance with ASTM C 131, and the sand is washed to meet the grading requirements of Table 1. The sand shall contain no more than 10% of acid soluble material. The bedding sand shall conform to the Micro Deval degradation test requirements contained in paragraph 503 – 4.2 B.

TABLE 1

GRADING REQUIREMENTS FOR BEDDING SAND

ASTM C 33

Sieve Size	Percent Passing
3/8 inch (9.5 mm)	100
No. 4 (4.75 mm)	95 to 100
No. 8 (2.36 mm)	80 to 100
No. 16 (1.18 mm)	50 to 85

No. 30 (600 um)	25 to 60
No. 50 (300 um)	10 to 30
No. 100 (150 um)	2 to 10
No. 200 (75 um)	0

503 2.3 Joint Sand

A. Joint Sand. All sand for joints shall conform to the grading requirements of ASTM C 144, which are contained in Table 2 of this specification, **except that 100% by weight shall pass the No. 16 sieve (1.18 mm)** Sand blasting sand may be used. Masonry and beach sand shall not be used. *Where locally available, bagged silica sand should be specified for joint sand.*

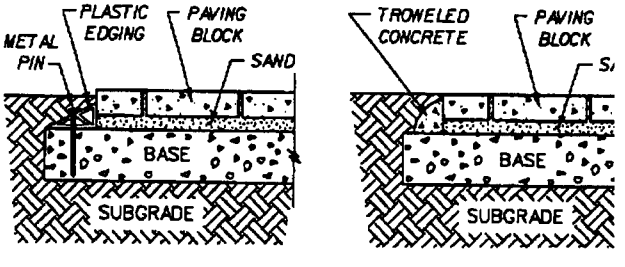
Table 2
Grading requirements for Joint Sand
ASTM C 144

Sieve Size	Percent Passing
No. 4 (4.75 mm)	100
No. 8 (2.36 mm)	95 to 100
No. 16 (1.18 mm)	70 to 100
No. 30 (600 um)	40 to 75
No. 50 (300 um)	10 to 35
No. 100 (150 um)	2 to 15
No. 200 (75 um)	0 to 10

503 2.4 Edge Restraints.

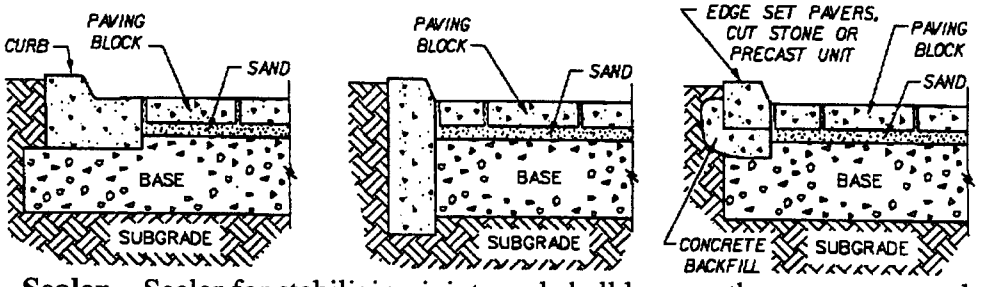
A. Edge Restraint. Edge restraints shall be fabricated and installed as shown on the Plans. Typical details for edge restraints are provided by the Interlocking Concrete Pavement Institute. The Engineer shall reference the applicable requirements and specification items for the type of edge restraint specified. Flush mounted edge restraint should be used for drainage of airport pavements. Aircraft trafficked pavers should use heavier load edge constraint.

Typical Light Load Edge Restraint



Typical Heavier Load Edge Restraint

503 – 2.5 Sealer



A. Sealer. Sealer for stabilizing joint sand shall be a urethane, or approved equal, capable of 100% elongation in accordance with ASTM D 2370. The sealer shall have demonstrated acceptable performance in similar application for a minimum of one (1) year. The sealer shall be applied in strict accordance with manufacturer's warranty. All sealer shall be indicated by the Engineer on the Plans.

503 – 2.6 Geotextiles

A. Geotextiles. Geotextiles for under the bedding sand and over base material according to location and overlap shown on Plans, shall be minimum overlap of 6 inches (150 mm) Geotextiles shall be Mirafi 600X or approved equal.

