



W912DQ-04-R-0016

**US Army Corps
of Engineers**
Kansas City District
You Matter - We Care

Airfield Improvements

McConnell Air Force Base, Kansas

**Volume 2: Airfield Repair Technical
Specifications**

July 2004

DEPARTMENT OF THE ARMY
 Kansas City District, Corps of Engineers
 757 Federal Building
 Kansas City, Missouri 64106

SPECIFICATIONS FOR CONSTRUCTION OF
 AIRFIELD IMPROVEMENTS
 MCCONNELL AIR FORCE BASE, KANSAS

VOLUME 2

AIRFIELD IMPROVEMENTS

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SECTION 02220

DEMOLITION

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A10.6 (1990; R 1998) Safety Requirements for Demolition Operations

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1 (1996) Safety and Health Requirements Manual

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

40 CFR 61-SUBPART M National Emission Standard for Asbestos

1.2 GENERAL REQUIREMENTS

Do not begin demolition until authorization is received from the Contracting Officer. Remove rubbish and debris from the project site; do not allow accumulations on airfield pavements. The work includes demolition, salvage of identified items and materials, and removal of resulting rubbish and debris. Rubbish and debris shall be removed from Government property daily, unless otherwise directed, to avoid accumulation at the demolition site. Materials that cannot be removed daily shall be stored in areas specified by the Contracting Officer. In the interest of occupational safety and health, the work shall be performed in accordance with EM 385-1-1, Section 23, Demolition, and other applicable Sections. In the interest of conservation, salvage shall be pursued to the maximum extent possible; salvaged items and materials shall be disposed of as specified.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-07 Certificates

Demolition plan; G, RO

Notifications; G, RO

Submit proposed salvage, demolition and removal procedures to the Contracting Officer for approval before work is started.

SD-11 Closeout Submittals

Receipts

Receipts or bills of lading, as specified.

1.4 REGULATORY AND SAFETY REQUIREMENTS

Comply with federal, state, and local hauling and disposal regulations. In addition to the requirements of the "Contract Clauses," safety requirements shall conform with ANSI A10.6.

1.4.1 Notifications

1.4.1.1 General Requirements

Furnish timely notification of demolition projects to Federal, State, regional, and local authorities in accordance with 40 CFR 61-SUBPART M. Notify the Regional Office of the United States Environmental Protection Agency (USEPA) or State's environmental protection agency, as appropriate and the Contracting Officer in writing 10 working days prior to the commencement of work in accordance with 40 CFR 61-SUBPART M.

1.4.2 Receipts

Submit a shipping receipt or bill of lading for all containers of ozone depleting substance (ODS) shipped to the Defense Depot, Richmond, Virginia.

1.5 DUST AND DEBRIS CONTROL

Prevent the spread of dust and debris on airfield pavements and avoid the creation of a nuisance or hazard in the surrounding area. Do not use water if it results in hazardous or objectionable conditions such as, but not limited to, ice, flooding, or pollution. Sweep pavements as often as necessary to control the spread of debris that may result in foreign object damage potential to aircraft.

1.6 PROTECTION

1.6.1 Traffic Control Signs

Where aircraft safety is endangered in the area of removal work, use traffic barricades with flashing lights. Anchor barricades in a manner to prevent displacement by jet or prop blast. Notify the Contracting Officer prior to beginning such work.

a. Barricades shall be low profile beam barricades, meeting the dimensions shown in the plans. Reflective material, orange florescent and white florescent diagonal shall be placed on all faces. Flashing lights shall be yellow and have a minimum of 5 candelas effective intensity and flash at a rate from 55 to 75 flashes per minutes.

b. The Contractor shall provide and post a sign at the access point

saying "Authorized Personnel Only".

c. The Contractor shall place guidance signs for his construction traffic as necessary.

1.6.2 Existing Work

Before beginning any demolition work, the Contractor shall survey the site and examine the drawings and specifications to determine the extent of the work. The Contractor shall take necessary precautions to avoid damage to existing items to remain in place, to be reused, or to remain the property of the Government; any damaged items shall be repaired or replaced as approved by the Contracting Officer. The Contractor shall coordinate the work of this section with all other work and shall construct and maintain shoring, bracing, and supports as required. The Contractor shall ensure that structural elements are not overloaded and shall be responsible for increasing structural supports or adding new supports as may be required as a result of any cutting, removal, or demolition work performed under this contract. Do not overload pavements to remain. Provide new supports and reinforcement for existing construction weakened by demolition or removal work. Repairs, reinforcement, or structural replacement must have Contracting Officer approval.

1.6.3 Facilities

Protect electrical and mechanical services and utilities. Where removal of existing utilities and pavement is specified or indicated, provide approved barricades, temporary covering of exposed areas, and temporary services or connections for electrical and mechanical utilities. Floors, roofs, walls, columns, pilasters, and other structural components that are designed and constructed to stand without lateral support or shoring, and are determined to be in stable condition, shall remain standing without additional bracing, shoring, or lateral support until demolished, unless directed otherwise by the Contracting Officer. The Contractor shall ensure that no elements determined to be unstable are left unsupported and shall be responsible for placing and securing bracing, shoring, or lateral supports as may be required as a result of any cutting, removal, or demolition work performed under this contract.

1.6.4 Protection of Personnel

During the demolition work the Contractor shall continuously evaluate the condition of the structure being demolished and take immediate action to protect all personnel working in and around the demolition site. No area, section, or component of floors, roofs, walls, columns, pilasters, or other structural element will be allowed to be left standing without sufficient bracing, shoring, or lateral support to prevent collapse or failure while workmen remove debris or perform other work in the immediate area.

1.7 BURNING

The use of burning at the project site for the disposal of refuse and debris will not be permitted .

1.8 FOREIGN OBJECT DAMAGE (FOD)

Aircraft and aircraft engines are subject to FOD from debris and waste material lying on airfield pavements. Remove all such materials that may appear on operational aircraft pavements due to the Contractor's

operations. If necessary, the Contracting Officer may require the Contractor to install a temporary barricade at the Contractor's expense to control the spread of FOD potential debris. The barricade shall consist of a fence covered with a fabric designed to stop the spread of debris; anchor the fence and fabric to prevent displacement by winds or jet/prop blasts. Remove barricade when no longer required.

1.9 RELOCATIONS

Perform the removal and reinstallation of relocated items as indicated with workmen skilled in the trades involved. Repair items to be relocated which are damaged or replace damaged items with new undamaged items as approved by the Contracting Officer.

1.10 REQUIRED DATA

Demolition plan shall include procedures for careful removal and disposition of materials specified to be salvaged, coordination with other work in progress, a disconnection schedule of utility services, and airfield lighting, a detailed description of methods and equipment to be used for each operation and of the sequence of operations. The procedures shall provide for safe conduct of the work in accordance with EM 385-1-1.

1.11 ENVIRONMENTAL PROTECTION

The work shall comply with the requirements of Section 01355A ENVIRONMENTAL PROTECTION .

1.12 USE OF EXPLOSIVES

Use of explosives will not be permitted.

1.13 AVAILABILITY OF WORK AREAS

Areas in which the work is to be accomplished will be available as indicated in the project drawings:

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 EXISTING FACILITIES TO BE REMOVED

3.1.1 Utilities and Related Equipment

Remove existing utilities , as indicated and terminate in a manner conforming to the nationally recognized code covering the specific utility and approved by the Contracting Officer. When utility lines are encountered that are not indicated on the drawings, the Contracting Officer shall be notified prior to further work in that area. Remove meters and related equipment and deliver to a location in accordance with instructions of the Contracting Officer. If utility lines are encountered that are not shown on drawings, contact the Contracting Officer for further instructions.

3.1.2 Paving and Slabs

Remove concrete and asphaltic concrete paving and slabs including aggregate base as shown in the plans, to the depth shown in the plans, but to a depth not less than 4 inches below new finish grade. Provide neat sawcuts at limits of pavement removal as specified in Section 02575 PAVEMENT REMOVAL.

3.1.3 Airfield Lighting

Remove edge lights as indicated. All runway edge lights removed shall be removed and reinstalled. All taxiway edge lights shall be removed and delivered to a location on McConnell AFB. Light fixtures which are not reinstalled shall be delivered to a location at McConnell Air Force Base as directed by the Contracting Officer. Remove associated transformers and light bases as indicated and deliver to a location on the station in accordance with instructions for the Contracting Officer. Remove the hand hole frames and lids as indicated. Where shown, hand hole frames and lids shall be reinstalled as shown in the plans. Hand hole frames and lids not reinstalled shall be delivered to a location at McConnell AFB as directed by the Contracting Officer.

3.1.4 Patching

Where removals leave holes and damaged surfaces exposed in the finished work, patch and repair these holes and damaged surfaces to match adjacent finished surfaces. Where new work is to be applied to existing surfaces, perform removals and patching in a manner to produce surfaces suitable for receiving new work. Finished surfaces of patched area shall be flush with the adjacent existing surface and shall match the existing adjacent surface as closely as possible as to texture and finish. Patching shall be as specified and indicated, and shall include:

- a. Holes and depressions left as a result of removals in existing masonry walls to remain shall be completely filled with an approved masonry patching material, applied in accordance with the manufacturer's printed instructions.

3.1.5 Structure Removals and Adjustments

Where shown on the plans, remove or adjust structures. Where a new structure is not to be constructed at the same location and around structure adjustments, backfill the excavation. Under new pavements, backfill with Controlled Low Strength Material (CLSM) to the top of the excavation or top of subgrade, whichever is lower. CLSM shall meet the requirements of Section 12526A. Outside of new pavement area, backfill with satisfactory material, as defined in Section 02300 to a depth of six inches below final grade. Compact satisfactory material in accordance with Section 02300. Place topsoil on top of satisfactory material to final grade.

3.2 DISPOSITION OF MATERIAL

3.2.1 Title to Materials

Except where specified in other sections, all materials and equipment removed, and not reused, shall become the property of the Contractor and shall be removed from Government property. Title to materials resulting from demolition, and materials and equipment to be removed, is vested in the Contractor upon approval by the Contracting Officer of the Contractor's

demolition and removal procedures, and authorization by the Contracting Officer to begin demolition. The Government will not be responsible for the condition or loss of, or damage to, such property after contract award. Materials and equipment shall not be viewed by prospective purchasers or sold on the site.

3.2.2 Reuse of Materials and Equipment

Remove and store materials and equipment to be reused or relocated to prevent damage, and reinstall as the work progresses.

3.2.3 Salvaged Materials and Equipment

Remove materials and equipment that are to be removed by the Contractor and that are to remain the property of the Government, and deliver to a storage site designated by the Contracting Officer.

Contractor shall salvage items and material to the maximum extent possible.

Material salvaged for the Contractor shall be stored as approved by the Contracting Officer and shall be removed from Government property before completion of the contract. Material salvaged for the Contractor shall not be sold on the site.

Salvaged items to remain the property of the Government shall be removed in a manner to prevent damage, and packed or crated to protect the items from damage while in storage or during shipment. Items damaged during removal or storage shall be repaired or replaced to match existing items. Containers shall be properly identified as to contents. The following items reserved as property of the Government shall be delivered to the areas designated:

- Airfield Lighting Edge Light Fixtures - not reinstalled at new locations
- Transformers
- Light Bases
- Hand hole frames and lids - not reinstalled at new locations.

The following items reserved as property of the using service shall be removed prior to commencement of work under this contract . Historical items shall be removed in a manner to prevent damage. The following historical items shall be delivered to the Government for disposition: Corner stones, contents of corner stones, and document boxes wherever located on the site.

3.2.4 Unsalvageable Material

Concrete, asphalt, masonry, and other noncombustible material, except concrete permitted to remain in place, shall become the property of the Contractor and disposed of off the site with the following exceptions: Concrete may be reused as crushed recycled concrete as specified, providing it meets all the requirements of the specification. Asphalt, less than 1-1/2 inch in diameter, may be spread, graded and compacted on the Contractor's haul roads, to the extent practical, as directed by the Contracting Officer. If approved by the Contracting Officer, concrete less than 1 1/2 inch in diameter, and without sharp edges, may be spread, grade and compacted on the Contractor's haul roads, to the extent practice, and as directed by the Contracting Officer. Asphalt and concrete, less than 1 1/2 inch in diameter, not spread on haul roads, may be stockpiled for

McConnell AFB's use, at a location determined by the Contracting Officer, on Government property, and shall become the Government's property, if accepted by the Contracting Officer. Concrete and asphalt not reused or stockpiled shall be disposed of off airport property.

3.3 CLEANUP

Debris and rubbish shall be removed from basement and similar excavations. Debris shall be removed and transported in a manner that prevents spillage on streets or adjacent areas. Local regulations regarding hauling and disposal shall apply.

-- End of Section --

SECTION 02300

EARTHWORK

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
(AASHTO)

AASHTO T 180 (2001) Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and an 457-mm (18-in) Drop

AASHTO T 224 (2001) Correction for Coarse Particles in the Soil Compaction Test

AMERICAN WATER WORKS ASSOCIATION(AWWA)

AWWA C600 (1999) Installation of Ductile-Iron Water Mains and Their Appurtenances

ASTM INTERNATIONAL (ASTM)

ASTM C 136 (2001) Sieve Analysis of Fine and Coarse Aggregates

ASTM C 33 (2003) Concrete Aggregates

ASTM D 1140 (2000) Amount of Material in Soils Finer than the No. 200 (75-micrometer) Sieve

ASTM D 1556 (2000) Density and Unit Weight of Soil in Place by the Sand-Cone Method

ASTM D 1557 (2002) Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/cu. ft. (2,700 kN-m/cu.m.))

ASTM D 2167 (1994; R 2001) Density and Unit Weight of Soil in Place by the Rubber Balloon Method

ASTM D 2487 (2000) Soils for Engineering Purposes (Unified Soil Classification System)

ASTM D 2922 (2001) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)

ASTM D 3017 (2001) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)

- ASTM D 422 (1963; R 2002) Particle-Size Analysis of Soils
- ASTM D 4318 (2000) Liquid Limit, Plastic Limit, and Plasticity Index of Soils
- ASTM D 698 (2000a) Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/cu. ft. (600 kN-m/cu. m.))

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

- EPA 530/F-93/004 (1993; Rev O; Updates I, II, IIA, IIB, and III) Test Methods for Evaluating Solid Waste (Vol IA, IB, IC, and II) (SW-846)
- EPA 600/4-79/020 (1983) Methods for Chemical Analysis of Water and Wastes

1.2 DEFINITIONS

1.2.1 Satisfactory Materials

Satisfactory materials shall comprise any materials classified by ASTM D 2487 as GW, GP, GM, GP-GM, GW-GM, GC, GP-GC, GM-GC, SW, SP, SM, SW-SM, SC, SW-SC, SP-SM, SP-SC, CL, ML, CL-ML, . Satisfactory materials for grading shall be comprised of stones less than 8 inches, except for fill material for pavements and railroads which shall be comprised of stones less than 3 inches in any dimension.

1.2.2 Unsatisfactory Materials

Materials which do not comply with the requirements for satisfactory materials are unsatisfactory. Unsatisfactory materials also include man-made fills; trash; refuse; backfills from previous construction; and material classified as satisfactory which contains root and other organic matter or frozen material. The Contracting Officer shall be notified of any contaminated materials.

1.2.3 Cohesionless and Cohesive Materials

Cohesionless materials include materials classified in ASTM D 2487 as GW, GP, SW, and SP. Cohesive materials include materials classified as GC, SC, ML, CL, MH, and CH. Materials classified as GM and SM will be identified as cohesionless only when the fines are nonplastic. Testing required for classifying materials shall be in accordance with ASTM D 4318, ASTM C 136, ASTM D 422, and ASTM D 1140.

1.2.4 Degree of Compaction

Degree of compaction required, except as noted in the second sentence, is expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D 1557 abbreviated as a percent of laboratory maximum density. Since ASTM D 1557 applies only to soils that have 30 percent or less by weight of their particles retained on the 3/4 inch sieve, the degree of compaction for material having more than 30 percent by

weight of their particles retained on the 3/4 inch sieve shall be expressed as a percentage of the maximum density in accordance with AASHTO T 180 Method D and corrected with AASHTO T 224. To maintain the same percentage of coarse material, the "remove and replace" procedure as described in the NOTE 8 in Paragraph 7.2 of AASHTO T 180 shall be used.

1.2.5 Topsoil

Material suitable for topsoils obtained from offsite areas OR excavations is defined as: Natural, friable soil representative of productive, well-drained soils in the area, free of subsoil, stumps, rocks larger than one inch diameter, brush, weeds, toxic substances, and other material detrimental to plant growth. Amend topsoil pH range to obtain a pH of 5.5 to 7.

1.2.6 Unstable Material

Unstable material shall consist of materials too wet to properly support the utility pipe, conduit, or appurtenant structure.

1.2.7 Select Granular Material

1.2.7.1 General Requirements

Select granular material shall consist of materials classified as GW, GP, SW, or SP, by ASTM D 2487 where indicated.

1.2.8 Initial Backfill Material

Initial backfill shall consist of select granular material or satisfactory materials free from rocks 3 inches or larger in any dimension or free from rocks of such size as recommended by the pipe manufacturer, whichever is smaller. When the pipe is coated or wrapped for corrosion protection, the initial backfill material shall be free of stones larger than 3 inches in any dimension or as recommended by the pipe manufacturer, whichever is smaller.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Dewatering Work Plan; G, RO

SD-03 Product Data

Utilization of Excavated Materials; G, RO

Shoulder Construction

Procedure and location for disposal of unused satisfactory material. Proposed source of borrow material. Notification of

encountering rock in the project. Advance notice on the opening of excavation or borrow areas. Advance notice on shoulder construction for rigid pavements.

SD-06 Test Reports

Testing
Borrow Site Testing

Within 24 hours of conclusion of physical tests, 2 copies of test results, including calibration curves and results of calibration tests. Results of testing at the borrow site.

SD-07 Certificates

Testing

Qualifications of the commercial testing laboratory or Contractor's testing facilities.

1.4 CLASSIFICATION OF EXCAVATION

No consideration will be given to the nature of the materials, and all excavation will be designated as unclassified excavation.

1.4.1 BLASTING

Blasting will not be permitted.

1.5 CRITERIA FOR BIDDING

Base bids on the following criteria:

- a. Surface elevations are as indicated.

1.6 DEWATERING WORK PLAN

Submit procedures for accomplishing dewatering work.

PART 2 PRODUCTS

2.1 REQUIREMENTS FOR OFFSITE SOILS

Offsite soils brought in for use as backfill shall be tested for TPH, BTEX and full TCLP including ignitability, corrosivity and reactivity. Backfill shall contain less than 100 parts per million (ppm) of total petroleum hydrocarbons (TPH) and less than 10 ppm of the sum of Benzene, Toluene, Ethyl Benzene, and Xylene (BTEX) and shall not fail the TCPL test. TPH concentrations shall be determined by using EPA 600/4-79/020 Method 418.1. BTEX concentrations shall be determined by using EPA 530/F-93/004 Method 5030/8020. TCLP shall be performed in accordance with EPA 530/F-93/004 Method 1311. Provide Borrow Site Testing for TPH, BTEX and TCLP from a composite sample of material from the borrow site, with at least one test from each borrow site. Material shall not be brought on site until tests have been approved by the Contracting Officer.

2.2 BURIED WARNING AND IDENTIFICATION TAPE

Polyethylene plastic and metallic core or metallic-faced, acid- and

alkali-resistant, polyethylene plastic warning tape manufactured specifically for warning and identification of buried utility lines. Provide tape on rolls, 3 inch minimum width, color coded as specified below for the intended utility with warning and identification imprinted in bold black letters continuously over the entire tape length. Warning and identification to read, "CAUTION, BURIED (intended service) LINE BELOW" or similar wording. Color and printing shall be permanent, unaffected by moisture or soil.

Warning Tape Color Codes

Yellow:	Electric
Yellow:	Gas, Oil; Dangerous Materials
Orange:	Telephone and Other Communications
Blue:	Water Systems
Green:	Sewer Systems
White:	Steam Systems
Gray:	Compressed Air

2.2.1 Warning Tape for Metallic Piping

Acid and alkali-resistant polyethylene plastic tape conforming to the width, color, and printing requirements specified above. Minimum thickness of tape shall be 0.003 inch. Tape shall have a minimum strength of 1500 psi lengthwise, and 1250 psi crosswise, with a maximum 350 percent elongation.

2.2.2 Detectable Warning Tape for Non-Metallic Piping

Polyethylene plastic tape conforming to the width, color, and printing requirements specified above. Minimum thickness of the tape shall be 0.004 inch. Tape shall have a minimum strength of 1500 psi lengthwise and 1250 psi crosswise. Tape shall be manufactured with integral wires, foil backing, or other means of enabling detection by a metal detector when tape is buried up to 3 feet deep. Encase metallic element of the tape in a protective jacket or provide with other means of corrosion protection.

2.3 DETECTION WIRE FOR NON-METALLIC PIPING

Detection wire shall be insulated single strand, solid copper with a minimum of 12 AWG.

PART 3 EXECUTION

3.1 STRIPPING OF TOPSOIL

Under all new airfield pavements, including shoulders, and where indicated or directed, topsoil shall be stripped to a depth of 4 inches. Topsoil shall be spread on areas already graded and prepared for topsoil, or transported and deposited in stockpiles convenient to areas that are to receive application of the topsoil later, or at locations indicated or specified. Topsoil shall be kept separate from other excavated materials, brush, litter, objectionable weeds, roots, stones larger than 2 inches in diameter, and other materials that would interfere with planting and maintenance operations. Any surplus of topsoil from excavations and grading shall be removed from the site.

3.2 GENERAL EXCAVATION

The Contractor shall perform excavation of every type of material encountered within the limits of the project to the lines, grades, and elevations indicated and as specified. Grading shall be in conformity with the typical sections shown and the tolerances specified in paragraph FINISHING. Satisfactory excavated materials shall be transported to and placed in fill or embankment within the limits of the work. Unsatisfactory materials encountered within the limits of the work shall be excavated below grade and replaced with satisfactory materials as directed. Such excavated material and the satisfactory material ordered as replacement shall be included in excavation. Surplus satisfactory excavated material not required for fill or embankment shall be disposed of in areas approved for surplus material storage or designated waste areas. Unsatisfactory excavated material shall be disposed of in designated waste or spoil areas.

During construction, excavation and fill shall be performed in a manner and sequence that will provide proper drainage at all times. Material required for fill or embankment in excess of that produced by excavation within the grading limits shall be excavated from the borrow areas indicated or from other approved areas selected by the Contractor as specified.

3.2.1 Ditches, Gutters, and Channel Changes

Excavation of ditches, gutters, and channel changes shall be accomplished by cutting accurately to the cross sections, grades, and elevations shown. Ditches and gutters shall not be excavated below grades shown. Excessive open ditch or gutter excavation shall be backfilled with satisfactory, thoroughly compacted, material or with suitable stone or cobble to grades shown. Material excavated shall be disposed of as shown or as directed, except that in no case shall material be deposited less than 4 feet from the edge of a ditch. The Contractor shall maintain excavations free from detrimental quantities of leaves, brush, sticks, trash, and other debris until final acceptance of the work.

3.2.2 Drainage Structures

Excavations shall be made to the lines, grades, and elevations shown, or as directed. Trenches and foundation pits shall be of sufficient size to permit the placement and removal of forms for the full length and width of structure footings and foundations as shown. Rock or other hard foundation material shall be cleaned of loose debris and cut to a firm, level, stepped, or serrated surface. Loose disintegrated rock and thin strata shall be removed. When concrete or masonry is to be placed in an excavated area, the bottom of the excavation shall not be disturbed. Excavation to the final grade level shall not be made until just before the concrete or masonry is to be placed.

3.2.3 Drainage

Provide for the collection and disposal of surface and subsurface water encountered during construction. Completely drain construction site during periods of construction to keep soil materials sufficiently dry. The Contractor shall establish/construct storm drainage features (ponds/basins) at the earliest stages of site development, and throughout construction grade the construction area to provide positive surface water runoff away from the construction activity and/or provide temporary ditches, swales, and other drainage features and equipment as required to maintain dry soils. When unsuitable working platforms for equipment operation and

unsuitable soil support for subsequent construction features develop, remove unsuitable material and provide new soil material as specified herein. It is the responsibility of the Contractor to assess the soil and ground water conditions presented by the plans and specifications and to employ necessary measures to permit construction to proceed.

3.2.4 Dewatering

Groundwater flowing toward or into excavations shall be controlled to prevent sloughing of excavation slopes and walls, boils, uplift and heave in the excavation and to eliminate interference with orderly progress of construction. French drains, sumps, ditches or trenches will not be permitted within 3 feet of the foundation of any structure, except with specific written approval, and after specific contractual provisions for restoration of the foundation area have been made. Control measures shall be taken by the time the excavation reaches the water level in order to maintain the integrity of the in situ material.

3.2.5 Trench Excavation Requirements

The trench shall be excavated as recommended by the manufacturer of the pipe to be installed. Trench walls below the top of the pipe shall be sloped, or made vertical, and of such width as recommended in the manufacturer's installation manual. Where no manufacturer's installation manual is available, trench walls shall be made vertical. The Contractor shall shore trench walls as appropriate to meet applicable safety standards.

Trench walls which are cut back shall be excavated to at least the angle of repose of the soil. Special attention shall be given to slopes which may be adversely affected by weather or moisture content. The trench width below the top of pipe shall not exceed 24 inches plus pipe outside diameter (O.D.) for pipes of less than 24 inches inside diameter and shall not exceed 36 inches plus pipe outside diameter for sizes larger than 24 inches inside diameter. Where recommended trench widths are exceeded, redesign, stronger pipe, or special installation procedures shall be utilized by the Contractor. The cost of redesign, stronger pipe, or special installation procedures shall be borne by the Contractor without any additional cost to the Government.

3.2.5.1 Bottom Preparation

The bottoms of trenches shall be accurately graded to provide uniform bearing and support for the bottom quadrant of each section of the pipe. Bell holes shall be excavated to the necessary size at each joint or coupling to eliminate point bearing. Stones of 3 inches or greater in any dimension, or as recommended by the pipe manufacturer, whichever is smaller, shall be removed to avoid point bearing.

3.2.5.2 Removal of Unyielding Material

Where unyielding material is encountered in the bottom of the trench, such material shall be removed 4 inches below the required grade and replaced with suitable materials as provided in paragraph BACKFILLING AND COMPACTION.

3.2.5.3 Removal of Unstable Material

Where unstable material is encountered in the bottom of the trench, such material shall be removed to the depth directed and replaced to the proper grade with select granular material as provided in paragraph BACKFILLING AND COMPACTION. When removal of unstable material is required due to the

Contractor's fault or neglect in performing the work, the resulting material shall be excavated and replaced by the Contractor without additional cost to the Government.

3.2.5.4 Excavation for Appurtenances

Excavation for manholes, catch-basins, inlets, or similar structures shall be sufficient to leave at least 12 inches clear between the outer structure surfaces and the face of the excavation or support members. Rock shall be cleaned of loose debris and cut to a firm surface either level, stepped, or serrated, as shown or as directed. Loose disintegrated rock and thin strata shall be removed. Removal of unstable material shall be as specified above. When concrete or masonry is to be placed in an excavated area, special care shall be taken not to disturb the bottom of the excavation. Excavation to the final grade level shall not be made until just before the concrete or masonry is to be placed.

3.2.5.5 Jacking, Boring, and Tunneling

Unless otherwise indicated, excavation shall be by open cut except that sections of a trench may be jacked, bored, or tunneled if, in the opinion of the Contracting Officer, the pipe, cable, or duct can be safely and properly installed and backfill can be properly compacted in such sections.

3.2.6 Underground Utilities

Prior to the start of any utility excavation, the Contractor shall obtain a dig permit from McConnell AFB Base CE. Movement of construction machinery and equipment over pipes and utilities during construction shall be at the Contractor's risk. Excavation made with power-driven equipment is not permitted within two feet of known Government-owned utility or subsurface construction. For work immediately adjacent to or for excavations exposing a utility or other buried obstruction, excavate by hand. Start hand excavation on each side of the indicated obstruction and continue until the obstruction is uncovered or until clearance for the new grade is assured. Support uncovered lines or other existing work affected by the contract excavation until approval for backfill is granted by the Contracting Officer. Report damage to utility lines or subsurface construction immediately to the Contracting Officer.

3.2.7 Structural Excavation

Ensure that footing subgrades have been inspected and approved by the Contracting Officer prior to concrete placement. Excavate to bottom of pile cap prior to placing or driving piles, unless authorized otherwise by the Contracting Officer. Backfill and compact over excavations and changes in grade due to pile driving operations to 95 percent of ASTM D 698 maximum density.

3.3 SELECTION OF BORROW MATERIAL

Borrow material shall be selected to meet the requirements and conditions of the particular fill or embankment for which it is to be used. Borrow material shall be obtained from the borrow areas from approved private sources. Unless otherwise provided in the contract, the Contractor shall obtain from the owners the right to procure material, pay royalties and other charges involved, and bear the expense of developing the sources, including rights-of-way for hauling. Borrow material from approved sources on Government-controlled land may be obtained without payment of royalties.

Unless specifically provided, no borrow shall be obtained within the limits of the project site without prior written approval. Necessary clearing, grubbing, and satisfactory drainage of borrow pits and the disposal of debris thereon shall be considered related operations to the borrow excavation.

3.4 OPENING AND DRAINAGE OF EXCAVATION AND BORROW PITS

Except as otherwise permitted, borrow pits and other excavation areas shall be excavated providing adequate drainage. Overburden and other spoil material shall be transported to designated spoil areas or otherwise disposed of as directed. Borrow pits shall be neatly trimmed and drained after the excavation is completed. The Contractor shall ensure that excavation of any area, operation of borrow pits, or dumping of spoil material results in minimum detrimental effects on natural environmental conditions.

3.5 GRADING AREAS

Where indicated, work will be divided into grading areas within which satisfactory excavated material shall be placed in embankments, fills, and required backfills. The Contractor shall not haul satisfactory material excavated in one grading area to another grading area except when so directed in writing. Stockpiles of satisfactory and unsatisfactory shall be placed and graded as specified. Stockpiles shall be kept in a neat and well drained condition, giving due consideration to drainage at all times. The ground surface at stockpile locations shall be cleared, grubbed, and sealed by rubber-tired equipment, excavated satisfactory and unsatisfactory materials shall be separately stockpiled. Stockpiles of satisfactory materials shall be protected from contamination which may destroy the quality and fitness of the stockpiled material. If the Contractor fails to protect the stockpiles, and any material becomes unsatisfactory, such material shall be removed and replaced with satisfactory material from approved sources.

3.6 GROUND SURFACE PREPARATION

3.6.1 General Requirements

Unsatisfactory material in surfaces to receive fill or in excavated areas shall be removed and replaced with satisfactory materials as directed by the Contracting Officer. The surface shall be scarified to a depth of 6 inches before the fill is started. Sloped surfaces steeper than 1 vertical to 4 horizontal shall be plowed, stepped, benched, or broken up so that the fill material will bond with the existing material. When subgrades are less than the specified density, the ground surface shall be broken up to a minimum depth of 6 inches, pulverized, and compacted to the specified density. When the subgrade is part fill and part excavation or natural ground, the excavated or natural ground portion shall be scarified to a depth of 12 inches and compacted as specified for the adjacent fill.

3.6.2 Frozen Material

Material shall not be placed on surfaces that are muddy, frozen, or contain frost. Compaction shall be accomplished by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, or other approved equipment well suited to the soil being compacted. Material shall be moistened or aerated as necessary to provide the moisture content that will readily facilitate obtaining the specified compaction with the equipment used.

Minimum subgrade density shall be as specified in paragraph TESTING.

3.7 UTILIZATION OF EXCAVATED MATERIALS

Unsatisfactory materials removed from excavations shall be disposed of in designated waste disposal or spoil areas. Satisfactory material removed from excavations shall be used, insofar as practicable, in the construction of fills, embankments, subgrades, shoulders, bedding (as backfill), and for similar purposes. No satisfactory excavated material shall be wasted without specific written authorization. Satisfactory material authorized to be wasted shall be disposed of in designated areas approved for surplus material storage or designated waste areas as directed. Newly designated waste areas on Government-controlled land shall be cleared and grubbed before disposal of waste material thereon. Coarse rock from excavations shall be stockpiled and used for constructing slopes or embankments adjacent to streams, or sides and bottoms of channels and for protecting against erosion. No excavated material shall be disposed of to obstruct the flow of any stream, endanger a partly finished structure, impair the efficiency or appearance of any structure, or be detrimental to the completed work in any way.

3.8 BURIED TAPE AND DETECTION WIRE

3.8.1 Buried Warning and Identification Tape

Provide buried utility lines with utility identification tape. Bury tape 12 inches below finished grade; under pavements and slabs, bury tape 6 inches below top of subgrade.

3.8.2 Buried Detection Wire

Bury detection wire directly above non-metallic piping at a distance not to exceed 12 inches above the top of pipe. The wire shall extend continuously and unbroken, from manhole to manhole. The ends of the wire shall terminate inside the manholes at each end of the pipe, with a minimum of 3 feet of wire, coiled, remaining accessible in each manhole. The wire shall remain insulated over its entire length. The wire shall enter manholes between the top of the corbel and the frame, and extend up through the chimney seal between the frame and the chimney seal. For force mains, the wire shall terminate in the valve pit at the pump station end of the pipe.

3.9 BACKFILLING AND COMPACTION

Backfill adjacent to any and all types of structures shall be placed and compacted to at least 90 percent laboratory maximum density for cohesive materials or 95 percent laboratory maximum density for cohesionless materials to prevent wedging action or eccentric loading upon or against the structure. Ground surface on which backfill is to be placed shall be prepared as specified in paragraph PREPARATION OF GROUND SURFACE FOR EMBANKMENTS. Compaction requirements for backfill materials shall also conform to the applicable portions of paragraphs PREPARATION OF GROUND SURFACE FOR EMBANKMENTS, EMBANKMENTS, and SUBGRADE PREPARATION, and Section 02300 EARTHWORK. Compaction shall be accomplished by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment.

3.9.1 Trench Backfill

Trenches shall be backfilled to the grade shown. The trench shall be

backfilled to 2 feet above the top of pipe prior to performing the required pressure tests. The joints and couplings shall be left uncovered during the pressure test.

3.9.1.1 Replacement of Unyielding Material

Unyielding material removed from the bottom of the trench shall be replaced with select granular material or initial backfill material.

3.9.1.2 Replacement of Unstable Material

Unstable material removed from the bottom of the trench or excavation shall be replaced with select granular material placed in layers not exceeding 6 inches loose thickness.

3.9.1.3 Bedding and Initial Backfill

Bedding shall be of the type and thickness shown. Initial backfill material shall be placed and compacted with approved tampers to a height of at least one foot above the utility pipe or conduit. The backfill shall be brought up evenly on both sides of the pipe for the full length of the pipe. Care shall be taken to ensure thorough compaction of the fill under the haunches of the pipe. Except as specified otherwise in the individual piping section, provide bedding for buried piping in accordance with AWWA C600, Type 4, except as specified herein. Backfill to top of pipe shall be compacted to 95 percent of ASTM D 698 maximum density. Plastic piping shall have bedding to spring line of pipe. Provide materials as follows:

Clean, coarsely graded natural gravel, crushed stone or a combination thereof identified as aggregate separation layer in accordance with Section 02716, or having a classification of GW or GP in accordance with ASTM D 2487 for bedding and backfill as indicated. Maximum particle size shall not exceed 3 inches.

3.9.1.4 Final Backfill

The remainder of the trench, except for special materials for roadways, railroads and airfields, shall be filled with satisfactory material. Backfill material shall be placed and compacted as follows:

- a. Roadways, Railroads, and Airfields: Backfill shall be placed up to the required elevation as specified. Water flooding or jetting methods of compaction will not be permitted.
- b. Sidewalks, Turfed or Seeded Areas and Miscellaneous Areas: Backfill shall be deposited in layers of a maximum of 12 inch loose thickness, and compacted to 85 percent maximum density for cohesive soils and 90 percent maximum density for cohesionless soils. Compaction by water flooding or jetting will not be permitted. This requirement shall also apply to all other areas not specifically designated above.

3.9.2 Backfill for Appurtenances

After the manhole, catchbasin, inlet, or similar structure has been constructed and the concrete has been allowed to cure for 7 days, backfill shall be placed in such a manner that the structure will not be damaged by the shock of falling earth. The backfill material shall be deposited and compacted as specified for final backfill, and shall be brought up evenly

on all sides of the structure to prevent eccentric loading and excessive stress.

3.10 SPECIAL REQUIREMENTS

Special requirements for both excavation and backfill relating to the specific utilities are as follows:

3.10.1 Electrical Distribution System

Direct burial cable and conduit or duct line shall have a minimum cover of 24 inches from the finished grade, unless otherwise indicated. Special trenching requirements for direct-burial electrical cables and conduits are specified in Section 16526A AIRFIELD AND HELIPORT LIGHTING AND VISUAL NAVIGATION AIDS.

3.10.2 Underdrainage Systems

Clean sand, crushed rock, or gravel meeting the following requirements:

- a. Perforated or Slotted-Wall Pipe: Backfill meeting requirements of Type I material as specified in Table 1. Place granular material as pipe is laid and extend fit for a minimum of one pipe diameter on each side of and 18 inches above the top of the pipe.

TABLE 1

<u>Type I</u> <u>Gradation E 11</u> <u>ASTM C 33</u>	
<u>ASTM D 422</u> <u>Sieve Size</u>	<u>Percent Passing</u>
1.5 inches	--
1 inch	--
3/8 inch	100
No. 4	95 - 100
No. 8	--
No. 16	45 - 80
No. 50	10 - 30
No. 100	0 - 10

3.11 EMBANKMENTS

3.11.1 Earth Embankments

Earth embankments shall be constructed from satisfactory materials free of organic or frozen material and rocks with any dimension greater than 3 inches. The material shall be placed in successive horizontal layers of loose material not more than 8 inches in depth. Each layer shall be spread uniformly on a soil surface that has been moistened or aerated as necessary, and scarified or otherwise broken up so that the fill will bond

with the surface on which it is placed. After spreading, each layer shall be plowed, disked, or otherwise broken up; moistened or aerated as necessary; thoroughly mixed; and compacted to at least 90 percent laboratory maximum density for cohesive materials or 95 percent laboratory maximum density for cohesionless materials. Compaction requirements for the upper portion of earth embankments forming subgrade for pavements shall be identical with those requirements specified in paragraph SUBGRADE PREPARATION. Compaction shall be accomplished by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment.

3.12 SUBGRADE PREPARATION

3.12.1 Proof Rolling

Proof rolling shall be done on an exposed subgrade free of surface water (wet conditions resulting from rainfall) which would promote degradation of an otherwise acceptable subgrade. After stripping, proof roll the existing subgrade of the areas to be paved with six passes of a dump truck loaded with 4 cubic yards of soil or 15 ton, pneumatic-tired roller. Operate the roller or truck in a systematic manner to ensure the number of passes over all areas, and at speeds between 2 1/2 to 3 1/2 mph. Notify the Contracting Officer a minimum of 3 days prior to proof rolling. Proof rolling shall be performed in the presence of the Contracting Officer. Rutting or pumping of material shall be undercut as directed by the Contracting Officer and replaced with fill and backfill material.

3.12.2 Construction

Subgrade shall be shaped to line, grade, and cross section, and compacted as specified. This operation shall include plowing, disking, and any moistening or aerating required to obtain specified compaction. Soft or otherwise unsatisfactory material shall be removed and replaced with satisfactory excavated material or other approved material as directed. Rock encountered in the cut section shall be excavated to a depth of 6 inches below finished grade for the subgrade. Low areas resulting from removal of unsatisfactory material or excavation of rock shall be brought up to required grade with satisfactory materials, and the entire subgrade shall be shaped to line, grade, and cross section and compacted as specified. After rolling, the surface of the subgrade for airfields shall not show deviations greater than 1/2 inch when tested with a 12 foot straightedge applied both parallel and at right angles to the centerline of the area. The elevation of the finish subgrade shall not vary more than 0.05 foot from the established grade and cross section.

3.12.3 Compaction

Compaction shall be accomplished by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment. Except for paved areas, each layer of the embankment shall be compacted to at least 90 percent of laboratory maximum density.

3.12.3.1 Subgrade for Shoulders

Subgrade for airfield shoulders shall be compacted to at least the percentage laboratory maximum density shown in the following table for the specific depths below the surface of the shoulder pavement.

Depth Below	_____
	Depth Below

Shoulder Pavement Surface	Cohesive Materials	Shoulder Pavement Surface	Cohesionless Materials
0" to 6"	100%	0" to 10"	100%
6" to 10"	95%	10" to 16"	95%
10" to 14"	90%	16" to 23"	90%
14" to 17"	85%	23" to 29"	85%

3.12.3.2 Subgrade for Airfield Pavements

Compact top 24 inches below finished pavement or top 12 inches of subgrades, whichever is greater, to 100 percent of ASTM D 1557; compact fill and backfill material to 100 percent of ASTM D 1557.

3.13 SHOULDER CONSTRUCTION

Shoulders shall be constructed of satisfactory excavated or borrow material or as otherwise shown or specified. Shoulders shall be constructed as soon as possible after adjacent paving is complete, but in the case of rigid pavements, shoulders shall not be constructed until permission of the Contracting Officer has been obtained. The entire shoulder area shall be compacted to at least the percentage of maximum density as specified in paragraph SUBGRADE PREPARATION above, for specific ranges of depth below the surface of the shoulder. Compaction shall be accomplished by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment. Shoulder construction shall be done in proper sequence in such a manner that adjacent ditches will be drained effectively and that no damage of any kind is done to the adjacent completed pavement. The completed shoulders shall be true to alignment and grade and shaped to drain in conformity with the cross section shown.

3.14 FINISHING

The surface of excavations, embankments, and subgrades shall be finished to a smooth and compact surface in accordance with the lines, grades, and cross sections or elevations shown. The degree of finish for graded areas shall be within 0.1 foot of the grades and elevations indicated except that the degree of finish for subgrades shall be specified in paragraph SUBGRADE PREPARATION. Gutters and ditches shall be finished in a manner that will result in effective drainage. The surface of areas to be turfed shall be finished to a smoothness suitable for the application of turfing materials. Settlement or washing that occurs in graded, topsoiled, or backfilled areas prior to acceptance of the work, shall be repaired and grades re-established to the required elevations and slopes.

3.14.1 Subgrade and Embankments

During construction, embankments and excavations shall be kept shaped and drained. Ditches and drains along subgrade shall be maintained to drain effectively at all times. The finished subgrade shall not be disturbed by traffic or other operation and shall be protected and maintained by the Contractor in a satisfactory condition until ballast, subbase, base, or pavement is placed. The storage or stockpiling of materials on the finished subgrade will not be permitted. No subbase, base course, ballast, or pavement shall be laid until the subgrade has been checked and approved, and in no case shall subbase, base, surfacing, pavement, or ballast be

placed on a muddy, spongy, or frozen subgrade.

3.14.2 Capillary Water Barrier 3.14.3 Grading Around Structures

Areas within 5 feet outside of each building and structure line shall be constructed true-to-grade, shaped to drain, and shall be maintained free of trash and debris until final inspection has been completed and the work has been accepted.

3.15 PLACING TOPSOIL

On areas to receive topsoil, the compacted subgrade soil shall be scarified to a 2 inch depth for bonding of topsoil with subsoil. Topsoil then shall be spread evenly to a thickness of 4 inches and graded to the elevations and slopes shown. Topsoil shall not be spread when frozen or excessively wet or dry. Material required for topsoil in excess of that produced by excavation within the grading limits shall be obtained from offsite areas .

3.16 TESTING

Testing shall be performed by an approved commercial testing laboratory or by the Contractor subject to approval. If the Contractor elects to establish testing facilities, no work requiring testing will be permitted until the Contractor's facilities have been inspected and approved by the Contracting Officer. Field in-place density shall be determined in accordance with ASTM D 1556, ASTM D 2167 or ASTM D 2922. When ASTM D 2922 is used, the calibration curves shall be checked and adjusted using only the sand cone method as described in ASTM D 1556. ASTM D 2922 results in a wet unit weight of soil and when using this method ASTM D 3017 shall be used to determine the moisture content of the soil. The calibration curves furnished with the moisture gauges shall also be checked along with density calibration checks as described in ASTM D 3017; the calibration checks of both the density and moisture gauges shall be made at the beginning of a job on each different type of material encountered and at intervals as directed by the Contracting Officer. When test results indicate, as determined by the Contracting Officer, that compaction is not as specified, the material shall be removed, replaced and recompact to meet specification requirements. Tests on recompact areas shall be performed to determine conformance with specification requirements. Inspections and test results shall be certified by a registered professional civil engineer. These certifications shall state that the tests and observations were performed by or under the direct supervision of the engineer and that the results are representative of the materials or conditions being certified by the tests. The following number of tests, if performed at the appropriate time, will be the minimum acceptable for each type operation.

3.16.1 Fill and Backfill Material Gradation

One test per 10,000 cubic yards stockpiled or in-place source material. Gradation of fill and backfill material shall be determined in accordance with ASTM C 136, ASTM D 422 or ASTM D 1140.

3.16.2 In-Place Densities

- a. One test per 5,000 square feet, or fraction thereof, of each lift of fill or backfill areas compacted by other than hand-operated machines.
- b. One test per 500 square feet, or fraction thereof, of each lift of

fill or backfill areas compacted by hand-operated machines.

3.16.3 Check Tests on In-Place Densities

If ASTM D 2922 is used, in-place densities shall be checked by ASTM D 1556 as follows:

- a. One check test per lift for each 25,000 square feet, or fraction thereof, of each lift of fill or backfill compacted by other than hand-operated machines.
- b. One check test per lift for each 5,000 square feet, of fill or backfill areas compacted by hand-operated machines.

3.16.4 Moisture Contents

In the stockpile, excavation, or borrow areas, a minimum of two tests per day per type of material or source of material being placed during stable weather conditions shall be performed. During unstable weather, tests shall be made as dictated by local conditions and approved by the Contracting Officer.

3.16.5 Optimum Moisture and Laboratory Maximum Density

Tests shall be made for each type material or source of material including borrow material to determine the optimum moisture and laboratory maximum density values. One representative test per 5,000 cubic yards of fill and backfill, or when any change in material occurs which may affect the optimum moisture content or laboratory maximum density.

3.16.6 Tolerance Tests for Subgrades

Continuous checks on the degree of finish specified in paragraph SUBGRADE PREPARATION shall be made during construction of the subgrades.

3.16.7 Displacement of Sewers

After other required tests have been performed and the trench backfill compacted to 2 feet above the top of the pipe, the pipe shall be inspected to determine whether significant displacement has occurred. This inspection shall be conducted in the presence of the Contracting Officer. Pipe sizes larger than 36 inches shall be entered and examined, while smaller diameter pipe shall be inspected by shining a light or laser between manholes or manhole locations, or by the use of television cameras passed through the pipe. If, in the judgment of the Contracting Officer, the interior of the pipe shows poor alignment or any other defects that would cause improper functioning of the system, the defects shall be remedied as directed at no additional cost to the Government.

3.17 DISPOSITION OF SURPLUS MATERIAL

Surplus material or other soil material not required or suitable for filling or backfilling, and brush, refuse, stumps, roots, and timber shall be removed from Government property as directed by the Contracting Officer.

-- End of Section --

SECTION 02373

GEOTEXTILE

PART 1 GENERAL

1.1 REFERENCES

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

ASTM INTERNATIONAL (ASTM)

ASTM D 4354	(1999) Sampling of Geosynthetics for Testing
ASTM D 4355	(2002) Deterioration of Geotextiles from Exposure to Light, Moisture and Heat in a Xenon-Arc Type Apparatus
ASTM D 4491	(1999a) Water Permeability of Geotextiles by Permittivity
ASTM D 4533	(1991; R 1996) Trapezoid Tearing Strength of Geotextiles
ASTM D 4632	(1991; R 1996) Grab Breaking Load and Elongation of Geotextiles
ASTM D 4751	(1999a) Determining Apparent Opening Size of a Geotextile
ASTM D 4759	(2002) Determining the Specification Conformance of Geosynthetics
ASTM D 4833	(2000e1) Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products
ASTM D 4873	(2002) Identification, Storage, and Handling of Geosynthetic Rolls and Samples

1.2 DEFINITIONS

For the purpose of this specification, the following definitions apply.

1.2.1 Geotextile Fabric

Geotextile fabric is used to encapsulate aggregate drainage course and at other locations shown in the plans, except at base course removal and replacement locations, as defined.

1.2.2 Geotextile Fabric for Base Course Removal and Replacement

Geotextile fabric for base course removal and replacement is used in the

replacement of unstable base course at locations to be determined after the bituminous surface course on runway overruns and taxiway shoulders has been removed.

1.3 MEASUREMENT

1.3.1 Geotextile Fabric

Geotextile fabric, as defined in Paragraph 1.2 will not be measured for unit price payment.

1.3.2 Geotextile Fabric for Base Course Removal and Replacement

Measurement for geotextile fabric for base course removal and replacement shall be made at the as built surface area in square yards covered by geotextile or used to encapsulate undercut back fill stone. Allowance will be made for geotextile in anchor and/or drainage trenches but no allowance will be made for waste, overlaps, damaged materials, repairs, or materials used for the convenience of the Contractor.

1.4 PAYMENT

1.4.1 Geotextile Fabric

Geotextile fabric, as defined in Paragraph 1.2, will not be paid for a unit price. Payment is to be included in the Job Base Bid.

1.4.2 Geotextile Fabric for Base Course Removal and Replacement

Geotextile fabric for base course removal and replacement, as defined in Paragraph 1.2, installed and accepted will be paid for at the respective contract unit price in the bidding schedule. This unit price shall include the cost of materials, equipment, installation, testing, and other costs associated with placement of the geotextile.

1.5 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Manufacturing Quality Control Sampling and Testing

A minimum of 15 days prior to scheduled use, manufacturer's quality control manual.

SD-04 Samples

Quality Assurance Samples and Tests

Samples for quality assurance testing; 15 days shall be allotted in the schedule to allow for testing.

SD-06 Test Reports

Geotextile fabric for base course removal and replacement; G, RO

Prior to base course removal and replacement, Contractor shall determine the repair limits and determine amount of geotextile fabric to be allowed until geotextile quantity is approved.

SD-07 Certificates

Geotextile

A minimum of 15 days prior to scheduled use, manufacturer's certificate of compliance stating that the geotextile meets the requirements of this section. For needle punched geotextiles, the manufacturer shall also certify that the geotextile has been continuously inspected using permanent on-line full-width metal detectors and does not contain any needles which could damage other geosynthetic layers. The certificate of compliance shall be attested to by a person having legal authority to bind the geotextile manufacturer.

1.6 DELIVERY, STORAGE AND HANDLING

Delivery, storage, and handling of geotextile shall be in accordance with ASTM D 4873.

1.6.1 Delivery

The Contracting Officer shall be notified a minimum of 24 hours prior to delivery and unloading of geotextile rolls. Rolls shall be packaged in an opaque, waterproof, protective plastic wrapping. The plastic wrapping shall not be removed until deployment. If quality assurance samples are collected, rolls shall be immediately rewrapped with the plastic wrapping. Geotextile or plastic wrapping damaged during storage or handling shall be repaired or replaced, as directed. Each roll shall be labeled with the manufacturer's name, geotextile type, roll number, roll dimensions (length, width, gross weight), and date manufactured.

1.6.2 Storage

Rolls of geotextile shall be protected from construction equipment, chemicals, sparks and flames, temperatures in excess of 160 degrees F, or any other environmental condition that may damage the physical properties of the geotextile. To protect geotextile from becoming saturated, rolls shall either be elevated off the ground or placed on a sacrificial sheet of plastic in an area where water will not accumulate.

1.6.3 Handling

Geotextile rolls shall be handled and unloaded with load carrying straps, a fork lift with a stinger bar, or an axial bar assembly. Rolls shall not be dragged along the ground, lifted by one end, or dropped to the ground.

PART 2 PRODUCTS

2.1 RAW MATERIALS

2.1.1 Geotextile

Geotextile shall be a woven or nonwoven pervious sheet of polymeric material and shall consist of long-chain synthetic polymers composed of at least 95 percent by weight polyolefins, polyesters, or polyamides. The use of woven slit film geotextiles (i.e. geotextiles made from yarns of a flat, tape-like character) will not be allowed. Stabilizers and/or inhibitors shall be added to the base polymer, as needed, to make the filaments resistant to deterioration by ultraviolet light, oxidation, and heat exposure. Re grind material, which consists of edge trimmings and other scraps that have never reached the consumer, may be used to produce the geotextile. Post-consumer recycled material may also be used. Geotextile shall be formed into a network such that the filaments or yarns retain dimensional stability relative to each other, including the edges. Geotextiles shall meet the requirements specified in Table 1. Where applicable, Table 1 property values represent minimum average roll values (MARV) in the weakest principal direction. Values for AOS represent maximum average roll values.

TABLE 1
MINIMUM PHYSICAL REQUIREMENTS FOR DRAINAGE GEOTEXTILE

PROPERTY	UNITS	ACCEPTABLE VALUES	TEST METHOD
GRAB STRENGTH	LBS	200	ASTM D 4632
PUNCTURE	LBS	75	ASTM D 4833
TRAPEZOID TEAR	LBS	75	ASTM D 4533
APPARENT OPENING SIZE	U.S. SIEVE	70-100	ASTM D 4751
PERMITTIVITY	SEC -1	0.2	ASTM D 4491
ULTRAVIOLET DEGRADATION	PERCENT	50 AT 500 HRS	ASTM D 4355

2.2 MANUFACTURING QUALITY CONTROL SAMPLING AND TESTING

The Manufacturer shall be responsible for establishing and maintaining a quality control program to assure compliance with the requirements of the specification. Documentation describing the quality control program shall be made available upon request. Manufacturing quality control sampling and testing shall be performed in accordance with the manufacturer's approved quality control manual. As a minimum, geotextiles shall be randomly sampled for testing in accordance with ASTM D 4354, Procedure A. Acceptance of geotextile shall be in accordance with ASTM D 4759. Tests not meeting the specified requirements shall result in the rejection of applicable rolls.

PART 3 EXECUTION

3.1 QUALITY ASSURANCE SAMPLES AND TESTS

3.1.1 Quality Assurance Samples

The Contractor shall provide assistance to the Contracting Officer in the collection of quality assurance samples. Samples shall be collected upon delivery to the site for quality assurance testing at the request of the Contracting Officer. . Samples shall be identified with a waterproof marker by manufacturer's name, product identification, lot number, roll number, and machine direction. The date and a unique sample number shall also be noted on the sample. The outer layer of the geotextile roll shall be discarded prior to sampling a roll. Samples shall then be collected by cutting the full-width of the geotextile sheet a minimum of 3 feet long in the machine direction. Rolls which are sampled shall be immediately resealed in their protective covering.

3.1.2 Quality Assurance Tests

The Contractor shall provide quality assurance samples to an Independent Laboratory. Samples will be tested to verify that geotextile meets the requirements specified in Table 1. Test method ASTM D 4355 shall not be performed on the collected samples. Geotextile product acceptance shall be based on ASTM D 4759. Tests not meeting the specified requirements shall result in the rejection of applicable rolls.

3.2 INSTALLATION

3.2.1 Subgrade Preparation

The surface underlying the geotextile shall be smooth and free of ruts or protrusions which could damage the geotextile. Subgrade materials and compaction requirements shall be in accordance with Section 02300.

3.2.2 Placement

The Contractor shall notify the Contracting Officer a minimum of 24 hours prior to installation of geotextile. Geotextile rolls which are damaged or contain imperfections shall be repaired or replaced as directed. The geotextile shall be laid flat and smooth so that it is in direct contact with the subgrade. The geotextile shall also be free of tensile stresses, folds, and wrinkles. On slopes steeper than 10 horizontal on 1 vertical, the geotextile shall be laid with the machine direction of the fabric parallel to the slope direction.

3.3 SEAMS

3.3.1 Overlap Seams

Geotextile panels shall be continuously overlapped a minimum of 24 inches at all longitudinal and transverse joints. Where seams must be oriented across the slope, the upper panel shall be lapped over the lower panel.