503-3.0 INITIAL ACCEPTANCE REQUIREMENTS

503 – 3.1 Submittals.

The Contractor shall submit the following for the approval of the Engineer at least 30 days prior to the start of concrete paver installation.

A. Certifications. The Contractor shall provide certifications that all materials to be incorporated into the work can meet the requirements of Section 503 – 2.1 and 503 – 4.2. Certifications shall be substantiated by data from tests performed within 90 days of the planned start date for installation.

B. Samples. The Contractor shall submit the following samples for preliminary testing and evaluation by the Engineer.

(1) **Pavers.** Ten (10) Concrete pavers, cured for 28 days, shall be submitted to the Engineer for testing and evaluation in accordance with Sections 503 – 4.1 and 503 - 4.2 of this Specification.

(1) **Bedding and Joint Sand.** Sieve analyses and samples of bedding and joint sand shall be submitted to the Engineer for evaluation and testing in accordance with Sections 503 – 4.1 and 503 - 4.2 of this Specification.

(1) **Sealer.** Manufacturer's catalogue cuts shall be submitted for sealer.

(1) **Geotextile.** Manufacturer's catalogue cuts shall be submitted for geotextile.

(1) **Edge Restraints.** Mill reports and steel detailing showing hole sizes and layout shall be submitted to the Engineer for approval, when steel angle edge restraints are shown on the Plans. When concrete edge restraints are shown on the Plans, the concrete shall conform to *(appropriate host specification)*

C. Statement of Contractor Qualifications. The paver Contractor shall have installed a within the preceding 12 months concrete paver project(s) of equal size of the proposed project or 300,000 square feet (30,000 square meters) whichever is less. Submit list to the Engineer of projects completed by Contractor. Include list of completed projects with project name, address, telephone numbers, names of Engineer/ Architects and Owners, and dates of construction.

503 – 3.2 Test Strip.

Test Strip. Prior to installation of unit pavers, construction a test strip at least 10 feet by 10 feet for each form and pattern of unit paver required. Build mock-up(s) using materials, base construction, joint sand special features for contiguous work, as indicated for final unit of work. The test strip shall also be used to establish "roll down" and sand surcharge requirements for grade control.

A. Location – Mock-ups on project site in the location as directed by Engineer.
B. Notify – Engineer in advance of dates when mock-up(s) will be erected.
C. Demonstrate – Quality of workmanship that will be produced in final unit of work.
D. Obtain Acceptance – Engineer's acceptance of mock-up(s) before start of final unit of work.
E. Retain and Maintain – Mock-up(s) during construction in undisturbed condition as a standard for judging work.
F. Accepted – Accepted mock-up(s) in undisturbed condition at time of substantial completion may become part of completed unit of work.

503 – 3.3 Concrete Mix Design.

Concrete Mix Design. Proportioning requirements for concrete for paver manufacturer shall be designed for compressive strength consistent with the acceptance criteria contained in Sections 503 – 4.1 and 503 4.2 Prior to the start of paver production

and after approval of all material to be used in the concrete, the Contractor shall submit compressive strengths at 28 days of the unit pavers, tested in accordance with Section 503 – 4.1 of this Specification. The mix design shall include a complete list of materials including type, brand, source and amount of cement, fly ash or other pozzolons, ground slag, and admixtures, and copies of test reports and certifications. Production shall not begin until the mix design and accompanying test data are reviewed and approved by the Engineer. The mix design shall be submitted at least 15 days prior to the start of paver production.

503-4.0 MATERIAL ACCEPTANCE

503 – 4.1 Acceptance Sampling Testing.

Acceptance Sampling and Testing. All testing for acceptance of concrete pavers, and bedding and joint sand, will be performed by the Engineer without cost to the Contractor. Concrete block will be sampled at the location of manufacture and tested by the Engineer for acceptance before shipment to the job site. Bedding and joint sand will be sampled from stockpiles maintained by the Contractor at the job site for testing by the Engineer.

A. **Concrete Pavers.** Concrete Pavers shall be sampled, tested and accepted by the Engineer on a lot basis. A lot shall be equal to the average production day of the concrete paver manufacture. Each lot shall be divided into five (5) equal sublots. Three (3) full size units shall be randomly located by the Engineer within each sublot in accordance with ASTM D 3665. Each specimen selected shall be suitable marked so that it can be identified according to lot, sublot, and sample number at any time. The Engineer shall perform the following tests for acceptance on the number of samples indicated below. The lot size shall consist of one-tenth (1/10) of the total area to be paved, or 60,000 units, whichever is smaller. The minimum lot size shall be 30,000 units.