3.4 PROTECTION

The geotextile shall be protected during installation from clogging, tears, and other damage. Damaged geotextile shall be repaired or replaced as

directed. Adequate ballast (e.g., sand bags) shall be used to prevent uplift by wind. The geotextile shall not be left uncovered for more than 14 days after installation.

3.5 REPAIRS

Torn or damaged geotextile shall be repaired. Clogged areas of geotextile shall be removed. Repairs shall be performed by placing a patch of the same type of geotextile over the damaged area. The patch shall extend a minimum of 12 inches beyond the edge of the damaged area. Patches shall be continuously fastened using approved methods. The machine direction of the patch shall be aligned with the machine direction of the geotextile being repaired. Geotextile rolls which cannot be repaired shall be removed and replaced. Repairs shall be performed at no additional cost to the Government

3.6 PENETRATIONS

Engineered penetrations of the geotextile shall be constructed by methods recommended by the geotextile manufacturer.

3.7 COVERING

Geotextile shall not be covered prior to inspection and approval by the Contracting Officer. Cover soil shall be placed in a manner that prevents soil from entering the geotextile overlap zone, prevents tensile stress from being mobilized in the geotextile, and prevents wrinkles from folding over onto themselves. On side slopes, soil backfill shall be placed from the bottom of the slope upward. Cover soil shall not be dropped onto the geotextile from a height greater than 3 feet. No equipment shall be operated directly on top of the geotextile without approval of the Contracting Officer. Equipment with ground pressures less than 7 psi shall be used to place the first lift over the geotextile. A minimum of 12 inches of soil shall be maintained between full-scale construction equipment and the geotextile. Cover soil material type, compaction, and testing requirements are described in Section 02300. Equipment placing cover soil shall not stop abruptly, make sharp turns, spin their wheels, or travel at speeds exceeding 5 mph.

-- End of Section --

SECTION 02575

PAVEMENT REMOVAL

PART 1 GENERAL

1.1 SUMMARY

This section covers removal of existing concrete pavement and bituminous pavement, complete.

1.2 REFERENCES (NOT APPLICABLE)

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Work Plan; G, RO

The Contractor shall furnish the proposed method for pavement removal and disposal.

SD-06 Test Reports

Base Course Excavation and Replacement Locations; G, RO

Prior to replacement of Base Course, Contractor shall mark out replacement locations, and tabulate area and summarize quantity. Base Course Excavation and Replacement shall not be allowed until all Base Course Excavation and Replacement locations have been approved.

1.4 EQUIPMENT

1.4.1 Sawing Equipment

1.4.1.1 Diamond Blade Saws

Equipment for sawing the perimeter of PCC concrete prior to removal shall be standard diamond-type concrete saws mounted on a wheeled chassis which can be easily guided to follow the required alignment. Blades shall be diamond tipped. If demonstrated to operate properly, abrasive blades may be used. Provide spares as required to maintain the required sawing rate. All saws shall be capable of sawing to the full depth required.

1.4.1.2 Wheel Saws

Equipment for making a parallel cut 24 inches from the perimeter of PCC concrete prior to removal shall be large diameter tungsten carbide tipped blades mounted on a heavy-duty chassis which will produce a saw kerf at least 1-1/2 inch wide. All saws shall be capable of sawing to the full depth required.

1.4.2 Milling Equipment

Equipment for milling the bituminous pavement shall be self-propelled rotomilling equipment with tungsten carbide tipped teeth. The equipment shall be capable of milling the pavement to the desired depth without damaging the pavement that is to remain.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION

3.1 GENERAL

When it is necessary to remove existing pavement and leave adjacent pavement in place, the Contractor's removal operation shall not cause damage to the adjacent or existing pavement. Any damage shall be repaired by the Contractor at no expense to the Government. Any existing pavement that is to remain that is damaged by the Contractor's actions, shall be removed and replaced (in accordance with the requirements of these specifications) at no additional cost to the Government.

3.2 WORK PLAN

The Contractor shall provide a plan documenting the proposed equipment, methods and sequence for pavement removal prior to commencing any removal activities.

3.3 REMOVAL OF BITUMINOUS PAVEMENT

3.3.1 Bituminous Pavement Removal

Where Bituminous Pavement Removal is shown in the plans, the existing pavement shall be completely removed, as necessary for construction of new pavement, transitional areas, and for other construction operations requiring pavement removal. Bituminous Pavement Removal shall include removal of bituminous concrete, aggregate base and subbase course and buried bituminous concrete to the depth shown in the plans, but not less than to a depth 4-inches below the new finished grade. All material shall be thoroughly removed.

3.3.1.1 Perimeter Saw Cut

When the existing bituminous pavement is to be removed and the adjacent bituminous pavement is to be left in place, the perimeter of the bituminous pavement to be removed shall be saw cut with a diamond blade saw prior to removal. Saw cuts shall be perpendicular to the pavement surface. Saw cut shall extend full depth of the bituminous concrete to be removed.

3.3.1.2 Removal and Disposal

Removal of the bituminous pavement shall be by approved methods. Any

damage occurring to surfaces or pavements to remain, due to the Contractor's operations shall be repaired as directed at the expense of the Contractor. Removed materials shall be disposed of off Government property.

3.3.1.3 Repair of Subbase

The Contractor shall take care to protect the subbase of adjacent pavement to remain. Subbase of adjacent pavement that sloughs out or otherwise removed, shall be repaired by the Contractor at no cost to the contract.

3.3.2 Bituminous Surface Removal

Where Bituminous Surface Removal, including Remove and Replace 2-inch Bituminous Surface and Remove Surface Treatment, is shown in the plans, the existing bituminous surface shall be removed for placement of new bituminous concrete. Bituminous Surface Removal shall include removal of bituminous concrete and aggregate base course to a depth of 2-inches below finished grade elevations. Where a P.C concrete duct is encountered, remove the top 2-inches of the P.C. concrete duct. All material shall be thoroughly removed.

3.3.2.1 Perimeter Saw Cut

When the existing bituminous pavement is to be removed and the adjacent bituminous pavement is to be left in place, the perimeter of the bituminous pavement to be removed shall be saw cut with a diamond blade saw prior to removal. Saw cuts shall be perpendicular to the pavement surface. Saw cut shall extend full depth of the bituminous concrete to be removed.

3.3.2.2 Removal and Disposal

Removal of the bituminous pavement shall be by rotomilling equipment. The milling equipment shall remove the existing bituminous material to smooth lines as detailed in the plans. Any damage occurring to surfaces or pavements to remain, due to the Contractor's operations shall be repaired as directed at the expense of the Contractor. Removed materials shall be disposed of off Government property.

3.3.2.3 Repair of Aggregate Base Course

The exposed aggregate base course shall be proofed rolled. Any soft and yielding areas found during the proof rolling operations shall be marked with paint. If directed by the Contracting Officer, the Contractor will replace the base course as specified in Paragraph: REPAIR OF UNDERLYING MATERIAL.

3.4 EXISTING PORTLAND CEMENT CONCRETE PAVEMENT REMOVAL AND REPAIR

3.4.1 Remaining Pavement Inventory

Where PCC Pavement Removal, including Bituminous Overlaid PCC Pavement Removal, is shown in the plans, the existing PCC concrete shall be thoroughly removed. Prior to commencing pavement removal operations, the Contractor shall inventory the pavement distresses (cracks, spalls, and corner breaks) along the pavement edge to remain. After pavement removal, the remaining edge shall again be surveyed to quantify any damage caused by Contractor's removal operations. Both surveys shall be performed by the Contractor, in the presence of the Contracting Officer. Repairs shall be made as indicated and as specified herein. All operations shall be

carefully controlled to prevent damage to the concrete pavement and to the underlying material to remain in place. All saw cuts shall be made perpendicular to the slab surface, forming rectangular areas.

3.4.2 Removal of Existing Pavement Slab

When existing concrete pavement is to be removed and adjacent concrete is to be left in place, the perimeter of the removal limits shall first be cut full depth with a standard diamond-type concrete saw. To the extent practical, the first saw cut shall be through an existing joint. In fillet reduction locations, the first saw cut is through the an existing joint or along the center axis of an existing panel. Next, a second full depth saw cut shall be made parallel to the joint at least 24 inches from the joint and at least 6 inches from the end of any dowels. This saw cut shall be made with a wheel saw as specified in paragraph: Wheel Saws. All pavement to be removed beyond the second saw cut shall be removed in accordance with the approved demolition work plan. All pavement between the second saw cut and the first saw cut line shall be removed by carefully pulling pieces and blocks away from the first saw cut face with suitable equipment and then picking them up for removal. In lieu of this method, this strip of concrete may be carefully broken up and removed using hand-held jackhammers, 30 lb or less, or other approved light-duty equipment which will not cause stress to propagate across the joint saw cut and cause distress in the pavement which is to remain in place. In lieu of the above specified removal method, the slab may be sawcut full depth to divide it into several pieces and each piece lifted out and removed. Suitable equipment shall be used to provide a truly vertical lift, and safe lifting devices used for attachment to the slab. Dowels of the size and spacing indicated shall be installed as shown on the drawings by epoxy resin bonding them in holes drilled in the joint face as specified in Section 02753.

3.4.3 Edge Repair

The edge of existing concrete pavement against which new pavement abuts shall be protected from damage at all times. Areas which are damaged during construction shall be removed and replaced as described below and as directed by the Contracting Officer at no cost to the Government. Repair of previously existing damage areas will be considered a subsidiary part of concrete pavement construction.

3.4.3.1 Spall Repair

Runway Pavement

Not more than 2.0 percent of each slab's edge shall be spalled as a result of the Contractor's actions. Slabs with edge spalls exceeding 2.0 percent of the slab's edge, regardless of spall size, shall be completely removed and replaced. Complete removal and replacement of a spalled slab shall be at no cost to the Government. For slab edges with spalls less than 2.0 percent of the slab's edge, repair each spall as directed. Repair materials and procedures shall be as specified in paragraph REPAIRING SPALLS ALONG JOINTS AND CRACKS of Section 02753.

Taxiway and Apron Pavement

Not more than 15.0 percent of each slab's edge shall be spalled as a result of the Contractor's actions. Slabs edge with spalls exceeding 15.0 percent of the slab's edge, regardless of spall size, shall be sawn full depth to

remove the slab's edge. For slab edges with spalls less than 15.0 percent of the slab's edge, repair each spall as directed. Repair materials and procedures shall be as specified in paragraph REPAIRING SPALLS ALONG JOINTS AND CRACKS of Section 02753.

3.4.3.2 Underbreak and Underlying Material

Underbreaks on Runway Pavement

Slabs with underbreak shall be completely removed and replaced. Replacement of the damaged slab shall be in accordance with paragraph: Removal and Replacement of Full Slabs of Section 02753 CONCRETE PAVEMENT FOR AIRFIELDS AND OTHER HEAVY DUTY PAVEMENTS.

Underbreaks on Taxiway and Apron Pavement

All underbreak shall be repaired by removal and repair of the damaged slabs shall be in accordance with paragraph: Removal and Replacement of Full Slabs of Section 02753 CONCRETE PAVEMENT FOR AIRFIELDS AND OTHER HEAVY DUTY PAVEMENTS.

Underlying Material

The underlying material adjacent to the edge of and under the existing pavement which is to remain in place shall be protected from damage or disturbance during removal operations and until placement of new concrete, and shall be shaped as shown on the drawings or as directed. Sufficient underlying material shall be kept in place outside the joint line to completely prevent disturbance of material under the pavement which is to remain in place. Any material under the portion of the concrete pavement to remain in place which is disturbed or loses its compaction shall be carefully removed and replaced with concrete.

3.5 REPAIR OF UNDERLYING MATERIAL

3.5.1 Base Course Excavation and Replacement

If upon completion of the Bituminous Surface Removal the existing aggregate base course is found to be unstable and yielding, the base course shall be removed in accordance with details in the plans and as specified herein. The locations of the Base Course Excavation and Replacement shall be designated by the Contracting Officer.

3.5.1.1 Base Course Excavation

The Contractor shall excavate to one foot below finished subgrade as needed to allow placement of the undercut backfill stone.

3.5.1.2 Geotextile

Prior to placing the undercut backfill stone, if directed by the Contracting Officer, the Contractor shall place Geotextile fabric on the subgrade in accordance with Section 02373 GEOTEXTILE.

3.5.1.3 Placement of Undercut Backfill Stone

The Contractor shall place aggregate meeting the requirements of Section 02716 AGGREGATE SEPARATION LAYER. The Contractor shall place undercut backfill stone at locations directed by the Contracting Officer using a

dump truck or other approved equipment capable of spreading the stone. Undercut backfill stone shall be placed in lifts not exceeding 12 inches in depth. The number of lifts shall be as directed by the Contracting Officer and shall not exceed two.

3.5.1.4 Compaction of Undercut Backfill Stone

The Contractor shall seat each lift of undercut backfill stone into the underlying material using tires or tracks of earth moving equipment. Seating operations shall push the stone into the underlying material to the satisfaction of the Contracting Officer. After seating operations are completed, the Contractor shall place additional undercut backfill stone material in accordance with Section 02716 over the backfill stone to finish elevations and compact as specified.

3.5.2 Bond Breaker Repair

Upon completion of PCC Pavement Removal, the surface of the existing bituminous bond breaker shall be repaired to provide a smooth surface for new unbonded PCC overlay.

3.5.2.1 Repair Method

- a. Depressions less than 1/2 inch below grade and less than 5 feet in diameter. Fill the depression with fine aggregate meeting the requirements of Section 02753 CONCRETE PAVEMENT FOR AIRFIELDS AND OTHER HEAVY-DUTY PAVEMENTS. Compact the fine aggregate with three passes of a steel wheel roller.
- b. Depression less than 1/2 inch below grade and greater than 5 feet in diameter. Grade the edges of the depression to form a 1/2 inch vertical to 2-inch horizontal transition.
- c. Depression greater than 1/2 inch but less than 1-1/2 inch. Either 1) mill the bond breaker surface to a depth of 1-1/2 inch and fill the depression with HMA meeting the requirements of Section 02749, in accordance with Section 02749; or 2) mill the bond breaker to a uniform depth and increase the new PC concrete pavement thickness accordingly; or 3) Fill the depression with bituminous sand mix in accordance with Section 02749.
- d. Depression greater than 1-1/2 inch. Fill the depression with HMA meeting the requirements of Section 02749, in accordance with Section 02749.

3.5.2.2 Curing Compound

The surface of the repaired bond breaker shall be sprayed with a double application of a membrane forming white pigmented curing compound meeting the requirements of Section 02753. Each application shall cure for a minimum of 24 hours prior to placement of the next application and placement of PCC pavement.

-- End of Section --

SECTION 02620A
 SUBDRAINAGE SYSTEM

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

- AASHTO M 252M (1996) Corrugated Polyethylene Drainage Tubing **
- AASHTO M 294 (2003) Corrugated Polyethylene Pipe, 300- to 1200-mm Diameter

ASTM INTERNATIONAL (ASTM)

- ASTM A 536 Standard Specification for Ductile Iron Castings
- ASTM C 231 (2003) Air Content of Freshly Mixed Concrete by the Pressure Method
- ASTM C 478 (2003) Precast Reinforced Concrete Manhole Sections
- ASTM D 1751 (1999) Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
- ASTM D 1752 (1984; R 1996e1) Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-04 Samples

- Filter Fabric; G, RO
- Pipe for Subdrains; G, RO

Samples of filter fabric, pipe, and pipe fittings, before

starting the work.

SD-07 Certificates

Filter Fabric; G, RO
Pipe for Subdrains; G, RO
Frame and Covers; RO

Certifications from the manufacturers attesting that materials meet specification requirements. Certificates are required for drain pipe, drain tile, fittings, and filter fabric. Certification on the ability of frame and cover to carry the imposed live load.

1.3 DELIVER, STORAGE, AND HANDLING

1.3.1 Delivery and Storage

Materials delivered to site shall be inspected for damage, unloaded, and stored with minimum handling. Materials shall not be stored directly on the ground. The inside of pipes and fittings shall be kept free of dirt and debris. During shipment and storage, filter fabric shall be wrapped in burlap or similar heavy duty protective covering. The storage area shall protect the fabric from mud, soil, dust, and debris. Filter fabric materials that are not to be installed immediately shall not be stored in direct sunlight. Plastic pipe shall be installed within 6 months from the date of manufacture unless otherwise approved.

1.3.2 Handling

Materials shall be handled in such a manner as to insure delivery to the trench in sound undamaged condition. Pipe shall be carried and not dragged to the trench.

PART 2 PRODUCTS

2.1 PIPE FOR SUBDRAINS

2.1.1 Plastic Pipe

Plastic pipe shall contain ultraviolet inhibitor to provide protection from exposure to direct sunlight.

2.1.1.1 Corrugated Polyethylene (PE) Pipe and Fittings

Use AASHTO M 252M for pipes 3 to 10 inches, AASHTO M 294 for pipes 12 to 24 inches in diameter. Fittings shall be manufacturer's standard type and shall conform to the indicated specification.

2.1.1.2 Pipe Perforations

Water inlet area shall be a minimum of 0.5 square inch per linear foot. Manufacturer's standard perforated pipe which essentially meets these requirements may be substituted with prior approval of the Contracting Officer.

- a. Circular Perforations in Plastic Pipe: Circular holes shall be cleanly cut not more than 3/8 inch or less than 3/16 inch in diameter and arranged in rows parallel to the longitudinal axis of

the pipe. Perforations shall be approximately 3 inches center-to-center along rows. The rows shall be approximately 1-1/2 inches apart and arranged in a staggered pattern so that all perforations lie at the midpoint between perforations in adjacent rows. The rows shall be spaced over not more than 155 degrees of circumference. The spigot or tongue end of the pipe shall not be perforated for a length equal to the depth of the socket, and perforations shall continue at uniform spacing over the entire length of the pipe.

- b. Slotted Perforations in Plastic Pipe: Circumferential slots shall be cleanly cut so as not to restrict the inflow of water and uniformly spaced along the length and circumference of the tubing. Width of slots shall not exceed 1/8 inch nor be less than 1/32 inch. The length of individual slots shall not exceed 1-1/4 inches on 3 inch diameter tubing, 10 percent of the tubing inside nominal circumference on 4 to 8 inch diameter tubing, and 2-1/2 inches on 10 inch diameter tubing. Rows of slots shall be symmetrically spaced so that they are fully contained in 2 quadrants of the pipe. Slots shall be centered in the valleys of the corrugations of profile wall pipe.

2.2 FILTER FABRIC

Filter fabric shall be a geotextile fabric, meeting the requirements of Geotextile, Section 02373.

2.3 DRAINAGE STRUCTURES

2.3.1 Concrete

Except for precast concrete, reinforcement shall conform to the requirements for 4,000 psi concrete in Section 03307A CONCRETE FOR MINOR STRUCTURES. The concrete mixtures shall have air content, by volume of concrete, based on measurements made immediately after discharge from the mixer of 5 to 7 percent when coarse-aggregate maximum size is 1-1/2 inches or smaller. Air content shall be determined in accordance with ASTM C 231.

The concrete covering over steel reinforcing shall be not less than 1 inch thick for covers and not less than 1-1/2 inches thick for walls and flooring. Concrete covering deposited directly against the ground shall be at least 3 inches thick between the steel and the ground. Expansion-joint filler material shall conform to ASTM D 1751 or ASTM D 1752.

2.3.2 Mortar

Mortar for pipe joints and connections to other drainage structures shall be composed of one part by volume of portland cement and two parts of sand. The quantity of water in the mixture shall be sufficient to produce a stiff workable mortar. Water shall be clean and free of injurious acids, alkalis, and organic impurities. The mortar shall be used within 30 minutes from the time the ingredients are mixed with water.

2.3.3 Manholes and Appurtenances

2.3.3.1 Precast Reinforced Concrete Manhole Risers and Tops

Precast reinforced concrete manhole risers and tops shall conform to ASTM C 478.

2.3.3.2 Precast Concrete Manhole Bases

If precast concrete manhole bases are used, the bases shall conform to ASTM C 478 and shall be of such a design as to effect suitable connection with influent and effluent lines and to provide a suitable base structure for riser sections.

2.3.3.3 Frames and Covers or Gratings

Frames and gratings, or frames and covers, except as otherwise permitted, shall be of either ductile iron with tensile strength test not less than ASTM A 536 . Weight, shape, and size shall be as indicated. Each casting, frame and cover shall be capable of withstanding a minimum working load of 100,000 PSI with a tire pressure of 250 PSI contact area. The minimum factor of safety shall be 2.5. Results of proof loads shall be submitted.

2.4 SUBDRAIN FILTER AND BEDDING MATERIAL

Subdrain filter and bedding material shall be washed sand, sand and gravel, crushed stone, crushed stone screenings, or slag composed of hard, tough, durable particles free from adherent coatings. Filter material shall not contain corrosive agents, organic matter, or soft, friable, thin, or elongated particles and shall be evenly graded between the limits specified in TABLE I. Gradation curves will exhibit no abrupt changes in slope denoting skip or gap grading. Filter materials shall be clean and free from soil and foreign materials. Filter blankets found to be dirty or otherwise contaminated shall be removed and replaced with material meeting the specific requirements, at no additional cost to the Government.

TABLE I. FILTER GRADATION

Sieve Designation	Percent by Weight Passing
1"	100
3/4"	90-100
1/2"	--
3/8"	31-65
#4	Max 20
#8	Max 8
#16	Max 5
#200	Max 1

PART 3 EXECUTION

3.1 EXCAVATION AND BEDDING FOR SUBDRAIN SYSTEMS

Trenching and excavation, including the removal of rock and unstable material, shall be in accordance with Section 02300 EARTHWORK. Bedding material shall be placed in the trench as indicated or as required as replacement materials used in those areas where unstable materials were removed. Compaction of the bedding material shall be as specified for cohesionless material in Section 02300 EARTHWORK.

3.2 MANHOLES AND FLUSHING AND OBSERVATION RISERS

3.2.1 Manholes

Manholes shall be installed complete with frames and covers or gratings at the locations and within the limits and sizes indicated. Manholes shall be constructed of one of the materials specified for manholes in paragraph DRAINAGE STRUCTURES. Joints shall be completely filled and shall be smooth and free of surplus mortar or mastic on the inside of the structure. Base for manholes shall be either precast or cast-in-place concrete.

3.2.2 Flushing and Observation Risers

Flushing and observation riser pipes with frames and covers shall be installed at the locations indicated. Risers shall be constructed of precast concrete. Joining of riser pipes to the subdrain system shall be as indicated.

3.3 INSTALLATION OF FILTER FABRIC AND PIPE FOR SUBDRAINS

3.3.1 Installation of Filter Fabric

3.3.1.1 Trench Lining and Overlaps

Trenches to be lined with filter fabric shall be graded to obtain smooth side and bottom surfaces so that the fabric will not bridge cavities in the soil or be damaged by projecting rock. The fabric shall be laid flat but not stretched on the soil, and it shall be secured with anchor pins. Overlaps shall be at least 12 inches, and anchor pins shall be used along the overlaps.

3.3.2 Installation of Pipe for Subdrains

3.3.2.1 Pipelaying

Each pipe shall be carefully inspected before it is laid. Any defective or damaged pipe shall be rejected. No pipe shall be laid when the trench conditions or weather is unsuitable for such work. Water shall be removed from trenches by sump pumping or other approved methods. The pipe shall be laid to the grades and alignment as indicated. The pipe shall be bedded to the established gradeline. Perforations shall be centered on the bottom of the pipe. Pipes of either the bell-and-spigot type or the tongue-and-groove type shall be laid with the bell or groove ends upstream. All pipes in place shall be approved before backfilling.

3.3.2.2 Jointings

- a. Perforated Corrugated Polyethylene Pipe: Perforated corrugated polyethylene drainage pipe shall be installed in accordance with the manufacturer's specifications and as specified herein. A pipe with physical imperfections shall not be installed. No more than 5 percent stretch in a section will be permitted.

3.4 INSTALLATION OF FILTER MATERIAL AND BACKFILLING FOR SUBDRAINS

After pipe for subdrains has been laid, inspected, and approved, filter material shall be placed around and over the pipe to the depth indicated. The filter material shall be placed in layers not to exceed 8 inches thick, and each layer shall be thoroughly compacted by mechanical tampers or rammers to obtain the required density. Compaction of filter material and the placement and compaction of overlying backfill material shall be in accordance with the applicable provisions specified in Section 02300 EARTHWORK.

3.5 TESTS

3.5.1 Pipe Test

Strength tests of pipe shall conform to field service test requirements of the Federal Specification, ASTM specification, or AASHTO specification covering the product (paragraph PIPE FOR SUBDRAINS).

3.6 CONNECTIONS

When the plans call for connections of subdrain pipe to existing or proposed pipe or structures, these connections shall be watertight and made so that a smooth uniform flow line will be obtained throughout the drainage system. Connection of the subdrain to existing or proposed concrete pipe and structures shall be as detailed in the plans and shall be accomplished by means of a compression-fit connection. The Contractor shall install the connection using procedures and equipment as referenced in manufactures written installation instructions. The connection shall be covered with a concrete collar.

-- End of Section --

SECTION 02714A

DRAINAGE LAYER

PART 1 GENERAL

1.1 REFERENCES

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

ASTM INTERNATIONAL (ASTM)

ASTM C 131	(2003) Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C 88	(1999a) Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM D 2487	(2000) Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 2922	(2001) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 3017	(2001) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
ASTM D 4791	(1999) Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate
ASTM D 75	(2003) Sampling Aggregates
ASTM E 548	(1994e1) General Criteria Used for Evaluating Laboratory Competence

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-06 Test Reports

Sampling and Testing; G, RO

Copies of field test results within 24 hours of completion of tests.

Approval of Materials; G, RO

Material sources and material test results prior to field use.

Evaluation; G, RO

Test section construction report.

1.3 SYSTEM DESCRIPTION

The Contractor shall build a drainage layer under the pavements as indicated on drawings and the drainage layer shall consist of Rapid Draining Material (RDM).

1.4 FIELD COMPACTION

Field compaction requirements shall be based on the results of a test section constructed by the Contractor, using the materials, methods, and equipment proposed for use in the work. The test section shall meet the requirements of paragraph TEST SECTION.

1.5 EQUIPMENT

1.5.1 General Requirements

All plant, equipment, and tools used in the performance of the work will be subject to approval before the work is started and shall be maintained in satisfactory working condition at all times.

1.5.2 Placement Equipment

An asphalt paving machine shall be used to place drainage layer material. Alternate methods may be used if it can be demonstrated in the test section that these methods obtain the specified results.

1.5.3 Compaction Equipment

A dual or single smooth 10 ton (min.) vibratory drum roller which provides a maximum compactive effort without crushing the drainage layer aggregate shall be used to compact drainage layer material.

1.6 WEATHER LIMITATION

Drainage layer material shall be placed when the atmospheric temperature is above 35 degrees F. Areas of completed drainage layer or underlying courses that are damaged by freezing, rainfall, or other weather conditions or by contamination from sediments, dust, dirt, or foreign material shall be corrected by the Contractor to meet specified requirements.

1.7 SAMPLING AND TESTING

1.7.1 General Requirements

Sampling and testing shall be the responsibility of the Contractor. Sampling and testing shall be performed by an approved commercial testing laboratory, or by the Contractor subject to approval. If the Contractor elects to establish testing facilities of his own, approval of such facilities shall be based on compliance with ASTM E 548, and no work requiring testing will be permitted until the Contractor's facilities have

been inspected and approved. The first inspection of the facilities will be at the expense of the Government and any subsequent inspections required because of failure of the first inspection shall be at the expense of the Contractor. Such costs will be deducted from the total amount due the Contractor. Drainage layer materials shall be tested to establish compliance with the specified requirements.

1.7.2 Sampling

Aggregate samples shall be taken in accordance with ASTM D 75.

1.7.3 Test Methods

1.7.3.1 Density Tests

Field density tests for RDM drainage layers shall be made in accordance with ASTM D 2922 by Direct Transmission Method for the full depth of the lift. When using this method, ASTM D 3017 shall be used to determine the moisture content of the aggregate drainage layer material. The calibration curves furnished with the moisture gauges shall be checked along with density calibration checks as described in ASTM D 3017. The calibration checks of both the density and moisture gauges shall be made by the prepared containers of material method, as described in paragraph "Calibration" of ASTM D 2922, on each different type of material being tested at the beginning of a job and at intervals as directed by the Contracting Officer.