(1) **Compressive Strength.** Compressive strength testing in accordance with ASTM C 140 shall be performed on samples at 28 days. One (1) full block sample from each sublot (5 total) shall be tested. The compressive strength for each sublot test shall be corrected for thickness and chamfer by multiplying the test result by 1.18. This result shall represent the compressive strength for each of the five (5) individual sublots

(2) **Absorption.** Five (5) full units, randomly selected from the (10) remaining units from each sublot, will be tested by the Engineer for absorption in accordance with Section 6 of ASTM C 140.

(3) **Dimensions.** The dimensions of the remaining five (5) units will be measured by the Engineer in accordance with Section 7 of ASTM C 140.

(4) **Abrasion Resistance.** Three (3) units shall be sampled out of every 500,000 units produced and abrasion resistance shall be measured in accordance with ASTM C 418.

(5) **Freeze – Thaw Durability.** Three (3) units shall be samples out of every 500,000 units produced and freeze-thaw durability shall be measured in accordance with ASTM C 67 at fifty (50) freeze thaw cycles. ***The requirements for freeze-thaw durability can be deleted where freezing conditions are mild or not anticipated.***

B. Bedding Sand. Bedding sand shall be sampled, tested and accepted by the Engineer on a lot basis. The lot size for bedding sand shall consist of the lessor of 20,000 square feet (2,000 square meters) or one-tenth (1/10) of total paved area. The minimum lot size shall be 10,000 square feet (1,000 square meters), except for the last lot, which shall consist of the number of square feet required for completion of paving. Each lot shall be subjected to the following tests for acceptance.

(1) **Gradation.** Each lot will be divided into two (2) equal sublots. One (1) sample shall be randomly located by the Engineer within the sublot in accordance with ASTM D 3665. The Engineer shall test each sample for grading in accordance with ASTM C 166 (Dry Sieve)

(2) **Bedding Sand Degradation.** One (1) lb. Sample shall be randomly located within each lot in accordance with ASTM D 3665. The sample shall be dried for 24 hours at 240 to 250 degrees F. Obtain three (3) sub-samples each weight 0.5 lb. By passing the main sample several times through a riffle box. Carry out a sieve analysis test on each sample according to ASTM C 136.

Remix each sub-sample and place in a nominal quart/liter capacity porcelain jar with two (2) 1-inch (25mm) diameter steel ball bearing weighting [75± 5] grams each. Rotate each jar at 50rpm for six (6) hours. Repeat the sieve analysis. Record the individual and average sieve analysis.

C. Joint Sand. Joint sand shall be accepted on the lot size specified in paragraph 503-4.1 (B), except that only one (1) sample will be randomly selected for each lot. The Engineer shall test the sample for grading in accordance with ASTM C 136 (Dry Sieve)

503 – 4.2 Acceptance Criteria.

A. Concrete Pavers. Concrete pavers shall be evaluated on a lot basis by the Engineer for compliance with the acceptance characteristics specified in paragraphs 503 – 4.2 A. (1) though (6), below. All acceptance requirements must be fully met as described below for a lot of concrete pavers. To be considered acceptable for incorporation into the work. Failure to meet any one or more of the acceptance requirements detail below will result in rejection of the entire lot of concrete pavers.

1. Compressive Strength. For acceptance, the average compressive strength of the five (5) blocks tested in accordance with paragraph 503 4.1. A (1) shall be 8,000 psi (55 Mpa) with no individual test less than 7,200 psi (50 Mpa), after correction for thickness and chamfer as specified in paragraph 503 4.1 A (1)

2. Absorption. A lot shall be accepted based on absorption when the average absorption for the five (5) samples tested for each lot in accordance with paragraph 503 4.1 A (3) is less than equal to 5 percent, with no individual unit having an absorption greater than 7 percent.

3. **Dimensional Tolerances.** The dimensional tolerances of each of the five (5) blocks sampled for each lot in accordance with paragraph 503 4.1 A (3) shall not vary by more than the following amounts.

A. Length + 1/16 inch (1.6mm)
B. Width + 1/16 inch (1.6mm)
C. Thickness + 1/8 inch (3.2mm)

Each side of each block within the sample shall be normal to the wearing surface and the opposite face. The side shall be considered normal if the sides do not deviate by more than 1/16 inches (1.6mm)

4. **Abrasion Resistance.** Samples tested in accordance with paragraph 503 4.1 A (4) shall not have a greater volume loss than 0.915 inch. 3 per 7.75 in.2, (15 cm3 per 50 cm3) The average thickness loss shall not exceed 0.118 in. (3 mm)

5. **Visual Requirements.** All blocks shall be sound and free from defects that would interfere with the proper placing of the blocks or impair the strength or performance of the construction.

6. **Freeze-Thaw Durability.** The average weight loss of samples tested in accordance with paragraph 503 4.1 A (6) shall not exceed 1%. *Freeze-thaw durability requirements may be deleted where freezing conditions are mild or not applicable.*

B. Bedding Sand. Bedding sand shall be evaluated by the Engineer on a lot basis for compliance with the following characteristics.

(1) **Gradation.** The two (2) samples of bedding sand tested in accordance with paragraph 503 4.1 B shall be averaged for comparison to the grading requirements of Table 1. The Contractor shall take appropriate corrective action when the acceptance tests indicate that the grading requirements are not being met.

(2) **Micro Deval Degradation.** For each sample tested in accordance with paragraph 503 4.1 B (2), the maximum increase in the percentages passing each sieve and the maximum individual percent passing shall be.

Sieve Size	Max. Increase	Max. Passing
No. 200 (75 um)	2%	2%
No. 100 (150 um)	5%	15%
No. 50 (300 um)	5%	35%

C. Joint Sand. Joint sand sampled and tested in accordance with paragraph 503 4.1 C shall be evaluated for compliance to the requirements of Section 503 2.3.

D. Sealer. The sealer shall meet the requirements of Section 503 2.5.

E. Compliance. Where any of the individual acceptance tests for concrete pavers and / or sand fail to meet the requirements specified above, the lot shall be rejected because of non-compliance subject to the following.

(1) **Removal of Defective Materials.** The Contractor may elect to inspect the lot, remove any items he / she considers to be defective and submit the remainder for re-sampling and re-testing by the Engineer in accordance with Section 503 4.1 and 503 4.2 of this Specification. The costs for re-sampling and re-testing shall be borne by the Contractor. Should these further test resulting fail to meet the requirements, the entire lot shall be rejected. Where defective materials have been discarded from the lot, the lot shall be considered a new lot and the initial test results shall not be used in the Engineer's evaluation for compliance.

503-5.0 DELIVERY, STORAGE, AND HANDLING

503 5.1 Delivery.

Deliver concrete pavers to project site in steel-banded, plastic-banded, or plastic wrapped cubes capable of transfer by fork lift or clamp lift. Unload pavers at project site without damage to pavers or existing construction.

503 5.2 Protection.

Protect unit pavers from damage during delivery, storage and construction. Sand shall be covered with waterproof coverage to prevent exposure to rainfall or removal by wing. Covering shall be secured in place

503-6.0 INSTALLATION

503 6.1 Preparation.

A. Edge Restraints. Edge restraints shall be installed in the manner and in the locations shown on the Plans and in accordance with Section 503 2.4. The location of the edge restraints can be adjusted within $\pm$ 2 inches (5 cm) of the Plan location to minimize cutting of concrete pavers. *For inlays or new construction where pavers will abut hot mix asphalt surfaces, the following additional requirements are recommended. Edge restraints shall be constructed in the following sequence.*

(1) Construction asphalt concrete courses to the bottom of the bedding sand layer, maintaining close control of grades and surface smoothness;

(2) Construct final lifts of asphalt concrete outside the areas designated for concrete pavers, and approximately 1 foot to 2 feet (30 cm to 60 cm) inside the concrete paver areas, maintaining close control of grades and surface smoothness. Sheets of "waxed" paper or other suitable bond breaking material may be used at the edge of the hot mix asphalt to facilitate cutting back the asphalt to its final location.

(3) Saw-cut the asphalt concrete material or concrete to neat, straight lines at the locations shown on the Plans, adjusting the saw-cut ± 2 inches (5cm) to facilitate concrete block installation.