1.7.3.2 Soundness Test

Soundness tests shall be made in accordance with ASTM C 88.

1.7.3.3 Los Angeles Abrasion Test

Los Angeles abrasion tests shall be made in accordance with ASTM C 131.

1.7.3.4 Flat or Elongated Particles Tests

Flat and/or elongated particles tests shall be made in accordance with ASTM D 4791.

1.7.3.5 Fractured Faces Tests

When aggregates are supplied from crushed gravel, approved test methods shall be used to assure the aggregate meets the requirements for fractured faces in paragraph AGGREGATES.

1.7.4 Initial Tests

One of each of the following tests shall be performed on the proposed material prior to commencing construction to demonstrate that the proposed material meets all specified requirements when furnished. If materials from more than one source are going to be utilized, this testing shall be completed for each source.

- a. Sieve Analysis including No. 200 size material.
- b. Flat and/or elongated particles
- c. Fractured Faces

d. Los Angeles abrasion.

e. Soundness.

1.7.5 Testing Frequency

1.7.6 Approval of Materials

1.7.6.1 Aggregate

The aggregate source shall be selected at least 30 days prior to field use in the test section. Tentative approval of the source will be based on certified test results to verify that materials proposed for use meet the contract requirements. Final approval of both the source and the material will be based on test section performance and tests for gradation, soundness, Los Angeles abrasion, flat and/or elongated particles tests and fractured faces tests. For aggregate drainage layer materials, these tests shall be performed on samples taken from the completed and compacted drainage layer course within the test section.

PART 2 PRODUCTS

2.1 AGGREGATES

Aggregates shall consist of clean, sound, hard, durable, angular particles of crushed stone, crushed gravel or crushed recycled concrete which meet the specification requirements. . The aggregates shall be free of silt and clay as defined by ASTM D 2487, vegetable matter, and other objectionable materials or coatings.

a. Crushed Recycle Concrete: Crushed recycled concrete shall consist of previously hardened portland cement concrete or other concrete containing pozzolanic binder material. The recycled material shall be free of all reinforcing steel, bituminous concrete surfacing, and any other foreign material and shall be crushed and processed to meet the required gradations for coarse aggregate. Crushed recycled concrete shall meet all other applicable requirements specified below.

2.1.1 Aggregate Quality

The aggregate shall have a soundness loss not greater than 18 percent weighted averaged at 5 cycles when tested in magnesium sulfate in accordance with ASTM C 88. The aggregate shall have a percentage of loss on abrasion not to exceed 40 after 500 revolutions as determined by ASTM C 131. The percentage of flat and/or elongated particles shall be determined by ASTM D 4791 with the following modifications. The aggregates shall be separated into 2 size fractions. Particles greater than 1/2 inch sieve and particles passing the 1/2 inch sieve and retained on the No. 4 sieve. The percentage of flat and/or elongated particles in either fraction shall not exceed 20. A flat particle is one having a ratio of width to thickness greater than 3; an elongated particle is one having a ratio of length to width greater than 3. When the aggregate is supplied from more than one source, aggregate from each source shall meet the specified requirements. When the aggregate is supplied from crushed gravel it shall be manufactured from gravel particles, 90 percent of which by weight are retained on the maximum-size sieve listed in TABLE I. In the portion retained on each sieve specified, the crushed gravel shall contain at least 75 percent by

weight of crushed pieces having two or more freshly fractured faces with the area of each face being at least equal to 75 percent of the smallest midsectional area of the face. When two fractures are contiguous, the angle between planes of the fractures must be at least 30 degrees in order to count as 2 fractured faces.

2.1.2 Recycling PCC Pavement

Existing PCC pavement may be crushed and reused as Drainage Layer provided the crushed material and the native soils/groundwater meet all of the following requirements.

- a. Crushed material must meet specified gradation requirements for the intended use.
- b. Crushed material must meet the quality requirements for the intended use. Quality includes meeting specification requirements for sulfate soundness, Abrasion loss, flat and/or elongated particles.
- c. Recycled concrete aggregates proposed for use shall be evaluated and tested by the Contractor for alkali-aggregate reactivity in accordance with ASTM C 1260. Test results shall have a measured expansion equal to or less than 0.08 percent at 16 days after casting. Should the test data indicate an expansion greater than 0.08 percent, the recycled concrete aggregate shall be rejected.
- d. Subgrade soils must be tested in accordance with CRD-C 403 "Method for Determination of Sulfate Ion in Soils and Water" to determine the presence of sulfates. Subgrade soils must have sulfate concentrations below 0.05% (by weight) to allow use of recycled concrete as a project material.
- e. Groundwater collected from borings within the project site must be tested in accordance with ASTM D 516 "Standard Test Method for Sulfate Ion in Water" to determine the presence of sulfates. Groundwater must have a sulfate concentration below 75 ppm to allow use of recycled concrete as a project material.

2.1.3 Gradation Requirements

Drainage layer aggregates shall be well graded within the limits specified in TABLE I.

TABLE I. GRADATION OF DRAINAGE LAYER MATERIAL

Percentage by Weight Passing Square-Mesh Sieve

Sieve Designation	Rapid draining Material (RDM)
1-1/2 inch	100
1 inch	70-100
3/4 inch	55-100
1/2 inch	40-80
3/8 inch	30-65
No. 4	10-50
No. 8	0-25
No. 16	0-5

NOTE 1: The values are based on aggregates of uniform specific gravity,

and the percentages passing the various sieves may require appropriate correction by the Contracting Officer when aggregates of varying specific gravities are used.

NOTE 3: For RDM, the coefficient of uniformity (CU) shall be greater than 3.5. (CU = D60/D10). The contractor is responsible for adjusting the RDM gradation within the ranges listed in Table I to provide a stable construction surface for the proposed equipment and method of transporting materials or the drainage layer can be stabilized with portland cement or asphalt at no additional cost to the government, if approved during the test section.

PART 3 EXECUTION

3.1 STOCKPILING AGGREGATES

Aggregates shall be stockpiled at locations designated by the Contracting Officer. Stockpile areas shall be cleared and leveled prior to stockpiling aggregates. Aggregates shall be stockpiled to prevent segregation and contamination. Aggregates obtained from different sources shall be stockpiled separately.

3.2 TEST SECTION

3.2.1 Data

A test section shall be constructed to evaluate the ability to carry traffic, including placement of overlaying material and the constructability of the drainage layer including required mixing, placement, and compaction procedures. Test section data will be used by the Contracting Officer to validate the required number of compaction passes given in paragraph Compaction Requirements and the field dry density requirements for full scale production.

3.2.2 Scheduling

The test section shall be constructed a minimum of 15 days prior to the start of full scale production to provide sufficient time for an evaluation of the proposed materials, equipment and procedures including Government QA testing.

3.2.3 Location and Size

The test section shall be placed outside production paving limits in an area with similar subgrade and subbase conditions approved by the Contracting Officer. The underlying courses and subgrade preparation, required for the pavement section, shall be completed, inspected and approved in the test section prior to constructing the drainage layer. The test section shall be a minimum of 100 feet long and two full paving lanes wide side by side.

3.2.4 Initial Testing

Certified test results, to verify that the materials proposed for use in the test section meet the contract requirements, shall be provided by the Contractor and approved by the Contracting Officer prior to the start of

the test section.

3.2.5 Mixing, Placement, and Compaction

Mixing, placement, and compaction shall be accomplished using equipment meeting the requirements of paragraph EQUIPMENT. Compaction equipment speed shall be no greater than 1.5 miles per hour. Compaction shall start from the outside edges of the paving lane and proceed to the centerline of the lift being placed. The roller shall stay a minimum of one half the roller width from the outside edge of the drainage layer being placed until the desired density is obtained. The outside edge shall then be rolled.

3.2.6 Procedure

3.2.6.1 RDM Aggregate Drainage Layer Tests

The test section shall be constructed with aggregate in a wet state so as to establish a correlation between number of roller passes and dry density achievable during field production. Three separate areas within the test section shall be designated, each area shall be tested for density, moisture, and gradation. All testing shall be completed in the middle third of the test section being placed. Density and moisture content tests shall be conducted in accordance with ASTM D 2922 and ASTM D 3017. Sieve analysis tests shall be conducted on samples, taken adjacent to the density test locations. One set of tests (i.e. density, moisture, and sieve analysis) shall be taken before the third compaction pass and after each subsequent compaction pass at three separate locations as directed by the Contracting Officer. A pass shall be considered the movement of a roller over the drainage layer area for one direction only. Compaction for the RDM shall consist of a maximum of 5 passes in the vibrating state and one final pass in the static state. Compaction passes and density readings shall continue until the difference between the average dry densities of any two consecutive passes is less than or equal to 1.0 pcf.

3.2.7 Evaluation

Within 10 days of completion of the test section, the Contractor shall submit to the Contracting Officer a Test Section Construction Report complete with all required test data and correlations. The Contracting Officer will evaluate the data and validate the required number of passes of the roller, the need for a final static pass of the roller, and provide the dry density for field density control during construction.

3.3 PREPARATION OF UNDERLYING COURSE

Prior to constructing the drainage layer, the underlying course shall be cleaned of all foreign materials. During construction, the underlying course shall contain no frozen material. The underlying course shall conform to Section 02716 AGGREGATE SEPARATION LAYER. Ruts or soft yielding spots in the underlying courses having inadequate compaction and deviations of the surface from the requirements set forth herein shall be corrected by loosening and removing soft or unsatisfactory material and by adding approved material, reshaping to line, and grade, and recompacting to specified density. The finished underlying course shall not be disturbed by traffic or other operations and shall be maintained by the Contractor in a satisfactory condition until the drainage layer is placed.

3.4 TRANSPORTING MATERIAL

3.4.1 Aggregate Drainage Layer Material

Aggregate drainage layer material shall be transported to the site in a manner which prevents segregation and contamination of materials.

3.5 PLACING

3.5.1 General Requisites

Drainage layer material shall be placed on the underlying course in lifts of uniform thickness using equipment meeting the requirements of paragraph EQUIPMENT. When a compacted layer 6 inches or less in thickness is required, the material shall be placed in a single lift. When a compacted layer in excess of 6 inches is required, the material shall be placed in lifts of equal thickness. No lift shall exceed 6 inches or be less than 3 inches when compacted. The lifts when compacted after placement shall be true to the grades or levels required with the least possible surface disturbance. Where the drainage layer is placed in more than one lift, the previously constructed lift shall be cleaned of loose and foreign material.

Such adjustments in placing procedures or equipment shall be made to obtain true grades and minimize segregation and degradation of the drainage layer material.

3.5.2 Hand Spreading

In areas where machine spreading is impractical, drainage layer material shall be spread by hand. The material shall be spread uniformly in a loose layer to prevent segregation. The material shall conform to the required grade and thickness after compaction.

3.6 COMPACTION REQUIREMENTS

Compaction shall be accomplished using rollers meeting the requirements of paragraph EQUIPMENT and operating at a rolling speed of no greater than 1.5 miles per hour. Each lift of drainage material, including shoulders when specified under the shoulders, shall be compacted with the number of passes of the roller as follows: RDM material shall use 4 passes in the vibratory state and one in the static. The Contracting Officer will validate the number of roller passes after the test section is evaluated and before production starts. In addition, a minimum field dry density, as specified by the Contracting Officer, shall be maintained. If the required field dry density is not obtained, the number of roller passes shall be adjusted in accordance with paragraph DEFICIENCIES. Aggregate shall be compacted in a moisture state as determined in the test section. Excessive rolling resulting in crushing of aggregate particles shall be avoided. In all places not accessible to the rollers, the drainage layer material shall be compacted with mechanical hand operated tampers.

3.7 FINISHING

The top surface of the drainage layer shall be finished after final compaction as determined from the test section. Adjustments in rolling and finishing procedures shall be made to obtain grades and minimize segregation and degradation of the drainage layer material.

3.8 EDGES OF DRAINAGE LAYER

Shoulder material shall be placed along the edges of the drainage layer course in a quantity that will compact to the thickness of the layer being constructed. At least 3 feet width of the shoulder shall be rolled and compacted simultaneously with the rolling and compacting of each lift of the drainage layer.

3.9 SMOOTHNESS TEST

The surface of the top lift shall not deviate more than 3/8 inch when tested with either a 10 or 12 foot straightedge applied parallel with and at right angles to the centerline of the area to be paved. Deviations exceeding 3/8 inch shall be corrected in accordance with paragraph DEFICIENCIES.

3.10 THICKNESS CONTROL

The completed thickness of the drainage layer shall be within 1/2 inch of the thickness indicated. Thickness shall be measured at intervals providing at least one measurement for each 500 square yards of drainage layer. Measurements shall be made in test holes at least 3 inches in diameter unless the contractor can demonstrate, for COR approval, that a steel rod pushed through the drainage layer clearly stops at the material interface. Where the measured thickness is more than 1/2 inch deficient, such areas shall be corrected in accordance with paragraph DEFICIENCIES. Where the measured thickness is 1/2 inch more than indicated, it will be considered as conforming to the requirements plus 1/2 inch, provided the surface of the drainage layer is within 1/2 inch of established grade. The average job thickness shall be the average of all job measurements as specified above but within 1/4 inch of the thickness shown on the drawings.

3.11 DEFICIENCIES

3.11.1 Grade and Thickness

Deficiencies in grade and thickness shall be corrected so that both grade and thickness tolerances are met. Thin layers of material shall not be added to the top surface of the drainage layer to meet grade or increase thickness. If the elevation of the top of the drainage layer is more than 1/2 inch above the plan grade it shall be trimmed to grade and finished in accordance with paragraph FINISHING. If the elevation of the top surface of the drainage layer is 1/2 inch or more below the required grade, the surface of the drainage layer shall be scarified to a depth of at least 3 inches, new material shall be added, and the layer shall be blended and recompacted to bring it to grade. Where the measured thickness of the drainage layer is more than 1/2 inch deficient, such areas shall be corrected by excavating to the required depth and replaced with new material to obtain a compacted lift thickness of at least 3 inches. The depth of required excavation shall be controlled to keep the final surface elevation within grade requirements and to preserve layer thicknesses of materials below the drainage layer.

3.11.2 Density

Density shall be considered deficient if the field dry density test results are below the dry density specified by the Contracting Officer. If the densities are deficient, the layer shall be rolled with 2 additional passes of the specified roller. If the dry density is still deficient, work will

be stopped until the cause of the low dry densities can be determined and reported to the Contracting Officer.

3.11.3 Smoothness

Deficiencies in smoothness shall be corrected as if they are deficiencies in grade or thickness. All tolerances for grade and thickness shall be maintained while correcting smoothness deficiencies.

-- End of Section --

SECTION 02715

WORKING PLATFORM

PART 1 GENERAL

1.1 REFERENCES

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

ASTM INTERNATIONAL (ASTM)

ASTM C 136	(2001) Sieve Analysis of Fine and Coarse Aggregates
ASTM C 25	(1999) Chemical Analysis of Limestone, Quicklime, and Hydrated Lime
ASTM C 50	(2000) Sampling, Sample Preparation, Packaging, and Marking of Lime and Limestone Products
ASTM C 618	Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete
ASTM D 1556	(2000) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 1557	(2002) Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/cu. ft. (2,700 kN-m/cu.m.))
ASTM D 2167	(1994; R 2001) Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D 2922	(2001) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 3017	(2001) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
ASTM D 422	(1963; R 2002) Particle-Size Analysis of Soils
ASTM D 4318	(2000) Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D 75	(2003) Sampling Aggregates
ASTM E 11	(2001) Wire Cloth and Sieves for Testing Purposes

1.2 DEFINITIONS

1.2.1 Lime-Treated Course

Lime-stabilized course, as used in this specification, is a mixture of lime and in-place or select borrow material uniformly blended, wetted, and thoroughly compacted to produce a pavement course which meets the criteria set forth in the plans and this specification.

1.2.2 Fly Ash Treated Course

Fly ash stabilized course, as used in this specification, is a mixture of fly ash and in-place or select borrow material uniformly blended, wetted, and thoroughly compacted to produce a pavement course which meets the criteria set forth in the plans and this specification.

1.2.3 Degree of Compaction

Degree of compaction required is expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D 1557 abbreviated as percent laboratory maximum density.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Plant, Equipment, Machines, and Tools; G, RO
Mix Design; G, RO

List of proposed equipment to be used in performance of construction work including descriptive data. Mix design at least 14 days before it is to be used.

Waybills and Delivery Tickets; G, RO

Copies of waybills and delivery tickets during the progress of the work. Certified waybills and delivery tickets for all materials actually used.

SD-06 Test Reports

Sampling and Testing; G, RO
Field Density; G, RO

Calibration curves and related test results prior to using the device or equipment being calibrated. Copies of field test results within 24 hours after the tests are performed. Certified copies of test results of materials and sources not less than 30 days before material is required for the work.

1.4 WAYBILLS AND DELIVERY TICKETS

Copies of waybills or delivery tickets shall be submitted during the progress of the work. Before the final payment is allowed waybills and certified delivery tickets shall be furnished for all lime and fly ash used in the construction.

1.5 JOB DESCRIPTION

The work specified consists of the construction of a lime or fly ash treated subgrade course. The work shall be performed in accordance with this specification and shall conform to the lines, grades, notes, and typical sections shown in the drawings. Sources of materials shall be selected well in advance of the time when materials will be required in the work.

1.6 STOCKPILING MATERIALS

Select material, including approved material available from excavation and grading, shall be stockpiled in the manner and at the locations designated. Before stockpiling material, storage sites shall be cleared and sloped to drain. Materials obtained from different sources shall be stockpiled separately.

1.7 PLANT, EQUIPMENT, MACHINES, AND TOOLS

1.7.1 General Requisites

Plant, equipment, machines, and tools used in the work shall be subject to approval and shall be maintained in satisfactory working condition at all times. Other compacting equipment may be used in lieu of that specified, where it can be demonstrated that the results are equivalent. Protective equipment, apparel, and barriers shall be provided to protect the eyes, respiratory system, and the skin of workers exposed to contact with lime dust or slurry.

1.7.2 Steel-Wheeled Rollers

Steel-wheeled rollers shall be the self-propelled type with a total weight of not less than 10 tons, and a minimum weight of 300 pounds per inch width of rear wheel. Wheels of the rollers shall be equipped with adjustable scrapers. The use of vibratory rollers is optional.

1.7.3 Pneumatic-Tired Rollers

Pneumatic-tired rollers shall have 4 or more tires, each loaded to a minimum of 30,000 pounds and inflated to a minimum pressure of 150 psi. The loading shall be equally distributed to all wheels, and the tires shall be uniformly inflated. Towing equipment shall also be pneumatic-tired.

1.7.4 Mechanical Spreader

Mechanical spreader shall be self-propelled or attached to a propelling unit capable of moving the spreader and material truck. The device shall be steerable and shall have variable speeds forward and reverse. The spreader and propelling unit shall be carried on tracks, rubber tires, or drum-type steel rollers that will not disturb the underlying material. The spreader shall contain a hopper, an adjustable screed, and outboard bumper rolls; and shall be designed to have a uniform, steady flow of material

from the hopper. The spreader shall be capable of laying material without segregation across the full width of the lane to a uniform thickness and to a uniform loose density so that when compacted, the layer or layers shall conform to thickness and grade requirements indicated. The Contracting Officer may require a demonstration of the spreader prior to approving use in performance of the work.

1.7.5 Sprinkling Equipment

Sprinkling equipment shall consist of tank trucks, pressure distributors, or other approved equipment designed to apply controlled quantities of water uniformly over variable widths of surface.

1.7.6 Tampers

Tampers shall be of an approved mechanical type, operated by either pneumatic pressure or internal combustion, and shall have sufficient weight and striking power to produce the compaction required.

1.7.7 Straightedge

The Contractor shall furnish and maintain at the site, in good condition, one 10 foot straightedge for each bituminous paver, for use in the testing of the finished surface. Straightedge shall be made available for Government use. Straightedges shall be constructed of aluminum or other lightweight metal and shall have blades of box or box-girder cross section with flat bottom reinforced to insure rigidity and accuracy. Straightedges shall have handles to facilitate movement on pavement.

1.8 WEATHER LIMITATIONS

Work on the lime or fly ash treated subgrade shall not be performed during freezing temperatures. When the temperature is below 40 degrees F, the completed course shall be protected against freezing by a sufficient covering of straw, or by other approved methods, until the course has dried out. Any areas of completed treated subgrade that are damaged by freezing, rainfall, or other weather conditions shall be brought to a satisfactory condition without additional cost to the Government. Lime or fly ash shall not be applied when the atmospheric temperature is less than 40 degrees F. No lime or fly ash shall be applied to soils that are frozen or contain frost, or when the underlying material is frozen. If the temperature falls below 35 degrees F, completed treated areas shall be protected against any detrimental effects of freezing.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Lime

Lime shall be a standard brand of quicklime or hydrated lime conforming to the following physical and chemical requirements:

- a. Lime shall be of such gradation that 99-1/2 percent passes a No. 20 sieve and a minimum of 85 percent passes a No. 100 sieve.
- b. Combined calcium oxide and magnesium oxide shall be not less than 70 percent.

2.1.2 Fly Ash

Fly ash shall meet ASTM C 618, Section 3.3 when sampled and tested in accordance with Sections 5, 6, and 8, unless otherwise shown on the plans. Fly ash shall be of the Class "C" designation containing a minimum of 25% CaO. The source of the ash shall be identified and approved in advance of treatment operations in order that laboratory tests can be completed prior to commencing work.

Fly ash shall be stored and handled in closed weatherproof containers until immediately before distribution. Temporary storage (less than 12 hours) of fly ash in open pits may be allowed provided that wetting of the fly ash by rain or ground water is not allowed. Fly ash exposed to moisture prior to mixing with soils shall be discarded.

2.1.3 Material to be Treated

Material to be stabilized shall consist of in-place material in the area .

2.1.4 Water

Water shall be clean, fresh, and free from injurious amounts of oil, acid, salt, alkali, organic matter, and other substances deleterious to the lime or soil-lime mixture, and shall be subject to approval.

2.2 MIX DESIGN

The purpose of the lime or fly ash treated subgrade layer is to provide a stable construction platform for building the pavement structure that has reduced susceptibility weakening due to changes in moisture content. The Contractor shall develop and submit for approval a proposed mix design prior to any soil treatment work. The mix shall be developed using samples of the material to be treated. The mix design shall be capable of producing a layer to adequately support all construction vehicles without rutting when compacted to the design percent of laboratory maximum density.

In addition, the resulting mixture shall have a Liquid Limit less than 30 and a Plasticity Index less than 10 when tested in accordance with ASTM D 4318.

PART 3 EXECUTION

3.1 LIME OR FLY ASH TREATED MIXTURE

The material to be stabilized shall be thoroughly pulverized and, when lime or fly ash is applied in the dry state, the mix shall be thoroughly blended at a moisture content below optimum. After mixing is completed, the proportions of the mixture shall be in accordance with the approved mix design. After blending, water shall be blended into the dry mix in amounts necessary to bring the moisture content to optimum. Field moisture content shall be controlled within plus or minus 2 percent of optimum. When the stabilized course is constructed in more than one layer, the previously constructed layer shall be cleaned of loose and foreign matter by sweeping with power sweeper or power brooms except that hand brooms may be used in areas where power cleaning is not practicable. Adequate drainage shall be provided during the entire construction period to prevent water from collecting or standing on the area to be treated or on pulverized, mixed, or partially mixed material. Line and grade stakes shall be provided as necessary for control. Grade stakes shall be in lines parallel to the centerline of the area under construction and suitably spaced for string

lining.

3.2 PREPARATION OF AREA TO BE TREATED

The area shall be cleaned of debris. The area will be inspected for adequate compaction and shall be capable of withstanding, without displacement, the compaction specified for the treated soil mixture. Debris and removed unsatisfactory in-place material shall be disposed of as specified.

3.2.1 In-Place Material to be Treated

The entire area shall be graded to conform to the lines, grades, and cross sections shown in the plans prior to being processed. Soft or yielding subgrade areas shall be made stable before construction is begun.

3.2.2 Quantity of Select Material

Sufficient select material shall be utilized to provide the required thickness of the treated layer after compaction. Where in-place mixing is to be accomplished, the soil shall be graded and shaped to the approximate section and grade shown before soil treatment is undertaken.

3.2.3 Grade Control

Underlying material shall be excavated to sufficient depth for the required treated-course thickness so that the finished treated course with the subsequent surface course will meet the fixed grade. Finished and completed treated area shall conform to the lines, grades, cross section, and dimensions indicated.

3.3 INSTALLATION

3.3.1 Mixed In-Place Method

3.3.1.1 Scarifying and Pulverizing of Soil

Prior to application of lime or fly ash, the soil shall be scarified and pulverized to a minimum depth of 6 inches. Scarification shall be controlled so that the layer beneath the layer to be treated is not disturbed. Depth of pulverizing shall not exceed the depth of scarification.

3.3.1.2 Application of Lime or Fly Ash

Pulverized material shall be shaped to approximately the cross section indicated. Lime or fly ash shall be applied so that when uniformly mixed with the soil, the mix design lime or fly ash content is obtained, and a sufficient quantity of treated soil is produced to construct a compacted treated course conforming to the lines, grades, and cross section indicated. Mechanical spreaders shall be used in applying bulk lime or fly ash. Distributors shall be used in applying slurry. No equipment except that used in spreading and mixing shall pass over the freshly applied lime or fly ash.

3.3.1.3 Initial Mixing

Immediately after the lime or fly ash has been distributed, the lime or fly ash and soil shall be mixed. Initial mixing shall be sufficient to

alleviate any dusting or wetting of the lime or fly ash that might occur in the event of wind or rainstorms. This may be accomplished several days in advance of the final application and mixing.

3.3.1.4 Water Application and Moist Mixing

Moisture content of the mixture shall be determined in preparation for final mixing. Moisture in the mixture following final mixing shall not be less than the water content determined to be optimum based on dry weight of soil and shall not exceed the optimum water content by more than 2 percentage points. Water may be added in increments as large as the equipment will permit; however, such increment of water shall be partially incorporated in the mix to avoid concentration of water near the surface. After the last increment of water has been added, mixing shall be continued until the water is uniformly distributed throughout the full depth of the mixture, including satisfactory moisture distribution along the edges of the section.

3.3.2 Edges of Treated Course

Approved material shall be placed along the edges of the treated course in a quantity that will compact to the thickness of the course being constructed, or to the thickness of each layer in a multiple-layer course, allowing at least a 1 foot width of the shoulder to be rolled and compacted simultaneously with the rolling and compacting of each layer of the stabilized course.

3.3.3 Layer Thickness

Compacted thickness of the treated course shall be selected by the Contractor and sufficient to produce a working platform for the Contractor's construction equipment, but in no case shall the course be less than 8 inches in compacted thickness. No layer shall be more than 8 inches or less than 3 inches in compacted thickness.

3.3.4 Compaction

Before compaction operations are started and as a continuation of the mixing operation, the mixture shall be thoroughly loosened and pulverized to the full depth. Compaction shall be started immediately after mixing is completed. During final compaction, the surface shall be moistened, if necessary, and shaped to the required lines, grades, and cross section. Density of compacted mixture shall be at least 95 percent of laboratory maximum density. Rolling shall begin at the outside edge of the surface and proceed to the center, overlapping on successive trips at least one-half the width of the roller. Alternate trips of the roller shall be slightly different lengths. At all times, the speed of the roller shall not cause displacement of the mixture to occur. Areas inaccessible to the rollers shall be compacted with mechanical tampers, and shall be shaped and finished by hand methods.

3.3.5 Finishing

The surface of the top layer shall be finished to the grade and cross section shown. The surface shall be of uniform texture. Light blading during rolling may be necessary for the finished surface to conform to the lines, grades, and cross sections. If the surface for any reason becomes rough, corrugated, uneven in texture, or traffic-marked prior to completion, the unsatisfactory portions shall be scarified, reworked,

relaid, or replaced as directed. If any portion of the course, when laid, becomes water-soaked for any reason, that portion shall be removed immediately, and the mix placed in a windrow and aerated until a moisture content within the limits specified is obtained; and then spread, shaped, and rolled as specified above.