(4) Remove the asphalt in a manner approved by the Engineer to the saw-cut lines.

(5) Install the steel angle edge restraint by spiking and install geotextile fabric strips along the length of the angle as shown on the Plans.

(6) After concrete block installation, as described below, apply joint sealing filler at the hot mix asphalt/concrete paver interface as shown on the Plans.

B. Base. The base course for the pavers shall be accepted by the Engineer before the start of paver installation. The base shall be cleared of all loose or foreign material. When indicated on the Plans, a geotextile fabric shall be installed prior to the installation of bedding sand.

C. Lines and Grades. Lines and grades shown on the Plans shall be established and maintained by the Contractor during the installation of the pavers. Allowance for sand surcharge levels should be made at this time.

D. Drainage. Adequate drainage shall be provided during construction by means of temporary drains, ditches, etc. to prevent the build-up of standing water.

503 6.2 Bedding Sand Installation.

A. Bedding sand shall comply with Section 503 – 2.2 and paragraph 503 – 4.2 B. of this Specification.

B. The finished surface of the base to receive the bedding sand shall be uniform and even, and meet all smoothness and grade requirements of the base course.

C. Bedding sand shall be spread to a uniform, even thickness, such that, after compaction, it forms a uniform layer, nominally 1 inch to maximum of 1.5 inches (25 to 40 mm), or as shown on the Plans. The Contractor shall allow for surcharge and compaction when establishing the loose thickness of bedding sand. For aircraft loading over 60,000 lb. it is recommended that 1 inch (25 mm) of bedding sand be used.

D. The test strip required by Section 503 – 3.2 shall be used to determine the true amount of surcharge required to obtain the correct levels.

E. The moisture content of the bedding sand shall remain relatively constant and within 2 percent of optimum moisture. The course shall not be subjected to any trafficking, either by mechanical equipment or pedestrian use.

F. The Contractor shall take all reasonable precautions to prevent the bedding sand from blowing to areas of the Terminal Apron or Taxiways that are open to aircraft operation.

If in the opinion of the Engineer, the Contractor's controls are not adequate, the Engineer shall limit the amount of sand that can be spread at any time.

G. Spreading of the laying course sand shall stop when the Engineer considers the weather conditions to be unsuitable. If inclement weather cause deterioration of the laying course sand it shall be lifted and stored to one side to drain prior to reuse.

503 – 6.3 Installation of Unit Pavers.

A. Do not use concrete pavers with chips, cracks, voids, or other defects, which may impair functional or structural performance.

B. Use full units without cutting where possible.

C. Ensure that pavers are free of foreign materials before installation.

D. Concrete pavers shall be installed using the laying pattern shown on the Plans.

E. Set concrete pavers with a consistent minimum joint width of 1/16-inch (1.5 mm) and a maximum of 1/8-inch (3 mm), being careful not to disturb the bedding sand. Ninety-five percent (95%) of the joints shall be 2 mm or less. Place pavers tight against spacer bars. Using string lines to keep straight joints lines.

F. The blocks shall be laid away from the existing laying face or edge restraint in such a manner as to ensure squareness of pattern.

G. Cut unit pavers with motor-driven masonry saw to provide clean, sharp, unchipped edges. Cut vertical faces on units to provide pattern indicated and to fit adjoining work neatly. Hammer cutting or mechanically split pavers are not acceptable. No cut segments shall be smaller than one-third (1/3) of unit.

H. Lay full blocks first. Lay string courses along all edge restraints and around all concrete collars and similar construction in accordance with details shown on the Plans.

I. If in the opinion of the Engineer weather conditions are such that the performance of the pavement may be affected, laying operations shall be discontinued and all laid blocks shall be lined and compacted prior to suspension of the works. On resumption of laying blocks, at least two (2) edge courses of existing blocks shall be lifted and the sand re-screeded before blocks are laid.

503 – 6.4 Compaction.

A. **Initial Compaction.** After the blocks have been laid on the bedding sand, and after all cut blocks have been inserted to provide a full and complete surface, and pattern lines have been straightened, vibrate concrete pavers into bedding with a low amplitude plate vibrator capable or at least 5,000 lb. (22 kN) compaction force and at least 75 hertz. The effective compactive force from the plate should not be less than 11 pounds per square inch .