3.3.6 Construction Joints

At the end of each phase of construction, a straight transverse construction joint shall be formed by cutting back into the completed work to form a true vertical face free of loose or shattered material. Material along construction joints not properly compacted shall be removed and replaced with treated mixture that is mixed, moistened, and compacted as specified.

3.3.7 Curing and Protection

Immediately after the treated area has been finished as specified above, the surface shall be protected against rapid drying for 7 days by moist curing using sprinklers or by placement of the overlying course.

3.4 SAMPLING AND TESTING

3.4.1 General Requirements

Sampling and testing shall be performed by an approved commercial testing laboratory or by facilities furnished by the Contractor. Work requiring testing will not be permitted until the facilities have been inspected and approved. The first inspection will be at the expense of the Government. Cost incurred for any subsequent inspection required because of failure of the facilities to pass the first inspection will be charged to the Contractor. Tests shall be performed in sufficient numbers and at the locations and times directed to ensure that materials and compaction meet specified requirements. Certified copies of the test results shall be furnished to the Contracting Officer.

3.4.2 Results

Results shall verify that the material complies with the specification. When the source of materials is changed or deficiencies are found, the initial analysis shall be repeated and the material already placed shall be retested to determine the extent of unacceptable material. All in-place unacceptable material shall be replaced.

3.4.3 Sampling

All aggregate samples for laboratory testing shall be taken in accordance with ASTM D 75. Samples of lime shall be taken in accordance with ASTM C 50.

3.4.4 Sieve Analysis

Before starting work, one sample of material to be stabilized shall be tested in accordance with ASTM C 136 and ASTM D 422 on sieves conforming to ASTM E 11. After the initial test, a minimum of one analysis shall be performed for each 1000 tons of material placed, with a minimum of three analyses for each day's run until the course is completed.

3.4.5 Liquid Limit and Plasticity Index

One liquid limit and plasticity index shall be performed for each sieve analysis. Liquid limit and plasticity index shall be in accordance with ASTM D 4318.

3.4.6 Chemical Analysis

Lime shall be tested for the specified chemical requirements in accordance with ASTM C 25. Three tests shall be conducted for each delivery of lime.

3.5 FIELD QUALITY CONTROL

Tests shall provide a moisture-density relationship for the treated soil mixture. Results of field quality control testing shall verify that materials comply with this specification. When a material source is changed, the new material shall be tested for compliance. When deficiencies are found, the initial analysis shall be repeated and the material already placed shall be retested to determine the extent of unacceptable material. All in-place unacceptable material shall be replaced or repaired, as directed by the Contracting Officer, at no additional cost to the Government.

3.5.1 Thickness Control

Completed thicknesses of the treated course shall be within 1/2 inch of the thickness indicated. Where the measured thickness of the treated course is more than 1/2 inch deficient, such areas shall be corrected by scarifying, adding mixture of proper gradation, reblading, and recompacting as directed. Where the measured thickness of the treated course is more than (1/2 inch thicker than indicated, it shall be considered as conforming to the specified thickness requirement. Average job thickness shall be the average of all thickness measurements taken for the job, but shall be within 1/4 inch of the thickness indicated. Thickness of the treated course shall be measured at intervals which ensure one measurement for each 500 square yards of treated course. Measurements shall be made in 3 inch diameter test holes penetrating the treated course.

3.5.2 Field Density

Field in-place density shall be determined in accordance with ASTM D 1556, ASTM D 2167 or ASTM D 2922. When ASTM D 2922 is used, the calibration curves shall be checked, and adjusted if necessary, using the sand cone method as described in paragraph Calibration of the ASTM publication. ASTM D 2922 results in a wet unit weight of soil and when using this method, ASTM D 3017 shall be used to determine the moisture content of the soil. The calibration curves furnished with the moisture gauges shall be checked along with density calibration checks as described in ASTM D 3017. If ASTM D 2922 is used, in-place densities shall be checked by ASTM D 1556 at least once per lift for each 2,500 square yards of treated material. Calibration curves and calibration tests results shall be furnished to the Contracting Officer within 24 hours of conclusion of the tests. At least one field density test shall be performed for each 250 square yards of each layer of subgrade material.

3.5.3 Smoothness Test

The surface of a treated layer shall show no deviations in excess of 3/8 inch when tested with the 10-foot straightedge. Deviations exceeding this

amount shall be corrected by removing material and replacing with new material, or by reworking existing material and compacting, as directed. Measurements for deviation from grade and cross section shown shall be taken in successive positions parallel to the road centerline with a 10-foot straightedge.

3.6 TRAFFIC

Completed portions of the treated soil area may be opened immediately to light traffic provided the curing is not impaired. After the curing period has elapsed, completed areas may be opened to all traffic, provided the treated course has hardened sufficiently to prevent marring or distorting of the surface by equipment or traffic. Heavy equipment shall not be permitted on the area during the curing period. Lime and water may be hauled over the completed area with pneumatic-tired equipment if approved. Finished portions of treated soil that are traveled on by equipment used in constructing an adjoining section shall be protected in a manner to prevent equipment from marring or damaging completed work.

3.7 MAINTENANCE

Treated areas shall be maintained in a satisfactory condition until the completed work is accepted. Maintenance shall include immediate repairs of any defects and shall be repeated as often as necessary to keep the area intact. Defects shall be corrected as specified herein.

3.8 DISPOSAL OF UNSATISFACTORY MATERIALS

Removed in-place materials that are unsuitable for treatment, material that is removed for the required correction of defective areas, waste material, and debris shall be disposed of off base property.

-- End of Section --

SECTION 02716

AGGREGATE SEPARATION LAYER

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
(AASHTO)

- AASHTO T 180 (2001) Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and an 457-mm (18-in) Drop
- AASHTO T 224 (2001) Correction for Coarse Particles in the Soil Compaction Test

ASTM INTERNATIONAL (ASTM)

- ASTM C 117 (2003) Materials Finer Than 75 micrometer (No. 200) Sieve in Mineral Aggregates by Washing
- ASTM C 127 (2001) Density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate
- ASTM C 128 (2001e1) Density, Relative Density (Specific Gravity), and Absorption of Fine Aggregate
- ASTM C 131 (2003) Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
- ASTM C 136 (2001) Sieve Analysis of Fine and Coarse Aggregates
- ASTM D 1556 (2000) Density and Unit Weight of Soil in Place by the Sand-Cone Method
- ASTM D 2167 (1994; R 2001) Density and Unit Weight of Soil in Place by the Rubber Balloon Method
- ASTM D 2922 (2001) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
- ASTM D 3017 (2001) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)

ASTM D 422	(1963; R 2002) Particle-Size Analysis of Soils
ASTM D 4318	(2000) Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D 75	(2003) Sampling Aggregates
ASTM E 11	(2001) Wire Cloth and Sieves for Testing Purposes

1.2 DEFINITIONS

For the purposes of this specification, the following definitions apply.

1.2.1 Aggregate Separation Layer

Aggregate separation layer (ASL) is well graded, durable aggregate uniformly moistened and mechanically stabilized by compaction.

1.2.2 Undercut Backfill Stone

Undercut backfill stone (UBS) is used in the replacement of unstable base course at locations to be determined after the bituminous surface course on runway overruns and taxiway shoulders has been removed.

1.2.3 Degree of Compaction

Degree of compaction shall be expressed as a percentage of the maximum density obtained by the test procedure presented in AASHTO T 180, Method D and corrected with AASHTO T 224.

1.3 UNIT PRICES

1.3.1 Measurement

1.3.1.1 Aggregate Separation Layer

Aggregate separation layer, as defined in Paragraph 1.2 will not be measured for unit price payment.

1.3.1.2 Undercut Backfill Stone

The tonnage of undercut backfill stone material will be the number of tons of aggregate, placed and accepted in the completed course, as determined by the Contracting Officer. Deductions will be made for any material wasted, unused, rejected, or used for convenience of the Contractor, and for water exceeding specified amount at time of weighing.

1.3.2 Payment for Quantities

1.3.2.1 Aggregate Separation Layer

Aggregate separation layer, as defined in Paragraph 1.2, will not be paid for at a unit price. Payment is to be included in the Job Base Bid.

1.3.2.2 Undercut Backfill Stone

Aggregate backfill stone, as defined in Paragraph 1.2, installed and

accepted as determined above, will be paid for at the respective contract unit price, which shall constitute full compensation for the removal of the unstable base course and construction and completion of undercut backfill stone.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Plant, Equipment, and Tools;

List of proposed equipment to be used in performance of construction work, including descriptive data.

SD-06 Test Reports

Sampling and testing; G, RO
Field Density Tests; G, RO

Calibration curves and related test results prior to using the device or equipment being calibrated. Copies of field test results within 24 hours after the tests are performed. Certified copies of test results for approval not less than 15 days before material is required for the work.

Undercut backfill stone; G, RO

Prior to base course removal and replacement, Contractor shall determine the removal limits and determine the amount of undercut backfill stone to be used. Removal shall not be allowed until undercut backfill stone quantity is approved.

1.5 SAMPLING AND TESTING

Sampling and testing shall be the responsibility of the Contractor. Sampling and testing shall be performed by a testing laboratory approved in accordance with Section 01451A CONTRACTOR QUALITY CONTROL. Work requiring testing will not be permitted until the testing laboratory has been inspected and approved. The materials shall be tested to establish compliance with the specified requirements; testing shall be performed at the specified frequency. The Contracting Officer may specify the time and location of the tests. Copies of test results shall be furnished to the Contracting Officer within 24 hours of completion of the tests.

1.5.1 Sampling

Samples for laboratory testing shall be taken in conformance with ASTM D 75. When deemed necessary, the sampling will be observed by the Contracting Officer.

1.5.2 Tests

The following tests shall be performed in conformance with the applicable standards listed.

1.5.2.1 Sieve Analysis

Sieve analysis shall be made in conformance with ASTM C 117 and ASTM C 136.

Sieves shall conform to ASTM E 11. Particle-size analysis of the soils shall also be completed in conformance with ASTM D 422.

1.5.2.2 Liquid Limit and Plasticity Index

Liquid limit and plasticity index shall be determined in accordance with ASTM D 4318.

1.5.2.3 Moisture-Density Determinations

The maximum density and optimum moisture content shall be determined in accordance with AASHTO T 180, Method D and corrected with AASHTO T 224. To maintain the same percentage of coarse material, the "remove and replace" procedure as described in the NOTE 8 in Paragraph 7.2 of AASHTO T 180 shall be used..

1.5.2.4 Field Density Tests

Density shall be field measured in accordance with ASTM D 1556, ASTM D 2167 or ASTM D 2922. For the method presented in ASTM D 1556 the base plate as shown in the drawing shall be used. For the method presented in ASTM D 2922 the calibration curves shall be checked and adjusted if necessary using only the sand cone method as described in paragraph Calibration, of the ASTM publication. Tests performed in accordance with ASTM D 2922 result in a wet unit weight of soil and when using this method, ASTM D 3017 shall be used to determine the moisture content of the soil. The calibration curves furnished with the moisture gauges shall also be checked along with density calibration checks as described in ASTM D 3017. The calibration checks of both the density and moisture gauges shall be made by the prepared containers of material method, as described in paragraph Calibration of ASTM D 2922, on each different type of material being tested at the beginning of a job and at intervals as directed.

1.5.2.5 Wear Test

Wear tests shall be made on ASL course material in conformance with ASTM C 131.

1.5.3 Testing Frequency

1.5.3.1 Initial Tests

One of each of the following tests shall be performed on the proposed material prior to commencing construction to demonstrate that the proposed material meets all specified requirements when furnished. If materials from more than one source are going to be utilized, this testing shall be completed for each source.

- a. Sieve Analysis.
- b. Liquid limit and plasticity index.

- c. Moisture-density relationship.
- d. Wear.

1.5.3.2 In Place Tests - ASL

Each of the following tests shall be performed on samples taken from the placed and compacted ASL. Samples shall be taken and tested at the rates indicated.

- a. Density tests shall be performed on every lift of material placed and at a frequency of one set of tests for every 250 square yards , or portion thereof, of completed area.
- b. Sieve Analysis shall be performed for every 500 tons , or portion thereof, of material placed.
- c. Liquid limit and plasticity index tests shall be performed at the same frequency as the sieve analysis.

1.5.3.3 In Place Tests - Undercut Backfill Stone

Undercut backfill encapsulated in geotextile fabric stone shall be compacted to the satisfaction of the Contracting Officer. Undercut backfill, not encapsulated, shall be compacted in accordance with Paragraph 1.4.3.2.

1.5.4 Approval of Material

The source of the material shall be selected 15 days prior to the time the material will be required in the work. Tentative approval of material will be based on initial test results. Final approval of the materials will be based on sieve analysis, liquid limit, and plasticity index tests performed on samples taken from the completed and fully compacted ASL.

1.6 WEATHER LIMITATIONS

Construction shall be done when the atmospheric temperature is above 35 degrees F. When the temperature falls below 35 degrees F, the Contractor shall protect all completed areas by approved methods against detrimental effects of freezing. Completed areas damaged by freezing, rainfall, or other weather conditions shall be corrected to meet specified requirements.

1.7 PLANT, EQUIPMENT, AND TOOLS

All plant, equipment, and tools used in the performance of the work will be subject to approval before the work is started and shall be maintained in satisfactory working condition at all times. The equipment shall be adequate and shall have the capability of producing the required compaction, meeting grade controls, thickness control, and smoothness requirements as set forth herein.

PART 2 PRODUCTS

2.1 AGGREGATES

The ASL shall consist of clean, sound, durable particles of crushed stone, crushed gravel, crushed recycled concrete, angular sand, or other approved material. ASL shall be free of lumps of clay, organic matter, and other objectionable materials or coatings. The portion retained on the No. 4 sieve shall be known as coarse aggregate; that portion passing the No. 4 sieve shall be known as fine aggregate.

2.1.1 Recycling PCC Pavement

Existing PCC pavement may be crushed and reused as Separation Layer provided the crushed material and the native soils/groundwater meet all of the following requirements.

- a. Crushed material must meet specified gradation requirements for the intended use.
- b. Crushed material must meet the quality requirements for the intended used. Quality includes meeting specification requirements for sulfate soundness, Abrasion loss, flat and/or elongated particles.
- c. Recycled concrete aggregates proposed for use shall be evaluated and tested by the Contractor for alkali-aggregate reactivity in accordance with ASTM C 1260. Test results shall have a measured expansion equal to or less than 0.08 percent at 16 days after casting. Should the test data indicate an expansion greater than 0.08 percent, the recycled concrete aggregate shall be rejected.
- d. Subgrade soils must be tested in accordance with CRD-C 403 "Method for Determination of Sulfate Ion in Soils and Water" to determine the presence of sulfates. Subgrade soils must have sulfate concentrations below 0.05% (by weight) to allow use of recycled concrete as a project material.
- e. Groundwater collected from borings within the project site must be tested in accordance with ASTM D 516 "Standard Test Method for Sulfate Ion in Water" to determine the presence of sulfates. Groundwater must have a sulfate concentration below 75 ppm to allow use of recycled concrete as a project material.

2.1.2 Coarse Aggregate

Coarse aggregates shall be angular particles of uniform density. When the coarse aggregate is supplied from more than one source, aggregate from each source shall meet the specified requirements and shall be stockpiled separately.

- a. Crushed Gravel: Crushed gravel shall be manufactured by crushing gravels, and shall meet all the requirements specified below.
- b. Crushed Stone: Crushed stone shall consist of freshly mined quarry rock, and shall meet all the requirements specified below.
- c. Crushed Recycled Concrete: Crushed recycled concrete shall consist of previously hardened portland cement concrete or other concrete containing pozzolanic binder material. The recycled material shall be free of all reinforcing steel, bituminous concrete surfacing, and any other foreign material and shall be crushed and processed to meet the required gradations for coarse aggregate. Crushed recycled concrete shall meet all other applicable requirements specified below.

2.1.2.1 Aggregate Separation Layer and Undercut Backfill Stone

ASL and UBS coarse aggregate shall not show more than 50 percent loss when subjected to the Los Angeles abrasion test in accordance with ASTM C 131. The amount of flat and elongated particles shall not exceed 30 percent. A flat particle is one having a ratio of width to thickness greater than 3; an elongated particle is one having a ratio of length to width greater than 3. In the portion retained on each sieve specified, the crushed aggregates shall contain at least 50 percent by weight of crushed pieces having two or more freshly fractured faces with the area of each face being at least equal to 75 percent of the smallest midsectional area of the piece. When two fractures are contiguous, the angle between planes of the fractures must be at least 30 degrees in order to count as two fractured faces. Crushed gravel shall be manufactured from gravel particles 50 percent of which, by weight, are retained on the maximum size sieve listed in TABLE 1.

2.1.3 Fine Aggregate

Fine aggregates shall be angular particles of uniform density. When the fine aggregate is supplied from more than one source, aggregate from each source shall meet the specified requirements.

2.1.3.1 Aggregate Separation Layer and Undercut Backfill Stone

ASL and UBS fine aggregate shall consist of screenings, angular sand, crushed recycled concrete fines, or other finely divided mineral matter processed or naturally combined with the coarse aggregate.

2.1.4 Gradation Requirements

The specified gradation requirements shall apply to the completed aggregate separation layer and undercut backfill stone. The aggregates shall have a maximum size of 1.5 inches and shall be continuously well graded within the limits specified in TABLE 1. Sieves shall conform to ASTM E 11.

TABLE I. GRADATION OF AGGREGATES

Percentage by Weight Passing Square-Mesh Sieve

Sieve Designation	No. 2
2 inch	----
1-1/2 inch	100
1 inch	60-100
1/2 inch	30-65
No. 4	20-50
No. 10	15-40
No. 40	5-25
No. 200	0-8

NOTE 1: Particles having diameters less than 0.0008 inch shall not be in excess of 3 percent by weight of the total sample tested.

NOTE 2: The values are based on aggregates of uniform specific gravity. If materials from different sources are used for the coarse and fine aggregates, they shall be tested in accordance with ASTM C 127 and ASTM C 128 to determine their specific gravities. If the specific gravities vary by more than 10 percent, the percentages passing the various sieves shall be corrected as directed by the Contracting Officer.

2.1.5 Liquid Limit and Plasticity Index

Liquid limit and plasticity index requirements shall apply to the completed course and shall also apply to any component that is blended to meet the required gradation. The portion of any component or of the completed course passing the No. 40 sieve shall be either nonplastic or have a liquid limit not greater than 25 and a plasticity index not greater than 5.

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

When the ASL is constructed in more than one layer, the previously constructed layer shall be cleaned of loose and foreign matter by sweeping with power sweepers or power brooms, except that hand brooms may be used in areas where power cleaning is not practicable. Adequate drainage shall be provided during the entire period of construction to prevent water from collecting or standing on the working area. Line and grade stakes shall be provided as necessary for control. Grade stakes shall be in lines parallel to the centerline of the area under construction and suitably spaced for string lining.

3.1.1 Undercut Backfill Stone

Undercut backfill stone shall be constructed in accordance with Section 02575.

3.2 OPERATION OF AGGREGATE SOURCES

Aggregates shall be obtained from offsite sources.

3.3 STOCKPILING MATERIAL

Prior to stockpiling of material, storage sites shall be cleared and leveled by the Contractor. All materials, including approved material available from excavation and grading, shall be stockpiled in the manner and at the locations designated. Aggregates shall be stockpiled on the cleared and leveled areas designated by the Contracting Officer to prevent segregation. Materials obtained from different sources shall be stockpiled separately.

3.4 PREPARATION OF UNDERLYING COURSE

Prior to constructing the ASL, the underlying course or subgrade shall be cleaned of all foreign substances. At the time of construction of the ASL, the underlying course shall contain no frozen material. The surface of the underlying course or subgrade shall meet specified compaction and surface tolerances. The underlying course shall conform to Section 02715 WORKING PLATFORM. Ruts or soft yielding spots in the underlying courses, areas having inadequate compaction, and deviations of the surface from the requirements set forth herein shall be corrected by loosening and removing soft or unsatisfactory material and by adding approved material, reshaping

to line and grade, and recompacting to specified density requirements. The finished underlying course shall not be disturbed by traffic or other operations and shall be maintained by the Contractor in a satisfactory condition until the ASL is placed.

3.5 INSTALLATION

3.5.1 Mixing the Materials

The coarse and fine aggregates shall be mixed in a stationary plant, or in a traveling plant or bucket loader on an approved paved working area. The Contractor shall make adjustments in mixing procedures or in equipment as directed to obtain true grades, to minimize segregation or degradation, to obtain the required water content, and to insure a satisfactory ASL meeting all requirements of this specification.

3.5.2 Placing

The mixed material shall be placed on the prepared subgrade or subbase in layers of uniform thickness with an approved spreader. When a compacted layer 6 inches or less in thickness is required, the material shall be placed in a single layer. When a compacted layer in excess of 6 inches is required, the material shall be placed in layers of equal thickness. No layer shall exceed 6 inches or less than 3 inches when compacted. The layers shall be so placed that when compacted they will be true to the grades or levels required with the least possible surface disturbance. Where the ASL is placed in more than one layer, the previously constructed layers shall be cleaned of loose and foreign matter by sweeping with power sweepers, power brooms, or hand brooms, as directed. Such adjustments in placing procedures or equipment shall be made as may be directed to obtain true grades, to minimize segregation and degradation, to adjust the water content, and to insure an acceptable ASL.

3.5.3 Grade Control

The finished and completed ASL shall conform to the lines, grades, and cross sections shown. Underlying material(s) shall be excavated and prepared at sufficient depth for the required ASL thickness so that the finished ASL with the subsequent surface course will meet the designated grades.

3.5.4 Edges of Base Course

The ASL shall be placed so that the completed section will be a minimum of 3 feet wider, on all sides, than the next layer that will be placed above it. Additionally, approved fill material shall be placed along the outer edges of ASL in sufficient quantities to compact to the thickness of the course being constructed, or to the thickness of each layer in a multiple layer course, allowing in each operation at least a 2 foot width of this material to be rolled and compacted simultaneously with rolling and compacting of each layer of ASL. If this base course material is to be placed adjacent to another pavement section, then the layers for both of these sections shall be placed and compacted along this edge at the same time.

3.5.5 Compaction

Each layer of the ASL shall be compacted as specified with approved compaction equipment. Water content shall be maintained during the

compaction procedure to within plus or minus 2 percent of the optimum water content determined from laboratory tests as specified in paragraph SAMPLING AND TESTING. Rolling shall begin at the outside edge of the surface and proceed to the center, overlapping on successive trips at least one-half the width of the roller. Alternate trips of the roller shall be slightly different lengths. Speed of the roller shall be such that displacement of the aggregate does not occur. In all places not accessible to the rollers, the mixture shall be compacted with hand-operated power tampers. Compaction shall continue until each layer has a degree of compaction that is at least 95 percent of laboratory maximum density through the full depth of the layer. The Contractor shall make such adjustments in compacting or finishing procedures as may be directed to obtain true grades, to minimize segregation and degradation, to reduce or increase water content, and to ensure a satisfactory ASL. Any materials that are found to be unsatisfactory shall be removed and replaced with satisfactory material or reworked, as directed, to meet the requirements of this specification.

3.5.6 Thickness

Compacted thickness of the aggregate course shall be as indicated. No individual layer shall exceed 6 inches nor be less than 3 inches in compacted thickness. The total compacted thickness of the ASL course shall be within 1/2 inch of the thickness indicated. Where the measured thickness is more than 1/2 inch deficient, such areas shall be corrected by scarifying, adding new material of proper gradation, reblading, and recompacting as directed. Where the measured thickness is more than 1/2 inch thicker than indicated, the course shall be considered as conforming to the specified thickness requirements. Average job thickness shall be the average of all thickness measurements taken for the job, but shall be within 1/4 inch of the thickness indicated. The total thickness of the ASL course shall be measured at intervals in such a manner as to ensure one measurement for each 500 square yards of ASL. Measurements shall be made in 3 inch diameter test holes penetrating the base course.

3.5.7 Finishing

The surface of the top layer of ASL shall be finished after final compaction by cutting any overbuild to grade and rolling with a steel-wheeled roller. Thin layers of material shall not be added to the top layer of base course to meet grade. If the elevation of the top layer of ASL is 1/2 inch or more below grade, then the top layer should be scarified to a depth of at least 3 inches and new material shall be blended in and compacted to bring to grade. Adjustments to rolling and finishing procedures shall be made as directed to minimize segregation and degradation, obtain grades, maintain moisture content, and insure an acceptable base course. Should the surface become rough, corrugated, uneven in texture, or traffic marked prior to completion, the unsatisfactory portion shall be scarified, reworked and recompacted or it shall be replaced as directed.

3.5.8 Smoothness

The surface of the top layer shall show no deviations in excess of 3/8 inch when tested with a 10 or 12 foot straightedge. Measurements shall be taken in successive positions parallel to the centerline of the area to be paved. Measurements shall also be taken perpendicular to the centerline at 50 foot intervals. Deviations exceeding this amount shall be corrected by removing material and replacing with new material, or by reworking existing material and compacting it to meet these specifications.

3.6 TRAFFIC

. Completed portions of the ASL may be opened to limited traffic, provided there is no marring or distorting of the surface by the traffic. Heavy equipment shall not be permitted except when necessary to construction, and then the area shall be protected against marring or damage to the completed work.

3.7 MAINTENANCE

The ASL shall be maintained in a satisfactory condition until the full pavement section is completed and accepted. Maintenance shall include immediate repairs to any defects and shall be repeated as often as necessary to keep the area intact. Any ASL that is not paved over prior to the onset of winter, shall be retested to verify that it still complies with the requirements of this specification. Any area of ASL that is damaged shall be reworked or replaced as necessary to comply with this specification.

3.8 DISPOSAL OF UNSATISFACTORY MATERIALS

Any unsuitable materials that must be removed shall be disposed of as directed . No additional payments will be made for materials that must be replaced.

-- End of Section --

SECTION 02721A
 SUBBASE COURSES

PART 1 GENERAL

1.1 REFERENCES

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

ASTM INTERNATIONAL (ASTM)

ASTM C 117	(2003) Materials Finer Than 75 micrometer (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C 131	(2003) Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C 136	(2001) Sieve Analysis of Fine and Coarse Aggregates
ASTM D 1557	(2002) Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/cu. ft. (2,700 kN-m/cu.m.))
ASTM D 2922	(2001) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 3017	(2001) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
ASTM D 422	(1963; R 2002) Particle-Size Analysis of Soils
ASTM D 4318	(2000) Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D 75	(2003) Sampling Aggregates
ASTM E 11	(2001) Wire Cloth and Sieves for Testing Purposes

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Equipment;

List of proposed equipment to be used in performance of construction work, including descriptive data.

SD-06 Test Reports

Sampling and Testing; G, RO

Copies of initial and in-place test results.

1.3 DEGREE OF COMPACTION

Degree of compaction is a percentage of the maximum density obtained by the test procedure presented in ASTM D 1557. In this specification, degree of compaction shall be a percentage of laboratory maximum density.

1.4 SAMPLING AND TESTING

Sampling and testing shall be the responsibility of the Contractor. Sampling and testing shall be performed by an approved testing laboratory in accordance with Section 01451A CONTRACTOR QUALITY CONTROL. Tests shall be performed at the specified frequency. No work requiring testing will be permitted until the testing laboratory has been inspected and approved. The materials shall be tested to establish compliance with the specified requirements.

1.4.1 Sampling

Samples for laboratory testing shall be taken in conformance with ASTM D 75. When deemed necessary, the sampling will be observed by the Contracting Officer.

1.4.2 Tests

1.4.2.1 Sieve Analysis

Sieve analysis shall be made in conformance with ASTM C 117 and ASTM C 136 and ASTM D 422. Sieves shall conform to ASTM E 11.

1.4.2.2 Liquid Limit and Plasticity Index

Liquid limit and plasticity index shall be determined in accordance with ASTM D 4318.

1.4.2.3 Moisture-Density Determinations

The maximum density and optimum moisture shall be determined in accordance with ASTM D 1557.