B. Vibrate after edge pavers are installed, and there is a completed, restrained surface; or before surface is exposed to rain. Before ending each day's work, vibrate installed concrete pavers within 3 feet (1 m) of the laying face and cover with sand.

C. **Joint Sand Installation and Compaction.** Immediately after vibration of the blocks to finished level, dry jointing sand shall be brushed over the surface course and the pavement shall be re-compacted until all joints are completely filled with sand. A minimum of two (2) passes shall be made, in addition to initial compaction, parallel and perpendicular to the joint pattern during joint sand installation. Additional sand shall be

added until joints are filled. Care shall be taken to ensure that the joints are filled and sand shall be constantly brushed over the surface and pavement re-compacted as necessary.

D. Final Compaction of Units. On completion of the initial vibration and joint filling with sand, the entire area shall be compacted with an 8 to 10 ton pneumatic rubber-tired roller having a tire pressure of 90 pounds/square inch (620 KPa/sq. m.) Replace any cracked pavers with whole units and roll pavers again.

503 6.5 Surface Tests.

A. Smoothness. After completion of final compaction, the finished surface shall not vary more than 1/4 inch (6 mm) when tested with 12 foot (3.6 m) straightedge in any direction.

B. Grade. After completion of final compaction, the finished surface shall deviate no more than 1/2 inch (13 mm) from the grade line, elevations, and cross sections shown on the Contract Drawings. The top of the pavers shall extend approximately 1/8 inch (3 mm) higher than surrounding appurtenances and asphalt pavement.

503 6.6 Sealer Application.

A. After final compaction, remove all excess sand and debris. Ensure that there is no sand in the chamfers. Apply the sealer as soon as practical after final compaction, strictly following the sealer manufacturer's requirements regarding application methods, equipment, and rate.

B. Traffic shall not be permitted on the pavement until the sealer has cured.

503 – 6.7 Joint Sealing Filler.

A. The joints at the interface between pavers and adjacent pavement and edge restraint shall be sealed with material conforming to Specifications as shown on the Plans.

503 – 6.8 Weather Limitations.

A. Cold Weather Protection. Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen sub-grades, soils, bases or setting beds. Remove and replace unit paver work damaged by frost or freezing.

B. Weather Restrictions. Do not install sand or pavers during heavy rain or snowfall.

503-7.0 CONTRACTOR QUALITY CONTROL

503 – 7.1 General.

A. The Contractor shall provide and maintain a quality control system that will provide methods and procedures to assure that all materials and completed construction submitted for acceptance conform to contract requirements whether manufactured or processed by the Contractor, or procured from Subcontractors or vendors. Although guidelines are established and certain requirements are specified herein, the Contractor shall assume full responsibility for accomplishing the stated purpose.

B. The Contractor shall provide and maintain a Quality Control Plan, hereinafter referred to as Plan, along with all the personnel, equipment, supplies and facilities necessary to obtain samples, perform and document tests, and otherwise ensure the quality of the products.

C. The Plan shall be submitted tot he Engineer at lease 15 days prior to the start of paving. The Contractor shall be prepared to discuss and present, before the start of paving, his understanding of the quality control responsibilities for specific items as included in these Specifications.

D. The Contractor shall perform process control sampling, testing, and inspection during all phases of the work at a rate sufficient to ensure that the work conforms to the Contract requirements.

503 – 7.2 Quality Control Plan.

The Plan may be operated wholly or in part by the Contractor or suppler, or by an independent organization; however, the Plan's administration, including compliance with the Plan and its modification, shall remain the responsibility of the Contractor.

A. Plan Contents. The Plan shall include as a minimum.
   (1) Quality Control organization chart.
   (2) Names and qualifications of personnel.
   (3) Area of responsibility and authority of each individual.
   (4) A listing of any outside organizations such as testing laboratories that will be employed by the Contractor and a description of the services they will provide; or indicate if tests will be performed by Contractor personnel.
   (5) Preparation and maintenance of Testing Plan which shall contain a listing of all tests to be performed by the Contractor and the frequency of testing.
   (6) Procedures for ensuring that test are taken in accordance with the Testing Plan, that they are documented, and that proper corrective actions are taken when necessary. The testing procedures shall be prescribed by clear and complete instructions and shall assure quality control testing of materials as required by the Specifications, or as necessary to maintain the specified quality.