1.4.2.4 Density Tests

Density shall be field measured in accordance with ASTM D 2922. The calibration curves shall be checked and adjusted, if necessary, using only the sand cone method as described in paragraph Calibration, of the ASTM publication. Tests performed in accordance with ASTM D 2922 result in a wet unit weight of soil and, when using this method, ASTM D 3017 shall be

used to determine the moisture content of the soil. The calibration curves furnished with the moisture gauges shall also be checked along with density calibration checks as described in ASTM D 3017. The calibration checks of both the density and moisture gauges shall be made by the prepared containers of material method, as described in paragraph Calibration, in ASTM D 2922, on each different type of material to be tested at the beginning of a job and at intervals as directed.

1.4.3 Testing Frequency

1.4.3.1 Initial Tests

One of each of the following tests shall be performed on the proposed material prior to commencing construction to demonstrate that the proposed material meets all specified requirements prior to installation.

- a. Sieve Analysis including 0.02 mm size material
- b. Liquid limit and plasticity index moisture-density relationship
- c. Wear
- d. Weight per cubic foot of Slag

1.4.3.2 In-Place Tests

One of each of the following tests shall be performed on samples taken from the placed and compacted subbase course. Samples shall be taken for each 1,000 square yards of each layer of material placed in each area.

- a. Sieve Analysis including 0.02 mm size material
- b. Field Density
- c. Moisture liquid limit and plasticity index

1.4.4 Approval of Material

The source of the material shall be selected 15 days prior to the time the material will be required in the work. Approval of the materials will be based on tests for gradation, liquid limit, and plasticity index performed on samples taken from the completed and compacted subbase course.

1.5 WEATHER LIMITATIONS

Construction shall be done when the atmospheric temperature is above 35 degrees F. When the temperature falls below 35 degrees F, the Contractor shall protect all completed areas by approved methods against detrimental effects of freezing. Completed areas damaged by freezing, rainfall, or other weather conditions shall be corrected to meet specified requirements.

1.6 EQUIPMENT

All plant, equipment, and tools used in the performance of the work will be subject to approval before the work is started and shall be maintained in satisfactory working condition at all times. The equipment shall be adequate and shall have the capability of producing the required compaction, meeting grade controls, thickness control, and smoothness requirements as set forth herein.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Recycling PCC Pavement

Existing PCC pavement may be crushed and reused as Subbase provided the crushed material and the native soils/groundwater meet all of the following requirements.

- a. Crushed material must meet specified gradation requirements for the intended use.
- b. Crushed material must meet the quality requirements for the intended used. Quality includes meeting specification requirements for sulfate soundness, Abrasion loss, flat and/or elongated particles.
- c. Recycled concrete aggregates proposed for use shall be evaluated and tested by the Contractor for alkali-aggregate reactivity in accordance with ASTM C 1260. Test results shall have a measured expansion equal to or less than 0.08 percent at 16 days after casting. Should the test data indicate an expansion greater than 0.08 percent, the recycled concrete aggregate shall be rejected.
- d. Subgrade soils must be tested in accordance with CRD-C 403 "Method for Determination of Sulfate Ion in Soils and Water" to determine the presence of sulfates. Subgrade soils must have sulfate concentrations below 0.05% (by weight) to allow use of recycled concrete as a project material.
- e. Groundwater collected from borings within the project site must be tested in accordance with ASTM D 516 "Standard Test Method for Sulfate Ion in Water" to determine the presence of sulfates. Groundwater must have a sulfate concentration below 75 ppm to allow use of recycled concrete as a project material.

2.1.2 Subbase Course

Aggregates shall consist of crushed stone, gravel, crushed recycled concrete, sand, or other sound, durable, approved materials processed and blended or naturally combined. Aggregates shall be durable and sound, free from lumps and balls of clay, organic matter, objectionable coatings, and other foreign material. Material retained on the No. 4 sieve shall have a percentage of wear not to exceed 45 percent after 500 revolutions when tested as specified in ASTM C 131. Aggregate shall be reasonably uniform in density and quality. Aggregates shall have a maximum size of 3/4 inch and shall be within the limits specified as follows:

Maximum Allowable Percentage by Weight
Passing Square-Mesh Sieve

Sieve Designation	No. 3
No. 10	--
No. 200	15

Particles having diameters less than 0.0008 inches shall not be in excess of 3 percent by weight of the total sample tested as determined in accordance with ASTM D 422. The portion of any blended component and of the completed course passing the No. 40 sieve shall be either nonplastic or shall have a liquid limit not greater than 25 and a plasticity index not greater than 5.

a. Crushed Recycled Concrete: Crushed recycled concrete shall consist of previously hardened portland cement concrete or other concrete containing pozzolanic binder material. The recycled material shall be free of all reinforcing steel, bituminous concrete surfacing, and any other foreign material and shall be crushed and processed to meet the required gradations for coarse aggregate. Crushed recycled concrete shall meet all other applicable requirements specified below.

PART 3 EXECUTION

3.1 OPERATION OF AGGREGATE SOURCES

All subbase shall be obtained from offsite sources.

3.2 STOCKPILING MATERIAL

Prior to stockpiling of material, storage sites shall be cleared and leveled by the Contractor. All materials, including approved material available from excavation and grading, shall be stockpiled in the manner and at the locations designated. Aggregates shall be stockpiled on the cleared and leveled areas designated by the Contracting Officer so as to prevent segregation. Materials obtained from different sources shall be stockpiled separately.

3.3 PREPARATION OF UNDERLYING MATERIAL

Prior to constructing the subbase course, the underlying course or subgrade shall be cleaned of all foreign substances. The surface of the underlying course or subgrade shall meet specified compaction and surface tolerances. Ruts, or soft yielding spots, in the underlying courses, subgrade areas having inadequate compaction, and deviations of the surface from the specified requirements, shall be corrected by loosening and removing soft or unsatisfactory material and by adding approved material, reshaping to line and grade, and recompacting to specified density requirements. The finished underlying course shall not be disturbed by traffic or other operations and shall be maintained by the Contractor in a satisfactory condition until the subbase course is placed.

3.4 GRADE CONTROL

The finished and completed subbase course shall conform to the lines, grades, and cross sections shown. The lines, grades, and cross sections shown shall be maintained by means of line and grade stakes placed by the Contractor at the work site.

3.5 MIXING AND PLACING MATERIALS

The materials shall be mixed and placed to obtain uniformity of the subbase material at the water content specified. The Contractor shall make such adjustments in mixing or placing procedures or in equipment as may be directed to obtain the true grades, to minimize segregation and degradation, to reduce or accelerate loss or increase of water, and to insure a satisfactory subbase course.

3.6 LAYER THICKNESS

The compacted thickness of the completed course shall be as indicated. When a compacted layer of 6 inches is specified, the material may be placed in a single layer; when a compacted thickness of more than 6 inches is

required, no layer shall exceed 6 inches nor be less than 3 inches when compacted.

3.7 COMPACTION

Each layer of the subbase course shall be compacted as specified with approved compaction equipment. Water content shall be maintained during the compaction procedure to within plus or minus 2 percent of optimum water content, as determined from laboratory tests, as specified in paragraph SAMPLING AND TESTING. In all places not accessible to the rollers, the mixture shall be compacted with hand-operated power tampers. Compaction shall continue until each layer is compacted through the full depth to at least 90 percent of laboratory maximum density. The Contractor shall make such adjustments in compacting or finishing procedures as may be directed to obtain true grades, to minimize segregation and degradation, to reduce or increase water content, and to ensure a satisfactory subbase course. Any materials that are found to be unsatisfactory shall be removed and replaced with satisfactory material or reworked, as directed, to meet the requirements of this specification.

3.8 EDGES

Approved material shall be placed along the edges of the subbase course in such quantity as will compact to the thickness of the course being constructed. When the course is being constructed in two or more layers, at least a 1 foot width of the shoulder shall be rolled and compacted simultaneously with the rolling and compacting of each layer of the subbase course, as directed.

3.9 SMOOTHNESS TEST

The surface of each layer shall not show deviations in excess of 3/8 inch when tested with a 12 foot straightedge applied parallel with and at right angles to the centerline of the area to be paved. Deviations exceeding this amount shall be corrected by removing material, replacing with new material, or reworking existing material and compacting, as directed.

3.10 THICKNESS CONTROL

The completed thickness of the subbase course shall be in accordance with the thickness and grade indicated on the drawings. The thickness of each course shall be measured at intervals providing at least one measurement for each 500 square yards or part thereof of subbase course. The thickness measurement shall be made by test holes, at least 3 inches in diameter through the course. The completed subbase course shall not be more than 1/2 inch deficient in thickness nor more than 1/2 inch above or below the established grade. Where any of these tolerances are exceeded, the Contractor shall correct such areas by scarifying, adding new material of proper gradation or removing material, and compacting, as directed. Where the measured thickness is 1/2 inch or more thicker than shown, the course will be considered as conforming with the specified thickness requirements plus 1/2 inch. The average job thickness shall be the average of the job measurements as specified above but within 1/4 inch of the thickness shown.

3.11 MAINTENANCE

The subbase course shall be maintained in a satisfactory condition until accepted.

-- End of Section --

SECTION 02722A

GRADED-CRUSHED AGGREGATE BASE COURSE

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
(AASHTO)

- AASHTO T 180 (2001) Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and an 457-mm (18-in) Drop
- AASHTO T 224 (2001) Correction for Coarse Particles in the Soil Compaction Test

ASTM INTERNATIONAL (ASTM)

- ASTM C 117 (2003) Materials Finer Than 75 micrometer (No. 200) Sieve in Mineral Aggregates by Washing
- ASTM C 127 (2001) Density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate
- ASTM C 128 (2001e1) Density, Relative Density (Specific Gravity), and Absorption of Fine Aggregate
- ASTM C 131 (2003) Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
- ASTM C 136 (2001) Sieve Analysis of Fine and Coarse Aggregates
- ASTM C 88 (1999a) Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
- ASTM D 1556 (2000) Density and Unit Weight of Soil in Place by the Sand-Cone Method
- ASTM D 2167 (1994; R 2001) Density and Unit Weight of Soil in Place by the Rubber Balloon Method
- ASTM D 2487 (2000) Soils for Engineering Purposes (Unified Soil Classification System)

ASTM D 2922	(2001) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 3017	(2001) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
ASTM D 422	(1963; R 2002) Particle-Size Analysis of Soils
ASTM D 4318	(2000) Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D 75	(2003) Sampling Aggregates
ASTM E 11	(2001) Wire Cloth and Sieves for Testing Purposes

1.2 DEFINITIONS

For the purposes of this specification, the following definitions apply.

1.2.1 Graded-crushed Aggregate Base Course

Graded-crushed aggregate (GCA) base course is well graded, crushed, durable aggregate uniformly moistened and mechanically stabilized by compaction. GCA is similar to ABC, but it has more stringent requirements and it produces a base course with higher strength and stability.

1.2.2 Degree of Compaction

Degree of compaction shall be expressed as a percentage of the maximum density obtained by the test procedure presented in AASHTO T 180, Method D and corrected with AASHTO T 224.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Plant, Equipment, and Tools;

List of proposed equipment to be used in performance of construction work, including descriptive data.

SD-06 Test Reports

Sampling and testing; G, RO
Field Density Tests; G, RO

Calibration curves and related test results prior to using the device or equipment being calibrated. Copies of field test results within 24 hours after the tests are performed. Certified copies of test results for approval not less than 15 days before material is required for the work.

1.4 SAMPLING AND TESTING

Sampling and testing shall be the responsibility of the Contractor. Sampling and testing shall be performed by a testing laboratory approved in accordance with Section 01451A CONTRACTOR QUALITY CONTROL. Work requiring testing will not be permitted until the testing laboratory has been inspected and approved. The materials shall be tested to establish compliance with the specified requirements; testing shall be performed at the specified frequency. The Contracting Officer may specify the time and location of the tests. Copies of test results shall be furnished to the Contracting Officer within 24 hours of completion of the tests.

1.4.1 Sampling

Samples for laboratory testing shall be taken in conformance with ASTM D 75. When deemed necessary, the sampling will be observed by the Contracting Officer.

1.4.2 Tests

The following tests shall be performed in conformance with the applicable standards listed.

1.4.2.1 Sieve Analysis

Sieve analysis shall be made in conformance with ASTM C 117 and ASTM C 136. Sieves shall conform to ASTM E 11. Particle-size analysis of the soils shall also be completed in conformance with ASTM D 422.

1.4.2.2 Liquid Limit and Plasticity Index

Liquid limit and plasticity index shall be determined in accordance with ASTM D 4318.

1.4.2.3 Moisture-Density Determinations

The maximum density and optimum moisture content shall be determined in accordance with AASHTO T 180, Method D and corrected with AASHTO T 224. To maintain the same percentage of coarse material, the "remove and replace" procedure as described in the NOTE 8 in Paragraph 7.2 of AASHTO T 180 shall be used.

1.4.2.4 Field Density Tests

Density shall be field measured in accordance with ASTM D 1556, ASTM D 2167 or ASTM D 2922. For the method presented in ASTM D 1556 the base plate as shown in the drawing shall be used. For the method presented in ASTM D 2922 the calibration curves shall be checked and adjusted if necessary using only the sand cone method as described in paragraph Calibration, of the ASTM publication. Tests performed in accordance with ASTM D 2922 result in a wet unit weight of soil and when using this method, ASTM D 3017 shall be used to determine the moisture content of the soil. The calibration curves furnished with the moisture gauges shall also be checked along with density calibration checks as described in ASTM D 3017. The calibration checks of both the density and moisture gauges shall be made by the prepared containers of material method, as described in paragraph Calibration of ASTM D 2922, on each different type of material being tested at the beginning of a job and at intervals as directed.

1.4.2.5 Wear Test

Wear tests shall be made on GCA course material in conformance with ASTM C 131.

1.4.2.6 Soundness

Soundness tests shall be made on GCA in accordance with ASTM C 88.

1.4.3 Testing Frequency

1.4.3.1 Initial Tests

One of each of the following tests shall be performed on the proposed material prior to commencing construction to demonstrate that the proposed material meets all specified requirements when furnished. If materials from more than one source are going to be utilized, this testing shall be completed for each source.

- a. Sieve Analysis .
- b. Liquid limit and plasticity index.
- c. Moisture-density relationship.
- d. Wear.
- e. Soundness.

1.4.3.2 In Place Tests

Each of the following tests shall be performed on samples taken from the placed and compacted GCA. Samples shall be taken and tested at the rates indicated.

- a. Density tests shall be performed on every lift of material placed and at a frequency of one set of tests for every 250 square yards , or portion thereof, of completed area.
- b. Sieve Analysis shall be performed for every 500 tons , or portion thereof, of material placed.
- c. Liquid limit and plasticity index tests shall be performed at the same frequency as the sieve analysis.

1.4.4 Approval of Material

The source of the material shall be selected 15 days prior to the time the material will be required in the work. Tentative approval of material will be based on initial test results. Final approval of the materials will be based on sieve analysis, liquid limit, and plasticity index tests performed on samples taken from the completed and fully compacted GCA.

1.5 WEATHER LIMITATIONS

Construction shall be done when the atmospheric temperature is above 35 degrees F. When the temperature falls below 35 degrees F, the Contractor shall protect all completed areas by approved methods against detrimental

effects of freezing. Completed areas damaged by freezing, rainfall, or other weather conditions shall be corrected to meet specified requirements.

1.6 PLANT, EQUIPMENT, AND TOOLS

All plant, equipment, and tools used in the performance of the work will be subject to approval before the work is started and shall be maintained in satisfactory working condition at all times. The equipment shall be adequate and shall have the capability of producing the required compaction, meeting grade controls, thickness control, and smoothness requirements as set forth herein.

PART 2 PRODUCTS

2.1 AGGREGATES

The GCA shall consist of clean, sound, durable particles of crushed stone, crushed gravel, crushed recycled concrete, angular sand, or other approved material. GCA shall be free of silt and clay as defined by ASTM D 2487, organic matter, and other objectionable materials or coatings. The portion retained on the No. 4 sieve shall be known as coarse aggregate; that portion passing the No. 4 sieve shall be known as fine aggregate.

2.1.1 Recycling PCC Pavement

Existing PCC pavement may be crushed and reused as Graded Crushed Aggregate provided the crushed material and the native soils/groundwater meet all of the following requirements.

- a. Crushed material must meet specified gradation requirements for the intended use.
- b. Crushed material must meet the quality requirements for the intended used. Quality includes meeting specification requirements for sulfate soundness, Abrasion loss, flat and/or elongated particles.
- c. Recycled concrete aggregates proposed for use shall be evaluated and tested by the Contractor for alkali-aggregate reactivity in accordance with ASTM C 1260. Test results shall have a measured expansion equal to or less than 0.08 percent at 16 days after casting. Should the test data indicate an expansion greater than 0.08 percent, the recycled concrete aggregate shall be rejected.
- d. Subgrade soils must be tested in accordance with CRD-C 403 "Method for Determination of Sulfate Ion in Soils and Water" to determine the presence of sulfates. Subgrade soils must have sulfate concentrations below 0.05% (by weight) to allow use of recycled concrete as a project material.
- e. Groundwater collected from borings within the project site must be tested in accordance with ASTM D 516 "Standard Test Method for Sulfate Ion in Water" to determine the presence of sulfates. Groundwater must have a sulfate concentration below 75 ppm to allow use of recycled concrete as a project material.

2.1.2 Coarse Aggregate

Coarse aggregates shall be angular particles of uniform density. When the coarse aggregate is supplied from more than one source, aggregate from each source shall meet the specified requirements and shall be stockpiled separately.

- a. Crushed Gravel: Crushed gravel shall be manufactured by crushing gravels, and shall meet all the requirements specified below.

b. Crushed Stone: Crushed stone shall consist of freshly mined quarry rock, and shall meet all the requirements specified below.

c. Crushed Recycled Concrete: Crushed recycled concrete shall consist of previously hardened portland cement concrete or other concrete containing pozzolanic binder material. The recycled material shall be free of all reinforcing steel, bituminous concrete surfacing, and any other foreign material and shall be crushed and processed to meet the required gradations for coarse aggregate. Crushed recycled concrete shall meet all other applicable requirements specified below.

2.1.2.1 Graded-Crushed Aggregate Base Course

GCA coarse aggregate shall not show more than 50 percent loss when subjected to the Los Angeles abrasion test in accordance with ASTM C 131. GCA coarse aggregate shall not exhibit a loss greater than 40 percent weighted average, at five cycles, when tested for soundness in magnesium sulfate in accordance with ASTM C 88. The amount of flat and elongated particles shall not exceed 20 percent for the fraction retained on the 1/2 inch sieve nor 20 percent for the fraction passing the 1/2 inch sieve. A flat particle is one having a ratio of width to thickness greater than 3; an elongated particle is one having a ratio of length to width greater than 3. In the portion retained on each sieve specified, the crushed aggregate shall contain at least 90 percent by weight of crushed pieces having two or more freshly fractured faces with the area of each face being at least equal to 75 percent of the smallest midsectional area of the piece. When two fractures are contiguous, the angle between planes of the fractures must be at least 30 degrees in order to count as two fractured faces. Crushed gravel shall be manufactured from gravel particles 90 percent of which by weight are retained on the maximum size sieve listed in TABLE 1.

2.1.3 Fine Aggregate

Fine aggregates shall be angular particles of uniform density. When the fine aggregate is supplied from more than one source, aggregate from each source shall meet the specified requirements.

2.1.3.1 Aggregate Base Course

ABC fine aggregate shall consist of screenings, angular sand, crushed recycled concrete fines, or other finely divided mineral matter processed or naturally combined with the coarse aggregate.

2.1.3.2 Graded-Crushed Aggregate Base Course

GCA fine aggregate shall consist of angular particles produced by crushing stone, recycled concrete, or gravel that meets the requirements for wear and soundness specified for GCA coarse aggregate. Fine aggregate shall be produced by crushing only particles larger than No. 4 sieve in size. The fine aggregate shall contain at least 90 percent by weight of particles having two or more freshly fractured faces in the portion passing the No. 4 sieve and retained on the No. 10 sieve, and in the portion passing the No. 10 sieve and retained on the No. 40 sieve.

2.1.4 Gradation Requirements

The specified gradation requirements shall apply to the completed base course. The aggregates shall have a maximum size of 1.5 inches and shall be continuously well graded within the limits specified in TABLE 1. Sieves shall conform to ASTM E 11.

TABLE I. GRADATION OF AGGREGATES

Percentage by Weight Passing Square-Mesh Sieve

Sieve Designation	No. 2
2 inch	----
1-1/2 inch	100
1 inch	60-100
1/2 inch	30-65
No. 4	20-50
No. 10	15-40
No. 40	5-25
No. 200	0-8

NOTE 1: Particles having diameters less than 0.0008 inch shall not be in excess of 3 percent by weight of the total sample tested.

NOTE 2: The values are based on aggregates of uniform specific gravity. If materials from different sources are used for the coarse and fine aggregates, they shall be tested in accordance with ASTM C 127 and ASTM C 128 to determine their specific gravities. If the specific gravities vary by more than 10 percent, the percentages passing the various sieves shall be corrected as directed by the Contracting Officer.

2.1.5 Liquid Limit and Plasticity Index

Liquid limit and plasticity index requirements shall apply to the completed course and shall also apply to any component that is blended to meet the required gradation. The portion of any component or of the completed course passing the No. 40 sieve shall be either nonplastic or have a liquid limit not greater than 25 and a plasticity index not greater than 5.

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

When the GCA is constructed in more than one layer, the previously constructed layer shall be cleaned of loose and foreign matter by sweeping with power sweepers or power brooms, except that hand brooms may be used in areas where power cleaning is not practicable. Adequate drainage shall be provided during the entire period of construction to prevent water from collecting or standing on the working area. Line and grade stakes shall be provided as necessary for control. Grade stakes shall be in lines parallel to the centerline of the area under construction and suitably spaced for string lining.

3.2 OPERATION OF AGGREGATE SOURCES

Aggregates shall be obtained from offsite sources.

3.3 STOCKPILING MATERIAL

Prior to stockpiling of material, storage sites shall be cleared and leveled by the Contractor. All materials, including approved material available from excavation and grading, shall be stockpiled in the manner and at the locations designated. Aggregates shall be stockpiled on the cleared and leveled areas designated by the Contracting Officer to prevent segregation. Materials obtained from different sources shall be stockpiled separately.

3.4 PREPARATION OF UNDERLYING COURSE

Prior to constructing the GCA, the underlying course or subgrade shall be cleaned of all foreign substances. At the time of construction of the GCA, the underlying course shall contain no frozen material. The surface of the underlying course or subgrade shall meet specified compaction and surface tolerances. The underlying course shall conform to Section 02300 EARTHWORK, Section 02721A SUBBASE COURSES or Section 02714A DRAINAGE LAYER. Ruts or soft yielding spots in the underlying courses, areas having inadequate compaction, and deviations of the surface from the requirements set forth herein shall be corrected by loosening and removing soft or unsatisfactory material and by adding approved material, reshaping to line and grade, and recompacting to specified density requirements. For cohesionless underlying courses containing sands or gravels, as defined in ASTM D 2487, the surface shall be stabilized prior to placement of the GCA. Stabilization shall be accomplished by mixing GCA into the underlying course and compacting by approved methods. The stabilized material shall be considered as part of the underlying course and shall meet all requirements of the underlying course. The finished underlying course shall not be disturbed by traffic or other operations and shall be maintained by the Contractor in a satisfactory condition until the GCA is placed.

3.5 INSTALLATION

3.5.1 Mixing the Materials

The coarse and fine aggregates shall be mixed in a stationary plant, or in a traveling plant or bucket loader on an approved paved working area. The Contractor shall make adjustments in mixing procedures or in equipment as directed to obtain true grades, to minimize segregation or degradation, to obtain the required water content, and to insure a satisfactory GCA meeting all requirements of this specification.

3.5.2 Placing

The mixed material shall be placed on the prepared subgrade or subbase in layers of uniform thickness with an approved spreader. When a compacted layer 6 inches or less in thickness is required, the material shall be placed in a single layer. When a compacted layer in excess of 6 inches is required, the material shall be placed in layers of equal thickness. No layer shall exceed 6 inches or less than 3 inches when compacted. The layers shall be so placed that when compacted they will be true to the grades or levels required with the least possible surface disturbance. Where the GCA is placed in more than one layer, the previously constructed

layers shall be cleaned of loose and foreign matter by sweeping with power sweepers, power brooms, or hand brooms, as directed. Such adjustments in placing procedures or equipment shall be made as may be directed to obtain true grades, to minimize segregation and degradation, to adjust the water content, and to insure an acceptable GCA.

3.5.3 Grade Control

The finished and completed GCA shall conform to the lines, grades, and cross sections shown. Underlying material(s) shall be excavated and prepared at sufficient depth for the required GCA thickness so that the finished GCA with the subsequent surface course will meet the designated grades.

3.5.4 Edges of Base Course

The GCA shall be placed so that the completed section will be a minimum of 2 feet wider, on all sides, than the next layer that will be placed above it. Additionally, approved fill material shall be placed along the outer edges of GCA in sufficient quantities to compact to the thickness of the course being constructed, or to the thickness of each layer in a multiple layer course, allowing in each operation at least a 2 foot width of this material to be rolled and compacted simultaneously with rolling and compacting of each layer of GCA. If this base course material is to be placed adjacent to another pavement section, then the layers for both of these sections shall be placed and compacted along this edge at the same time.

3.5.5 Compaction

Each layer of the GCA shall be compacted as specified with approved compaction equipment. Water content shall be maintained during the compaction procedure to within plus or minus 2 percent of the optimum water content determined from laboratory tests as specified in paragraph SAMPLING AND TESTING. Rolling shall begin at the outside edge of the surface and proceed to the center, overlapping on successive trips at least one-half the width of the roller. Alternate trips of the roller shall be slightly different lengths. Speed of the roller shall be such that displacement of the aggregate does not occur. In all places not accessible to the rollers, the mixture shall be compacted with hand-operated power tampers. Compaction shall continue until each layer has a degree of compaction that is at least 100 percent of laboratory maximum density through the full depth of the layer. The Contractor shall make such adjustments in compacting or finishing procedures as may be directed to obtain true grades, to minimize segregation and degradation, to reduce or increase water content, and to ensure a satisfactory GCA. Any materials that are found to be unsatisfactory shall be removed and replaced with satisfactory material or reworked, as directed, to meet the requirements of this specification.

3.5.6 Thickness

Compacted thickness of the aggregate course shall be as indicated. No individual layer shall exceed 6 inches nor be less than 3 inches in compacted thickness. The total compacted thickness of the GCA course shall be within 1/2 inch of the thickness indicated. Where the measured thickness is more than 1/2 inch deficient, such areas shall be corrected by scarifying, adding new material of proper gradation, reblading, and recompacting as directed. Where the measured thickness is more than 1/2

inch thicker than indicated, the course shall be considered as conforming to the specified thickness requirements. Average job thickness shall be the average of all thickness measurements taken for the job, but shall be within 1/4 inch of the thickness indicated. The total thickness of the GCA course shall be measured at intervals in such a manner as to ensure one measurement for each 500 square yards of base course. Measurements shall be made in 3 inch diameter test holes penetrating the base course.

3.5.7 Proof Rolling

Proof rolling of the GCA under the bituminous overrun pavement shall be in addition to the compaction specified and shall consist of the application of 30 coverages with a heavy pneumatic-tired roller having four or more tires, each loaded to a minimum of 30,000 pounds and inflated to a minimum of 150 psi. Proof rolling of GCA under bituminous shoulder pavement is not required. In areas designated, proof rolling shall be applied to the top of the underlying material on which GCA is laid and to each layer of GCA. Water content of the underlying material shall be maintained at optimum or at the percentage directed from start of compaction to completion of proof rolling of that layer. Water content of each layer of the GCA shall be maintained at the optimum percentage directed from start of compaction to completion of proof rolling. Any GCA materials or any underlying materials that produce unsatisfactory results by proof rolling shall be removed and replaced with satisfactory materials, recompacted and proof rolled to meet these specifications.

3.5.8 Finishing

The surface of the top layer of GCA shall be finished after final compaction and proof rolling by cutting any overbuild to grade and rolling with a steel-wheeled roller. Thin layers of material shall not be added to the top layer of base course to meet grade. If the elevation of the top layer of GCA is 1/2 inch or more below grade, then the top layer should be scarified to a depth of at least 3 inches and new material shall be blended in, compacted and proof rolled to bring to grade. Adjustments to rolling and finishing procedures shall be made as directed to minimize segregation and degradation, obtain grades, maintain moisture content, and insure an acceptable base course. Should the surface become rough, corrugated, uneven in texture, or traffic marked prior to completion, the unsatisfactory portion shall be scarified, reworked and recompacted or it shall be replaced as directed.

3.5.9 Smoothness

The surface of the top layer shall show no deviations in excess of 3/8 inch when tested with a 10 or 12 foot straightedge. Measurements shall be taken in successive positions parallel to the centerline of the area to be paved. Measurements shall also be taken perpendicular to the centerline at 50 foot intervals. Deviations exceeding this amount shall be corrected by removing material and replacing with new material, or by reworking existing material and compacting it to meet these specifications.

3.6 TRAFFIC

Completed portions of the GCA course may be opened to limited traffic, provided there is no marring or distorting of the surface by the traffic. Heavy equipment shall not be permitted except when necessary to construction, and then the area shall be protected against marring or damage to the completed work.

3.7 MAINTENANCE

The GCA shall be maintained in a satisfactory condition until the full pavement section is completed and accepted. Maintenance shall include immediate repairs to any defects and shall be repeated as often as necessary to keep the area intact. Any GCA that is not paved over prior to the onset of winter, shall be retested to verify that it still complies with the requirements of this specification. Any area of GCA that is damaged shall be reworked or replaced as necessary to comply with this specification.

3.8 DISPOSAL OF UNSATISFACTORY MATERIALS

Any unsuitable materials that must be removed shall be disposed of as directed . No additional payments will be made for materials that must be replaced.

-- End of Section --

SECTION 02748A

BITUMINOUS TACK AND PRIME COATS

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
(AASHTO)

AASHTO M 81	(1992; R 2000) Cut-Back Asphalt (Rapid-Curing Type)
AASHTO M 82	(1975; R 2000) Cut-Back Asphalt (Medium-Curing Type)
AASHTO T 40	(2002) Sampling Bituminous Materials

ASTM INTERNATIONAL (ASTM)

ASTM D 140	(2001) Sampling Bituminous Materials
ASTM D 2027	(1997) Cutback Asphalt (Medium-Curing Type)
ASTM D 2028	(1997) Cutback Asphalt (Rapid-Curing Type)
ASTM D 2397	(2002) Cationic Emulsified Asphalt
ASTM D 2995	(1999) Determining Application Rate of Bituminous Distributors
ASTM D 977	(2003) Emulsified Asphalt

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-06 Test Reports

Sampling and Testing; G, RO

Copies of all test results for bituminous materials, within 24 hours of completion of tests. Certified copies of the manufacturer's test reports indicating compliance with applicable

specified requirements, not less than 30 days before the material is required in the work.

1.3 PLANT, EQUIPMENT, MACHINES AND TOOLS

1.3.1 General Requirements

Plant, equipment, machines and tools used in the work shall be subject to approval and shall be maintained in a satisfactory working condition at all times.

1.3.2 Bituminous Distributor

The distributor shall have pneumatic tires of such size and number to prevent rutting, shoving or otherwise damaging the base surface or other layers in the pavement structure. The distributor shall be designed and equipped to spray the bituminous material in a uniform coverage at the specified temperature, at readily determined and controlled rates with an allowable variation from the specified rate of not more than plus or minus 5 percent, and at variable widths. Distributor equipment shall include a separate power unit for the bitumen pump, full-circulation spray bars, tachometer, pressure gauges, volume-measuring devices, adequate heaters for heating of materials to the proper application temperature, a thermometer for reading the temperature of tank contents, and a hand hose attachment suitable for applying bituminous material manually to areas inaccessible to the distributor. The distributor shall be equipped to circulate and agitate the bituminous material during the heating process.

1.3.3 Power Brooms and Power Blowers

Power brooms and power blowers shall be suitable for cleaning the surfaces to which the bituminous coat is to be applied.

1.4 WEATHER LIMITATIONS

Bituminous coat shall be applied only when the surface to receive the bituminous coat is dry. Bituminous coat shall be applied only when the atmospheric temperature in the shade is 50 degrees F or above and when the temperature has not been below 35 degrees F for the 12 hours prior to application.

PART 2 PRODUCTS

2.1 TACK COAT

Emulsified asphalt shall conform to ASTM D 977 or ASTM D 2397 or Grade SS-1H or CSS-1H. Cutback asphalt shall conform to ASTM D 2028 or AASHTO M 81, Grade RC-70.

2.2 PRIME COAT

Cutback asphalt shall conform to ASTM D 2027 or AASHTO M 82, Grade MC-30, MC-70, or MC-250.

PART 3 EXECUTION

3.1 PREPARATION OF SURFACE

Immediately before applying the bituminous coat, all loose material, dirt,

clay, or other objectionable material shall be removed from the surface to be treated. The surface shall be dry and clean at the time of treatment.

3.2 APPLICATION RATE

The exact quantities within the range specified, which may be varied to suit field conditions, will be determined by the Contracting Officer.

3.2.1 Tack Coat

Bituminous material for the tack coat shall be applied in quantities of not less than 0.05 gallon nor more than 0.15 gallon per square yard of pavement surface.

3.2.2 Prime Coat

Bituminous material for the prime coat shall be applied in quantities of not less than 0.15 gallon nor more than 0.40 gallon per square yard of pavement surface.

3.3 APPLICATION TEMPERATURE

3.3.1 Viscosity Relationship

Asphalt application temperature shall provide an application viscosity between 10 and 60 seconds, Saybolt Furol, or between 20 and 120 centistokes, kinematic. The temperature viscosity relation shall be furnished to the Contracting Officer.

3.3.2 Temperature Ranges

The viscosity requirements shall determine the application temperature to be used. The following is a normal range of application temperatures:

Liquid Asphalts

MC-30	85-190 degrees F
MC-70	120-225 degrees F
MC-250	165-270 degrees F
RC-70	120-200 degrees F*

Emulsions

SS-1h	70-160 degrees F
CSS-1h	70-160 degrees F

*These temperature ranges exceed the flash point of the material and care should be taken in their heating.

3.4 APPLICATION

3.4.1 General

Following preparation and subsequent inspection of the surface, the bituminous coat shall be applied at the specified rate with uniform distribution over the surface to be treated. All areas and spots missed by the distributor shall be properly treated with the hand spray. Until the

succeeding layer of pavement is placed, the surface shall be maintained by protecting the surface against damage and by repairing deficient areas at no additional cost to the Government. If required, clean dry sand shall be spread to effectively blot up any excess bituminous material. No smoking, fires, or flames other than those from the heaters that are a part of the equipment shall be permitted within 25 feet of heating, distributing, and transferring operations of bituminous material other than bituminous emulsions. All traffic, except for paving equipment used in constructing the surfacing, shall be prevented from using the underlying material, whether primed or not, until the surfacing is completed. The bituminous coat shall conform to all requirements as described herein.

3.4.2 Prime Coat

The prime coat will be required if it will be at least seven days before a the surfacing (Asphalt cement hot mix concrete) layer is constructed on the underlying (base course, etc) compacted material. The type of liquid asphalt and application rate will be as specified herein. The Contractor shall protect the underlying from any damage (water, traffic, etc.) until the surfacing is placed. If the Contractor places the surfacing within seven days, the choice of protection measures or actions to be taken is at the Contractor's option. Damage to the underlying material caused by lack of, or inadequate, protection shall be repaired (recompacted or replaced) by approved methods at no additional cost to the Government. If the Contractor options to use the prime coat, it shall be applied as soon as possible after consolidation of the underlying material. To obtain uniform application of the prime coat on the surface treated at the junction of previous and subsequent applications, building paper shall be spread on the surface for a sufficient distance back from the ends of each application to start and stop the prime coat on the paper. Immediately after application, the building paper shall be removed and destroyed.

3.4.3 Tack Coat

Tack coat shall be applied at the locations shown on the drawings.

3.5 CURING PERIOD

Following application of the bituminous material and prior to application of the succeeding layer of pavement, the bituminous coat shall be allowed to cure and to obtain evaporation of any volatiles or moisture. Prime coat shall be allowed to cure without being disturbed for a period of at least 48 hours or longer, as may be necessary to attain penetration into the treated course.

3.6 FIELD QUALITY CONTROL

Samples of the bituminous material shall be tested for compliance with the applicable specified requirements. A sample shall be obtained and tested by the Contractor for every 1,000 gallons of bituminous material used used shall be obtained by the Contractor as directed, under the supervision of the Contracting Officer. The sample may be retained and tested by the Government at no cost to the Contractor.

3.7 SAMPLING AND TESTING

Sampling and testing shall be performed by an approved commercial testing laboratory or by facilities furnished by the Contractor. No work requiring testing will be permitted until the facilities have been inspected and

approved.

3.7.1 Sampling

The samples of bituminous material, unless otherwise specified, shall be in accordance with ASTM D 140 or AASHTO T 40. Sources from which bituminous materials are to be obtained shall be selected and notification furnished the Contracting Officer within 15 days after the award of the contract.

3.7.2 Calibration Test

The Contractor shall furnish all equipment, materials, and labor necessary to calibrate the bituminous distributor. Calibration shall be made with the approved job material and prior to applying the bituminous coat material to the prepared surface. Calibration of the bituminous distributor shall be in accordance with ASTM D 2995.

3.7.3 Trial Applications

Before providing the complete bituminous coat, three lengths of at least 100 feet for the full width of the distributor bar shall be applied to evaluate the amount of bituminous material that can be satisfactorily applied.

3.7.3.1 Tack Coat Trial Application Rate

Unless otherwise authorized, the trial application rate of bituminous tack coat materials shall be applied in the amount of 0.05 gallons per square yard. Other trial applications shall be made using various amounts of material as may be deemed necessary.

3.7.3.2 Prime Coat Trial Application Rate

Unless otherwise authorized, the trial application rate of bituminous materials shall be applied in the amount of 0.25 gallon per square yard. Other trial applications shall be made using various amounts of material as may be deemed necessary.

3.7.4 Sampling and Testing During Construction

Quality control sampling and testing shall be performed as required in paragraph FIELD QUALITY CONTROL.

-- End of Section --

SECTION 02749

HOT-MIX ASPHALT (HMA) FOR AIRFIELDS

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
(AASHTO)

AASHTO MP 1a (2003) Performance Graded Asphalt Binder

AASHTO TP53 (2000) Determining Asphalt Content of Hot Mix Asphalt by the Ignition Method **

ASPHALT INSTITUTE (AI)

AI MS-02 (6th Edition; R 1997) Mix Design Methods for Asphalt

ASTM INTERNATIONAL (ASTM)

ASTM C 117 (2003) Materials Finer Than 75 micrometer (No. 200) Sieve in Mineral Aggregates by Washing

ASTM C 1252 (2003) Uncompacted Void Content of Fine Aggregate (as Influenced by Particle Shape, Surface Texture, and Grading)

ASTM C 127 (2001) Density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate

ASTM C 128 (2001e1) Density, Relative Density (Specific Gravity), and Absorption of Fine Aggregate

ASTM C 131 (2003) Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine

ASTM C 136 (2001) Sieve Analysis of Fine and Coarse Aggregates

ASTM C 142 (1997) Clay Lumps and Friable Particles in Aggregates

ASTM C 566 (1997) Total Evaporable Moisture Content of Aggregate by Drying

ASTM C 88 (1999a) Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate

ASTM D 140 (2001) Sampling Bituminous Materials

ASTM D 1461 (1985; R 2001) Moisture or Volatile Distillates in Bituminous Paving Mixtures

ASTM D 1559 (1989) Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus **

ASTM D 2041 (2003) Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures

ASTM D 2172 (2001e1) Quantitative Extraction of Bitumen from Bituminous Paving Mixtures

ASTM D 2419 (2002) Sand Equivalent Value of Soils and Fine Aggregate

ASTM D 242 (1995; R 2000e1) Mineral Filler for Bituminous Paving Mixtures

ASTM D 2489 (2002) Estimating Degree of Particle Coating of Bituminous-Aggregate Mixtures

ASTM D 2726 (2000) Bulk Specific Gravity and Density of Non-Absorptive Compacted Bituminous Mixtures

ASTM D 2950 (1991; R 1997) Density of Bituminous Concrete in Place by Nuclear Methods

ASTM D 3203 (1994; R 2000) Percent Air Voids in Compacted Dense and Open Bituminous Paving Mixtures

ASTM D 3665 (2002) Random Sampling of Construction Materials

ASTM D 3666 (2003) Minimum Requirements for Agencies Testing and Inspecting Road and Paving Materials

ASTM D 4125 (1994;R 2000) Asphalt Content of Bituminous Mixtures by the Nuclear Method

ASTM D 4791 (1999) Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate

ASTM D 4867/D 4867M (1996) Effect of Moisture on Asphalt Concrete Paving Mixtures

ASTM D 5444 (1998) Mechanical Size Analysis of Extracted Aggregate

ASTM D 6307 (1998) Asphalt Content of Hot Mix Asphalt by Ignition Method

ASTM D 995 (1995b; R 2002) Mixing Plants for Hot-Mixed, Hot-Laid Bituminous Paving Mixtures

STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION (CDT)

CDT Test 526 (2002) Test Method for Operation of California Profilograph and Evaluation of Profiles

U.S. ARMY CORPS OF ENGINEERS (USACE)

COE CRD-C 171 (1995) Standard Test Method for Determining Percentage of Crushed Particles in Aggregate

COE CRD-C 650-95 (1995) Standard Method for Density and Percent Voids of Compacted Bituminous Paving Mixtures

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Placement Plan; G, RO

Proposed placement plan, indicating lane widths, longitudinal joints, and transverse joints for each course or lift.

SD-03 Product Data

Mix Design; G, RO

Proposed JMF.

Contractor Quality Control; G, RO

Quality control plan.

SD-04 Samples

Asphalt Cement Binder

5 gallon sample for mix design verification.

Aggregates

Sufficient materials to produce 200 lb of blended mixture for mix design verification.

SD-06 Test Reports

Aggregates; G, RO
QC Monitoring

Bituminous Pavement Repair; G, RO

Prior to the start of bituminous pavement repair, the Contractor shall mark out bituminous repair locations, and tabulate type, severity and area of repair and shall summarize all quantities. Bituminous pavement repairs shall not be allowed until all bituminous pavement repair quantities are approved.

Aggregate and QC test results.

SD-07 Certificates

Asphalt Cement Binder; G, RO

Copies of certified test data.

Testing Laboratory; G, RO

Certification of compliance.

1.3 DESCRIPTION OF WORK

The work shall consist of pavement courses composed of mineral aggregate and asphalt material heated and mixed in a central mixing plant and placed on a prepared course. HMA designed and constructed in accordance with this section shall conform to the lines, grades, thicknesses, and typical cross sections shown on the drawings. Each course shall be constructed to the depth, section, or elevation required by the drawings and shall be rolled, finished, and approved before the placement of the next course. The Contractor shall submit a Placement Plan as specified in the Submittals paragraph.

1.4 METHOD OF MEASUREMENT

1.4.1 Hot-Mix Asphalt Mixture for Airfield Pavement

The amount paid for will be the number of short tons of hot-mix asphalt mixture used in the accepted work. Hot-mix asphalt mixture for airfield pavement shall be weighed after mixing, and no separate payment will be made for weight of asphalt cement material incorporated herein.

1.4.2 Bituminous Pavement Repair

The quantity of bituminous pavement repair to be paid for will be the number of square feet of repair, constructed and accepted by the Contracting Officer. Bituminous concrete used at locations where new duct bank is installed underneath an existing bituminous concrete pavement, Section 16526A, will not be measured for payment as bituminous pavement repair, but shall be considered incidental to duct bank installation.

1.5 BASIS OF PAYMENT

1.5.1 Hot-Mix Asphalt Mixture for Airfield Pavement

Quantities of hot-mix asphalt mixture for airfield pavement, determined as specified above, will be paid for at respective contract unit prices or at reduced prices adjusted in accordance with paragraph MATERIAL ACCEPTANCE AND PERCENT PAYMENT. Payment shall constitute full compensation for furnishing all materials, equipment, plant, and tools; and for all labor and other incidentals necessary to complete work required by this section of the specification.

1.5.2 Bituminous Pavement Repair

Bituminous pavement repair, measured as specified, will be paid for at the contract unit price per square foot when completed and accepted, which shall constitute full compensation for the construction and completion of the bituminous pavement repair, including saw cuts, pavement removal, base course repair supplying and installing bituminous prime coat and hot mix asphalt, compaction and for all labor, equipment, tools, and incidentals necessary to complete the item.

1.6 ASPHALT MIXING PLANT

Plants used for the preparation of hot-mix asphalt shall conform to the requirements of ASTM D 995 with the following changes:

- a. Truck Scales. The asphalt mixture shall be weighed on approved scales furnished by the Contractor, or on certified public scales at the Contractor's expense. Scales shall be inspected and sealed at least annually by an approved calibration laboratory.
- b. Testing Facilities. The Contractor shall provide laboratory facilities at the plant for the use of the Government's acceptance testing and the Contractor's quality control testing.
- c. Inspection of Plant. The Contracting Officer shall have access at all times, to all areas of the plant for checking adequacy of equipment; inspecting operation of the plant; verifying weights, proportions, and material properties; checking the temperatures maintained in the preparation of the mixtures and for taking samples. The Contractor shall provide assistance as requested, for the Government to procure any desired samples.
- d. Storage Bins. The asphalt mixture may be stored in non-insulated storage bins for a period of time not exceeding 3 hours. The asphalt mixture may be stored in insulated storage bins for a period of time not exceeding 8 hours. The mix drawn from bins shall meet the same requirements as mix loaded directly into trucks.

1.7 HAULING EQUIPMENT

Trucks used for hauling hot-mix asphalt shall have tight, clean, and smooth metal beds. To prevent the mixture from adhering to them, the truck beds shall be lightly coated with a minimum amount of paraffin oil, lime solution, or other approved material. Petroleum based products shall not be used as a release agent. Each truck shall have a suitable cover to protect the mixture from adverse weather. When necessary to ensure that the mixture will be delivered to the site at the specified temperature,

truck beds shall be insulated or heated and covers (tarps) shall be securely fastened. To deliver mix to the paver, the Contractor shall use a material transfer vehicle which shall be operated to produce continuous forward motion of the paver.

1.8 ASPHALT PAVERS

Asphalt pavers shall be self-propelled, with an activated screed, heated as necessary, and shall be capable of spreading and finishing courses of hot-mix asphalt which will meet the specified thickness, smoothness, and grade. The paver shall have sufficient power to propel itself and the hauling equipment without adversely affecting the finished surface.

1.8.1 Receiving Hopper

The paver shall have a receiving hopper of sufficient capacity to permit a uniform spreading operation. The hopper shall be equipped with a distribution system to place the mixture uniformly in front of the screed without segregation. The screed shall effectively produce a finished surface of the required evenness and texture without tearing, shoving, or gouging the mixture.

1.8.2 Automatic Grade Controls

If an automatic grade control device is used, the paver shall be equipped with a control system capable of automatically maintaining the specified screed elevation. The control system shall be automatically actuated from either a reference line and/or through a system of mechanical sensors or sensor-directed mechanisms or devices which will maintain the paver screed at a predetermined transverse slope and at the proper elevation to obtain the required surface. The transverse slope controller shall be capable of maintaining the screed at the desired slope within plus or minus 0.1 percent. A transverse slope controller shall not be used to control grade.

The controls shall be capable of working in conjunction with any of the following attachments:

- a. Ski-type device of not less than 30 feet in length.
- b. Taut stringline set to grade.
- c. Short ski or shoe for joint matching.
- d. Laser control.

1.9 ROLLERS

Rollers shall be in good condition and shall be operated at slow speeds to avoid displacement of the asphalt mixture. The number, type, and weight of rollers shall be sufficient to compact the mixture to the required density while it is still in a workable condition. Equipment which causes excessive crushing of the aggregate shall not be used.

1.10 WEATHER LIMITATIONS

The hot-mix asphalt shall not be placed upon a wet surface or when the surface temperature of the underlying course is less than specified in Table 1. The temperature requirements may be waived by the Contracting Officer, if requested; however, all other requirements, including compaction, shall be met.

Table 1. Surface Temperature Limitations of Underlying Course

Mat Thickness, inches	Degrees F
3 or greater	40
Less than 3	45

PART 2 PRODUCTS

2.1 AGGREGATES

Aggregates shall consist of crushed stone, crushed gravel, crushed slag, screenings, natural sand and mineral filler, as required. The portion of material retained on the No. 4 sieve is coarse aggregate. The portion of material passing the No. 4 sieve and retained on the No. 200 sieve is fine aggregate. The portion passing the No. 200 sieve is defined as mineral filler. All aggregate test results and samples shall be submitted to the Contracting Officer at least 14 days prior to start of construction. Aggregate testing shall have been performed within 90 days of performing the mix design.

2.1.1 Coarse Aggregate

Coarse aggregate shall consist of sound, tough, durable particles, free from films of material that would prevent thorough coating and bonding with the asphalt material and free from organic matter and other deleterious substances. The coarse aggregate particles shall meet the following requirements:

- a. The percentage of loss shall not be greater than 40 percent after 500 revolutions when tested in accordance with ASTM C 131.
- b. The percentage of loss shall not be greater than 18 percent after five cycles when tested in accordance with ASTM C 88 using magnesium sulfate.
- c. At least 75 percent by weight of coarse aggregate shall have at least two or more fractured faces when tested in accordance with COE CRD-C 171. Fractured faces shall be produced by crushing.
- d. The particle shape shall be essentially cubical and the aggregate shall not contain more than 20 percent, by weight, of flat and elongated particles (3:1 ratio of maximum to minimum) when tested in accordance with ASTM D 4791.
- e. Clay lumps and friable particles shall not exceed 0.3 percent, by weight, when tested in accordance with ASTM C 142.

2.1.2 Fine Aggregate

Fine aggregate shall consist of clean, sound, tough, durable particles. The aggregate particles shall be free from coatings of clay, silt, or any objectionable material and shall contain no clay balls. The fine aggregate particles shall meet the following requirements:

- a. The quantity of natural sand (noncrushed material) added to the aggregate blend shall not exceed 15 percent by weight of total

aggregate.

b. The individual fine aggregate sources shall have a sand equivalent value greater than 45 when tested in accordance with ASTM D 2419.

c. The fine aggregate portion of the blended aggregate shall have an uncompacted void content greater than 45.0 percent when tested in accordance with ASTM C 1252 Method A.

d. Clay lumps and friable particles shall not exceed 0.3 percent, by weight, when tested in accordance with ASTM C 142.

2.1.3 Mineral Filler

Mineral filler shall be nonplastic material meeting the requirements of ASTM D 242.

2.1.4 Aggregate Gradation

The combined aggregate gradation shall conform to gradations specified in Table 2, when tested in accordance with ASTM C 136 and ASTM C 117, and shall not vary from the low limit on one sieve to the high limit on the adjacent sieve or vice versa, but grade uniformly from coarse to fine.

Table 2. Aggregate Gradations

Sieve Size, inch	Gradation 2	
	Percent Passing by Mass	
1	---	
3/4	100	
1/2	76-96	
3/8	69-89	
No. 4	53-73	
No. 8	38-60	
No. 16	26-48	
No. 30	18-38	
No. 50	11-27	
No. 100	6-18	
No. 200	3-6	

2.2 ASPHALT CEMENT BINDER

Asphalt cement binder shall conform to AASHTO MP 1a Performance Grade (PG) 64-22. . Test data indicating grade certification shall be provided by the supplier at the time of delivery of each load to the mix plant. Copies of these certifications shall be submitted to the Contracting Officer. The supplier is defined as the last source of any modification to the binder. The Contracting Officer may sample and test the binder at the mix plant at any time before or during mix production. Samples for this verification testing shall be obtained by the Contractor in accordance with ASTM D 140 and in the presence of the Contracting Officer. These samples shall be furnished to the Contracting Officer for the verification testing, which shall be at no cost to the Contractor. Samples of the asphalt cement specified shall be submitted for approval not less than 14 days before start of the test section.

2.3 MIX DESIGN

The Contractor shall develop the mix design. The asphalt mix shall be composed of a mixture of well-graded aggregate, mineral filler if required, and asphalt material. The aggregate fractions shall be sized, handled in separate size groups, and combined in such proportions that the resulting mixture meets the grading requirements of the job mix formula (JMF). No hot-mix asphalt for payment shall be produced until a JMF has been approved.

The hot-mix asphalt shall be designed using hand-held hammer procedures contained in AI MS-02 and the criteria shown in Table 3. Laboratory compaction temperatures for Polymer Modified Asphalts shall be as recommended by the asphalt cement manufacturer. If the Tensile Strength Ratio (TSR) of the composite mixture, as determined by ASTM D 4867/D 4867M is less than 75, the aggregates shall be rejected or the asphalt mixture treated with an anti-stripping agent. The amount of anti-stripping agent added shall be sufficient to produce a TSR of not less than 75. If an antistrip agent is required, it shall be provided by the Contractor at no additional cost. Sufficient materials to produce 200 pound of blended mixture shall be provided to the Contracting Officer for verification of mix design at least 14 days prior to construction of test section.

2.3.1 JMF Requirements

The job mix formula shall be submitted in writing by the Contractor for approval at least 14 days prior to the start of the test section and shall include as a minimum:

- a. Percent passing each sieve size.
- b. Percent of asphalt cement.
- c. Percent of each aggregate and mineral filler to be used.
- d. Asphalt viscosity grade, penetration grade, or performance grade.
- e. Number of blows of hammer per side of molded specimen.
- f. Laboratory mixing temperature.
- g. Lab compaction temperature.
- h. Temperature-viscosity relationship of the asphalt cement.
- i. Plot of the combined gradation on the 0.45 power gradation chart, stating the nominal maximum size.
- j. Graphical plots of stability, flow, air voids, voids in the mineral aggregate, and unit weight versus asphalt content as shown in AI MS-02.
- k. Specific gravity and absorption of each aggregate.
- l. Percent natural sand.
- m. Percent particles with two or more fractured faces (in coarse aggregate).
- n. Fine aggregate angularity.

- o. Percent flat or elongated particles (in coarse aggregate).
- p. Tensile Strength Ratio.
- q. Antistrip agent (if required) and amount.
- r. List of all modifiers and amount.
- s. Correlation of hand-held hammer with mechanical hammer.
- t. Percentage and properties (asphalt content, binder properties, and aggregate properties) of RAP in accordance with paragraph RECYCLED HOT-MIX ASPHALT, if RAP is used.

Table 3. Marshall Design Criteria

Test Property	50 Blow Mix
Stability, pounds minimum	1350 ⁽¹⁾
Flow, 0.01 inch	8-18 ⁽²⁾
Air voids, percent	2-4
Percent Voids in mineral aggregate (minimum)	See Table 4
Dust Proportion ⁽³⁾	0.8-1.2
TSR, minimum percent	75

(1) This is a minimum requirement. The average during construction shall be significantly higher than this number to ensure compliance with the specifications.

(2) The flow requirement is not applicable for Polymer Modified Asphalts

(3) Dust Proportion is calculated as the aggregate content, expressed as a percent of mass, passing the No. 200 sieve, divided by the effective asphalt content, in percent of total mass of the mixture.

Table 4. Minimum Percent Voids in Mineral Aggregate (VMA)⁽⁴⁾

Aggregate (See Table 2)	Minimum VMA, percent
Gradation 2	14.0

(4) Calculate VMA in accordance with AI MS-02, based on ASTM D 2726 bulk specific gravity for the aggregate.

2.3.2 Adjustments to JMF

The JMF for each mixture shall be in effect until a new formula is approved in writing by the Contracting Officer. Should a change in sources of any materials be made, a new mix design shall be performed and a new JMF approved before the new material is used. The Contractor will be allowed to adjust the JMF within the limits specified below to optimize mix volumetric properties. Adjustments to the JMF shall be limited to plus or minus 3 percent on the 1/2 inch, No. 4. and No. 8 sieves; and plus or minus 0.40 percent binder content. Tolerances given above may permit the aggregate grading to be outside the limits shown in Table 2; this is acceptable. Adjustments to the JMF shall be limited to plus or minus 1.0 percent on the No. 200 sieve. The resulting aggregate grading shall not be outside the limits shown in Table 2. If adjustments are needed that exceed these limits, a new mix design shall be developed.