B. Plan Elements. The Plan shall address all elements which affect the quality of the concrete pavers, including but not necessarily limited tot he following.

   (1) Mix Design for Paver Production.

   (2) Quality of Cementitous Materials and Admixtures.

   (3) Proportioning.

(4) Control of Water – Cement Ratio.

(5) Required Strength.

(6) Placement of Bedding Sand.

(7) Moisture Content and Absorption of Bedding Sand.

(8) Thickness, Smoothness, and Grade Control.

C. Plan Administration. The Plan shall address management and coordination of activities of the personnel assigned to the function and shall incorporate the use of the following types of personnel.

(1) Plan Administrator. The individual administering the Plan must be a full time employee of the Contractor or Paver Installer or a consultant employed by the Contractor or Paver Installer. In either case, the individual employed shall have full authority to institute any and all actions necessary for the successful operation of the Plan.

(2) Plant Control Technician (PCT) This person shall utilize laboratory test results and other quality control practices to ensure the quality of aggregates, cementitous materials, admixtures, and other mix components and adjust and control mix proportioning to meet the mix design(s) for paver production. The Plan shall detail the frequency of each type of test, when and how corrective actions are to be taken, and the means of documentation.
The PCT shall be responsible for periodically inspecting all equipment utilized in proportioning and mixing to ensure its proper operating condition and to ensure that proportioning and mixing is in conformance with mix design and other Specification requirements. The Plan shall set forth how these duties and responsibilities will be accomplished and documented. The PCT may be employee of the paver manufacturer.

(1) 3Field Control Technician (FCT) This person shall be responsible for periodically inspecting all equipment and processes utilized in placing to ensure that placing of pavers and bedding and joint sand is in conformance with the Specifications. The Plan shall set fourth how these duties and responsibilities will be accomplished and documented.

The Field Control Technician, who can be the Installer's on-site superintendent, shall also be responsible for the following.

(1) Examine surfaces indicated to receive unit pavers for compliance with required installation tolerances. Verify that all surfaces to receive pavers are in proper condition, and that no conditions exist which may adversely affect progress or quality of work.
(2) Verify that base is dry and ready to support bedding material, pavers, and imposed loads.
(3) Verify base gradients and elevations.

(4) Verify location, type, installation, and elevations of adjacent edge restraints, drainage inlets, grounding lugs, and other appurtenances in the pavement.
(5) Provide adequate drainage during the entire construction phase by means of temporary drains, ditches, or other means to prevent the build-up of standing water.

503 – 7.3 Quality Control Testing.

The Contractor shall perform any quality control tests necessary to control the production and construction processes applicable to these Specifications and as set forth in the approved Quality Control Plan.

(1) Batch proportioning.
(2) Aggregate gradation (evidence from quarry tickets will be acceptable)
(3) Aggregate moisture content.
(4) Water-cement Ratio.
(5) Density measurements.

A minimum of two (2) tests for each shall be made for each production day. For automated plants with recordation, the Contractor can submit printed tickets, in lieu of daily testing, provided evidence of recent plant calibration is submitted to the Engineer for approval prior to the start of production.

A. Bedding and Joint Sand. The Contractor shall control the gradation and moisture content of the bedding and joint sand used for installation. In addition, the Contractor shall determine the optimum moister content for the bedding sand in accordance with ASTM D 1557 and control the moisture content during construction to –2 percent and +3 percent of the optimum moisture content. A minimum of one (1) moisture content test shall be performed for each lot, as defined in accordance with paragraph 503 – 4.1.
B. Moisture content testing shall be in accordance with ASTM C 566.

503-8.0 MATERIALS AND TESTING REQUIREMENTS

503 – 8. 1 Testing.

ASTM C 67	Standard Methods of Sampling and Testing Brick and Clay Tile, Freezing and Thawing.
ASTM C 140	Method of Sampling and Testing Concrete Masonry Units.
ASTM C 136	Method for Sieve Analysis for Fine and Coarse Aggregate.
ASTM D 3665	Random Sampling of Paving Materials.

503 – 8. 2 Material Requirements.

ASTM C 33	Specification for Concrete Aggregates.
ASTM C 144	Standard Specification of Aggregate for Masonry Mortar.
ASTM C 936	Specification for Solid Interlocking Concrete Paving Units.
ASTM C 979	Specification for Pigments for Integrally Colored Concrete.