PART 3 EXECUTION

3.1 PREPARATION OF ASPHALT BINDER MATERIAL

The asphalt cement material shall be heated avoiding local overheating and providing a continuous supply of the asphalt material to the mixer at a uniform temperature. The temperature of unmodified asphalts shall be no more than 325 degrees F when added to the aggregates. Performance Graded (PG) asphalts shall be within the temperature range of 265 to 320 degrees F when added to the aggregates.

3.2 PREPARATION OF MINERAL AGGREGATE

The aggregate for the mixture shall be heated and dried prior to mixing. No damage shall occur to the aggregates due to the maximum temperature and rate of heating used. The temperature of the aggregate and mineral filler shall not exceed 350 degrees F when the asphalt cement is added. The temperature shall not be lower than is required to obtain complete coating and uniform distribution on the aggregate particles and to provide a mixture of satisfactory workability.

3.3 PREPARATION OF HOT-MIX ASPHALT MIXTURE

The aggregates and the asphalt cement shall be weighed or metered and introduced into the mixer in the amount specified by the JMF. The combined materials shall be mixed until the aggregate obtains a uniform coating of asphalt binder and is thoroughly distributed throughout the mixture. Wet mixing time shall be the shortest time that will produce a satisfactory mixture, but no less than 25 seconds for batch plants. The wet mixing time for all plants shall be established by the Contractor, based on the procedure for determining the percentage of coated particles described in ASTM D 2489, for each individual plant and for each type of aggregate used.

The wet mixing time will be set to at least achieve 95 percent of coated particles. The moisture content of all hot-mix asphalt upon discharge from the plant shall not exceed 0.5 percent by total weight of mixture as measured by ASTM D 1461.

3.4 PREPARATION OF THE UNDERLYING SURFACE

Immediately before placing the hot mix asphalt, the underlying course shall be cleaned of dust and debris. A prime coat shall be applied in accordance with the contract specifications.

3.5 TEST SECTION

Prior to full production, the Contractor shall place a test section for each JMF used. The contractor shall construct a test section 250 - 500 feet long and two paver passes wide placed in two lanes, with a longitudinal cold joint. The test section shall be of the same depth as 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 construction of the test section shall be the same equipment to be used on the remainder of the course represented by the test section. The test section shall be placed as part of the project pavement as approved by the Contracting Officer.

3.5.1 Sampling and Testing for Test Section

One random sample shall be taken at the plant, triplicate specimens compacted, and tested for stability, flow, and laboratory air voids. A portion of the same sample shall be tested for theoretical maximum density (TMD), aggregate gradation and asphalt content. Four randomly selected cores shall be taken from the finished pavement mat, and four from the longitudinal joint, and tested for density. Random sampling shall be in accordance with procedures contained in ASTM D 3665. The test results shall be within the tolerances shown in Table 5 for work to continue. If all test results meet the specified requirements, the test section shall remain as part of the project pavement. If test results exceed the tolerances shown, the test section shall be removed and replaced at no cost to the Government and another test section shall be constructed.

Table 5. Test Section Requirements for Material and Mixture Properties

Property	Specification Limit
Aggregate Gradation-Percent Passing (Individual Test Result)	
No. 4 and larger	JMF plus or minus 8
No. 8, No. 16, No. 30, and No. 50	JMF plus or minus 6
No. 100 and No. 200	JMF plus or minus 2.0
Asphalt Content, Percent (Individual Test Result)	JMF plus or minus 0.5
Laboratory Air Voids, Percent (Average of 3 specimens)	JMF plus or minus 1.0
VMA, Percent (Average of 3 specimens)	14 minimum
Stability, pounds (Average of 3 specimens)	1350 minimum
Flow, 0.01 inches (Average of 3 specimens)	8 - 18
Mat Density, Percent of TMD (Average of 4 Random Cores)	93.0 - 96.5
Joint Density, Percent of TMD (Average of 4 Random Cores)	91.5 - 96.5

Table 5. Test Section Requirements for Material and Mixture Properties

Property	Specification Limit
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3.5.2 Additional Test Sections

If the initial test section should prove to be unacceptable, the necessary adjustments to the JMF, plant operation, placing procedures, and/or rolling procedures shall be made. A second test section shall then be placed. Additional test sections, as required, shall be constructed and evaluated for conformance to the specifications. Full production shall not begin until an acceptable section has been constructed and accepted.

3.6 TESTING LABORATORY

The laboratory used to develop the JMF and for Government acceptance testing shall meet the requirements of ASTM D 3666. A certification signed by the manager of the laboratory stating that it meets these requirements or clearly listing all deficiencies shall be submitted to the Contracting Officer prior to the start of construction. The certification shall contain as a minimum:

- a. Qualifications of personnel; laboratory manager, supervising technician, and testing technicians.
- b. A listing of equipment to be used in developing the job mix.
- c. A copy of the laboratory's quality control system.
- d. Evidence of participation in the AASHTO Materials Reference Laboratory (AMRL) program.

3.7 TRANSPORTING AND PLACING

3.7.1 Transporting

The hot-mix asphalt shall be transported from the mixing plant to the site in clean, tight vehicles. Deliveries shall be scheduled so that placing and compacting of mixture is uniform with minimum stopping and starting of the paver. Adequate artificial lighting shall be provided for night placements. Hauling over freshly placed material will not be permitted until the material has been compacted as specified, and allowed to cool to 140 degrees F.

3.7.2 Placing

The mix shall be placed and compacted at a temperature suitable for obtaining density, surface smoothness, and other specified requirements. Upon arrival, the mixture shall be placed to the full width by an asphalt paver; it shall be struck off in a uniform layer of such depth that, when the work is completed, it shall have the required thickness and conform to the grade and contour indicated. The speed of the paver shall be regulated to eliminate pulling and tearing of the asphalt mat. Unless otherwise permitted, placement of the mixture shall begin along the centerline of a crowned section or on the high side of areas with a one-way slope. The mixture shall be placed in consecutive adjacent strips having a minimum width of 10 feet. The longitudinal joint in one course shall offset the longitudinal joint in the course immediately below by at least 1 foot;

however, the joint in the surface course shall be at the centerline of the pavement. Transverse joints in one course shall be offset by at least 10 feet from transverse joints in the previous course. Transverse joints in adjacent lanes shall be offset a minimum of 10 feet. On isolated areas where irregularities or unavoidable obstacles make the use of mechanical spreading and finishing equipment impractical, the mixture may be spread and luted by hand tools.

3.8 COMPACTION OF MIXTURE

After placing, the mixture shall be thoroughly and uniformly compacted by rolling. The surface shall be compacted as soon as possible without causing displacement, cracking or shoving. The sequence of rolling operations and the type of rollers used shall be at the discretion of the Contractor, with the exception that the Contractor shall not apply more than three passes with a vibratory roller in the vibrating mode. The speed of the roller shall, at all times, be sufficiently slow to avoid displacement of the hot mixture and be effective in compaction. Any displacement occurring as a result of reversing the direction of the roller, or from any other cause, shall be corrected at once. Sufficient rollers shall be furnished to handle the output of the plant. Rolling shall continue until the surface is of uniform texture, true to grade and cross section, and the required field density is obtained. To prevent adhesion of the mixture to the roller, the wheels shall be kept properly moistened but excessive water will not be permitted. In areas not accessible to the roller, the mixture shall be thoroughly compacted with hand tampers. Any mixture that becomes loose and broken, mixed with dirt, contains check-cracking, or is in any way defective shall be removed full depth, replaced with fresh hot mixture and immediately compacted to conform to the surrounding area. This work shall be done at the Contractor's expense. Skin patching will not be allowed.

3.9 JOINTS

The formation of joints shall be made ensuring a continuous bond between the courses and to obtain the required density. All joints shall have the same texture as other sections of the course and meet the requirements for smoothness and grade.

3.9.1 Transverse Joints

The roller shall not pass over the unprotected end of the freshly laid mixture, except when necessary to form a transverse joint. When necessary to form a transverse joint, it shall be made by means of placing a bulkhead or by tapering the course. The tapered edge shall be cut back to its full depth and width on a straight line to expose a vertical face prior to placing the adjacent lane. The cutback material shall be removed from the project. In both methods, all contact surfaces shall be given a light tack coat of asphalt material before placing any fresh mixture against the joint.

3.9.2 Longitudinal Joints

Longitudinal joints which are irregular, damaged, uncompacted, cold (less than 175 degrees F at the time of placing the adjacent lane), or otherwise defective, shall be cut back a maximum of 3 inches from the top edge of the lift with a cutting wheel to expose a clean, sound vertical surface for the full depth of the course. All cutback material shall be removed from the project. All contact surfaces shall be given a light tack coat of asphalt material prior to placing any fresh mixture against the joint. The

Contractor will be allowed to use an alternate method if it can be demonstrated that density, smoothness, and texture can be met.

3.10 CONTRACTOR QUALITY CONTROL

3.10.1 General Quality Control Requirements

The Contractor shall develop an approved Quality Control Plan. Hot-mix asphalt for payment shall not be produced until the quality control plan has been approved. The plan shall address all elements which affect the quality of the pavement including, but not limited to:

- a. Mix Design
- b. Aggregate Grading
- c. Quality of Materials
- d. Stockpile Management
- e. Proportioning
- f. Mixing and Transportation
- g. Mixture Volumetrics
- h. Moisture Content of Mixtures
- i. Placing and Finishing
- j. Joints
- k. Compaction
- l. Surface Smoothness
- m. Truck bed release agent

3.10.2 Testing Laboratory

The Contractor shall provide a fully equipped asphalt laboratory located at the plant or job site. It shall be equipped with heating and air conditioning units to maintain a temperature of 75 degrees F plus or minus 5 degrees F. Laboratory facilities shall be kept clean and all equipment shall be maintained in proper working condition. The Contracting Officer shall be permitted unrestricted access to inspect the Contractor's laboratory facility, to witness quality control activities, and to perform any check testing desired. The Contracting Officer will advise the Contractor in writing of any noted deficiencies concerning the laboratory facility, equipment, supplies, or testing personnel and procedures. When the deficiencies are serious enough to adversely affect test results, the incorporation of the materials into the work shall be suspended immediately and will not be permitted to resume until the deficiencies are corrected.

3.10.3 Quality Control Testing

The Contractor shall perform all quality control tests applicable to these specifications and as set forth in the Quality Control Program. The testing program shall include, but shall not be limited to, tests for the

control of asphalt content, aggregate gradation, temperatures, aggregate moisture, moisture in the asphalt mixture, laboratory air voids, stability, flow, in-place density, grade and smoothness. A Quality Control Testing Plan shall be developed as part of the Quality Control Program.

3.10.3.1 Asphalt Content

A minimum of two tests to determine asphalt content will be performed per lot (a lot is defined in paragraph MATERIAL ACCEPTANCE AND PERCENT PAYMENT) by one of the following methods: extraction method in accordance with ASTM D 2172, Method A or B, the ignition method in accordance with the AASHTO TP53, ASTM D 6307, or the nuclear method in accordance with ASTM D 4125, provided each method is calibrated for the specific mix being used. For the extraction method, the weight of ash, as described in ASTM D 2172, shall be determined as part of the first extraction test performed at the beginning of plant production; and as part of every tenth extraction test performed thereafter, for the duration of plant production. The last weight of ash value obtained shall be used in the calculation of the asphalt content for the mixture.

3.10.3.2 Aggregate Gradation and Specific Gravity

Aggregate gradations shall be determined a minimum of twice per lot from mechanical analysis of recovered aggregate in accordance with ASTM D 5444 or ASTM D 6307. For batch plants, aggregates shall be tested in accordance with ASTM C 136 using actual batch weights to determine the combined aggregate gradation of the mixture. The specific gravity of each aggregate size grouping shall be determined for each 20,000 tons in accordance with ASTM C 127 or ASTM C 128.

3.10.3.3 Temperatures

Temperatures shall be checked at least four times per lot, at necessary locations, to determine the temperature at the dryer, the asphalt cement in the storage tank, the asphalt mixture at the plant, and the asphalt mixture at the job site.

3.10.3.4 Aggregate Moisture

The moisture content of aggregate used for production shall be determined a minimum of once per lot in accordance with ASTM C 566.

3.10.3.5 Moisture Content of Mixture

The moisture content of the mixture shall be determined at least once per lot in accordance with ASTM D 1461 or an approved alternate procedure.

3.10.3.6 Laboratory Air Voids, Marshall Stability and Flow

Mixture samples shall be taken at least four times per lot and compacted into specimens, using 50 blows per side with the Marshall hammer as described in ASTM D 1559. After compaction, the laboratory air voids of each specimen shall be determined, as well as the Marshall stability and flow.

3.10.3.7 In-Place Density

The Contractor shall conduct any necessary testing to ensure the specified density is achieved. A nuclear gauge may be used to monitor pavement

density in accordance with ASTM D 2950.

3.10.3.8 Grade and Smoothness

The Contractor shall conduct the necessary checks to ensure the grade and smoothness requirements are met in accordance with paragraph MATERIAL ACCEPTANCE AND PERCENT PAYMENT.

3.10.3.9 Additional Testing

Any additional testing, which the Contractor deems necessary to control the process, may be performed at the Contractor's option.

3.10.3.10 QC Monitoring

The Contractor shall submit all QC test results to the Contracting Officer on a daily basis as the tests are performed. The Contracting Officer reserves the right to monitor any of the Contractor's quality control testing and to perform duplicate testing as a check to the Contractor's quality control testing.

3.10.4 Sampling

When directed by the Contracting Officer, the Contractor shall sample and test any material which appears inconsistent with similar material being produced, unless such material is voluntarily removed and replaced or deficiencies corrected by the Contractor. All sampling shall be in accordance with standard procedures specified.

3.10.5 Control Charts

For process control, the Contractor shall establish and maintain linear control charts on both individual samples and the running average of last four samples for the parameters listed in Table 6, as a minimum. These control charts shall be posted as directed by the Contracting Officer and shall be kept current at all times. The control charts shall identify the project number, the test parameter being plotted, the individual sample numbers, the Action and Suspension Limits listed in Table 6 applicable to the test parameter being plotted, and the Contractor's test results. Target values from the JMF shall also be shown on the control charts as indicators of central tendency for the cumulative percent passing, asphalt content, and laboratory air voids parameters. When the test results exceed either applicable Action Limit, the Contractor shall take immediate steps to bring the process back in control. When the test results exceed either applicable Suspension Limit, the Contractor shall halt production until the problem is solved. The Contractor shall use the control charts as part of the process control system for identifying trends so that potential problems can be corrected before they occur. Decisions concerning mix modifications shall be made based on analysis of the results provided in the control charts. The Quality Control Plan shall indicate the appropriate action which shall be taken to bring the process into control when certain parameters exceed their Action Limits.

Table 6. Action and Suspension Limits for the Parameters to be Plotted on Individual and Running Average Control Charts

Parameter to be Plotted	Individual Samples		Running Average of Last Four Samples	
	Action Limit	Suspension Limit	Action Limit	Suspension Limit
No. 4 sieve, Cumulative % Passing, deviation from JMF target; plus or minus values	6	8	4	5
No. 30 sieve, Cumulative % Passing, deviation from JMF target; plus or minus values	4	6	3	4
No. 200 sieve, Cumulative % Passing, deviation from JMF target; plus or minus values	1.4	2.0	1.1	1.5
Stability, pounds (minimum)				
50 blow JMF	950	830	1350	1230
Flow, 0.01 inches				
50 blow JMF	8 min. 18 max.	7 min. 19 max.	9 min. 17 max.	8 min. 18 max.
Asphalt content, % deviation from JMF target; plus or minus value	0.4	0.5	0.2	0.3
Laboratory Air Voids, % deviation from JMF target value	No specific action and suspension limits set since this parameter is used to determine percent payment			
In-place Mat Density, % of TMD	No specific action and suspension limits set since this parameter is used to determine percent payment			
In-place Joint Density, % of TMD	No specific action and suspension limits set since this parameter is used to determine percent payment			

3.11 MATERIAL ACCEPTANCE AND PERCENT PAYMENT

Testing for acceptability of work will be performed by the Contractor. Acceptance of the plant produced mix and in-place requirements will be on a lot to lot basis. A standard lot for all requirements will be equal to 2000 short tons. Where appropriate, adjustment in payment for individual lots of hot-mix asphalt will be made based on in-place density, laboratory air voids, grade and smoothness in accordance with the following paragraphs. Grade and surface smoothness determinations will be made on the lot as a whole. Exceptions or adjustments to this will be made in situations where the mix within one lot is placed as part of both the

intermediate and surface courses, thus grade and smoothness measurements for the entire lot cannot be made. In order to evaluate laboratory air voids and in-place (field) density, each lot will be divided into four equal sublots.

3.11.1 Percent Payment

When a lot of material fails to meet the specification requirements for 100 percent pay as outlined in the following paragraphs, that lot shall be removed and replaced. The lot pay factor is determined by taking the lowest computed pay factor based on either laboratory air voids, in-place density, grade or smoothness (each discussed below).

3.11.2 Sublot Sampling

One random mixture sample for determining laboratory air voids, theoretical maximum density, and for any additional testing the Contracting Officer desires, will be taken from a loaded truck delivering mixture to each sublot, or other appropriate location for each sublot. All samples will be selected randomly, using commonly recognized methods of assuring randomness conforming to ASTM D 3665 and employing tables of random numbers or computer programs. Laboratory air voids will be determined from three laboratory compacted specimens of each sublot sample in accordance with ASTM D 1559. The specimens will be compacted within 2 hours of the time the mixture was loaded into trucks at the asphalt plant. Samples will not be reheated prior to compaction and insulated containers will be used as necessary to maintain the temperature.

3.11.3 Additional Sampling and Testing

The Contracting Officer reserves the right to direct additional samples and tests for any area which appears to deviate from the specification requirements. The cost of any additional testing will be paid for by the Contractor. Testing in these areas will be in addition to the lot testing, and the requirements for these areas will be the same as those for a lot.

3.11.4 Laboratory Air Voids and Theoretical Maximum Density

Laboratory air voids will be calculated in accordance with ASTM D 3203 by determining the Marshall density of each lab compacted specimen using the laboratory-prepared, thoroughly dry method in ASTM D 2726 and determining the theoretical maximum density (TMD) of every other sublot sample using ASTM D 2041. Laboratory air void calculations for each sublot will use the latest theoretical maximum density values obtained, either for that sublot or the previous sublot. The mean absolute deviation of the four laboratory air void contents (one from each sublot) from the JMF air void content will be evaluated and a pay factor determined from Table 7. All laboratory air void tests will be completed and reported within 24 hours after completion of construction of each lot. The TMD is also used for computation of compaction, as required in paragraph: Mat and Joint Densities.

3.11.5 Mean Absolute Deviation

An example of the computation of mean absolute deviation for laboratory air voids is as follows: Assume that the laboratory air voids are determined from 4 random samples of a lot (where 3 specimens were compacted from each sample). The average laboratory air voids for each sublot sample are determined to be 3.5, 3.0, 4.0, and 3.7. Assume that the target air voids

from the JMF is 4.0. The mean absolute deviation is then:

$$\begin{aligned} \text{Mean Absolute Deviation} &= (|3.5 - 4.0| + |3.0 - 4.0| + |4.0 - 4.0| + |3.7 - 4.0|)/4 \\ &= (0.5 + 1.0 + 0.0 + 0.3)/4 = (1.8)/4 = 0.45 \end{aligned}$$

The mean absolute deviation for laboratory air voids is determined to be 0.45. It can be seen from Table 7 that the lot's pay factor based on laboratory air voids, is 100 percent.

Table 7. Pay Factor Based on Laboratory Air Voids

Mean Absolute Deviation of Lab Air Voids from JMF	Pay Factor, %
1.00 or less	100
1.01 and above	reject (0)

3.11.6 In-place Density

3.11.6.1 General Density Requirements

For determining in-place density, one random core (4 inches or 6 inches in diameter) will be taken by the Contractor from the mat (interior of the lane) of each subplot, and one random core will be taken from the joint (immediately over joint) of each subplot. Each random core will be full thickness of the layer being placed. When the random core is less than 1 inch thick, it will not be included in the analysis. In this case, another random core will be taken. After air drying in accordance with ASTM D 2726 for laboratory-prepared, thoroughly dry specimens, cores obtained from the mat and from the joints will be used for in-place density determination.

3.11.6.2 Mat and Joint Densities

Field densities will be conducted in accordance with COE CRD-C 650-95. The average in-place mat and joint densities are expressed as a percentage of the average TMD for the lot. The average TMD for each lot will be determined as the average TMD of the two random samples per lot. The average in-place mat density and joint density for a lot are determined and compared with Table 8 to calculate a single pay factor per lot based on in-place density, as described below. First, a pay factor for both mat density and joint density are determined from Table 8. The area associated with the joint is then determined and will be considered to be 10 feet wide times the length of completed longitudinal construction joint in the lot. This area will not exceed the total lot size. The length of joint to be considered will be that length where a new lane has been placed against an adjacent lane of hot-mix asphalt pavement, either an adjacent freshly paved lane or one paved at any time previously. The area associated with the joint is expressed as a percentage of the total lot area. A weighted pay factor for the joint is determined based on this percentage (see example below). The pay factor for mat density and the weighted pay factor for joint density is compared and the lowest selected. This selected pay factor is the pay factor based on density for the lot. When the TMD on both sides of a longitudinal joint is different, the average of these two TMD will be used as the TMD needed to calculate the percent joint density. All density results for a lot will be completed and reported within 24 hours after the construction of that lot.

Table 8. Pay Factor Based on In-place Density

Average Mat Density (4 Cores)	Pay Factor, %	Average Joint Density (4 Cores)
Between 93.1 and 96.4 93.0 or Less and Below 96.5 and Above	100.0 0.0 Reject	91.6 and Above 91.5

3.11.6.3 Pay Factor Based on In-place Density

If the pay factor for either the average mat density or average joint density is 0.0% (reject) the pay factor for the entire lot is 0.0% and the entire lot is rejected. Rejected lots shall be removed and replaced at no additional cost to the Government.

3.11.6.4 Resampling

If, in the opinion of the Contracting Officer, any or all test in a lot are non-representative of the mat/joint density, the Contracting Officer may require the Contractor to resample the mat or joint in accordance with these requirements. The old test results shall be discarded and the new test results shall be used to determine the mat/joint density.

3.11.7 Grade

Within 5 working days after completion of a particular lot incorporating the final wearing course, the Contractor shall test the final wearing surface of the pavement for conformance with specified plan grade requirements. All testing shall be performed in the presence of the Contracting Officer. The final wearing surface of pavement shall conform to the elevations and cross sections shown and shall vary not more than 0.05 foot from the plan grade established and approved at site of work. Finished surfaces at juncture with other pavements shall coincide with finished surfaces of abutting pavements. Deviation from the plan elevation will not be permitted in areas of pavements where closer conformance with planned elevation is required for the proper functioning of drainage and other appurtenant structures involved. The grade will be determined by running lines of levels at intervals of 25 feet, or less, longitudinally and transversely, to determine the elevation of the completed pavement surface. Detailed notes of the results of the testing shall be kept and a copy furnished to the Government immediately after each day's testing. In areas where the grade exceeds the 0.05 foot tolerance by more than 50 percent, the Contractor shall remove the surface lift full depth; the Contractor shall then replace the lift with hot-mix asphalt to meet specification requirements, at no additional cost to the Government. Diamond grinding may be used to remove high spots to meet grade requirements. Skin patching for correcting low areas or planing or milling for correcting high areas will not be permitted.

3.11.8 Surface Smoothness

The Contractor shall use both of the following methods to test and evaluate surface smoothness of the pavement. All testing shall be performed in the presence of the Contracting Officer. Detailed notes of the results of the testing shall be kept and a copy furnished to the Government immediately

after each day's testing. The profilograph method shall be used for all longitudinal and transverse testing, except where the runs would be less than 200 feet in length and the ends where the straightedge shall be used. Where drawings show required deviations from a plane surface (crowns, drainage inlets, etc.), the surface shall be finished to meet the approval of the Contracting Officer.

3.11.8.1 Smoothness Requirements

a. Straightedge Testing: The finished surfaces of the pavements shall have no abrupt change of 1/8 inch or more, and all pavements shall be within the tolerances specified in Table 9 when checked with an approved 12 foot straightedge.

Table 9. Straightedge Surface Smoothness--Pavements

Pavement Category	Direction of Testing	Tolerance, inches
-----	-----	-----
All other airfields and helicopter paved areas	Longitudinal	1/4
	Transverse	1/4

b. Profilograph Testing: The finished surfaces of the pavements shall have no abrupt change of 1/8 inch or more, and all pavement shall have a Profile Index not greater than specified in Table 10 when tested with an approved California-type profilograph. If the extent of the pavement in either direction is less than 200 feet, that direction shall be tested by the straightedge method and shall meet requirements specified above.

Table 10. Profilograph Surface Smoothness--Pavements

Pavement Category	Direction of Testing	Maximum Specified Profile Index (inch/mile)
-----	-----	-----
All Other Airfield & Helicopter Paved Areas	Longitudinal	9
	Transverse	9

3.11.8.2 Testing Method

After the final rolling, but not later than 24 hours after placement, the surface of the pavement in each entire lot shall be tested by the Contractor in such a manner as to reveal all surface irregularities exceeding the tolerances specified above. Separate testing of individual sublots is not required. If any pavement areas are ground, these areas shall be retested immediately after grinding. The entire area of the pavement shall be tested in both a longitudinal and a transverse direction on parallel lines. The transverse lines shall be 15 feet or less apart, as directed. The longitudinal lines shall be at the centerline of each paving lane for lines less than 20 feet and at the third points for lanes 20 feet or greater. Other areas having obvious deviations shall also be tested. Longitudinal testing lines shall be continuous across all joints.

a. Straightedge Testing. The straightedge shall be held in contact

with the surface and moved ahead one-half the length of the straightedge for each successive measurement. The amount of surface irregularity shall be determined by placing the freestanding (unleveled) straightedge on the pavement surface and allowing it to rest upon the two highest spots covered by its length, and measuring the maximum gap between the straightedge and the pavement surface in the area between these two high points.

b. Profilograph Testing. Profilograph testing shall be performed using approved equipment and procedures described in CDT Test 526. The equipment shall utilize electronic recording and automatic computerized reduction of data to indicate "must-grind" bumps and the Profile Index for the pavement. The "blanking band" shall be 0.2 inches wide and the "bump template" shall span 1 inch with an offset of 0.4 inch. The profilograph shall be operated by an approved, factory-trained operator on the alignments specified above. A copy of the reduced tapes shall be furnished the Government at the end of each day's testing.

3.11.8.3 Payment Adjustment for Smoothness

a. Straightedge Testing. Location and deviation from straightedge for all measurements shall be recorded. When 20.0 percent or more of the measurements exceed the tolerance, the lot shall be removed and replaced at no additional cost to the Government. Regardless of the above, any small individual area with surface deviation which exceeds the tolerance given above by more than 50 percent, shall be corrected by diamond grinding to meet the specification requirements above or shall be removed and replaced at no additional cost to the Government.

b. Profilograph Testing. Location and data from all profilograph measurements shall be recorded. When the Profile Index exceeds the tolerance by 4.0 inches/mile or more, the lot shall be removed and replaced at no additional cost to the Government. Regardless of the above, any small individual area with surface deviation which exceeds the tolerance given above by more than 5.0 inches/mile or more, shall be corrected by grinding to meet the specification requirements above or shall be removed and replaced at no additional cost to the Government.

c. Bumps ("Must Grind" Areas). Any bumps ("must grind" areas) shown on the profilograph trace which exceed 0.4 inch in height shall be reduced by diamond grinding until they do not exceed 0.3 inch when retested. Such grinding shall be tapered in all directions to provide smooth transitions to areas not requiring grinding. The following will not be permitted: (1) skin patching for correcting low areas, (2) planing or milling for correcting high areas. At the Contractor's option, pavement areas, including ground areas, may be rechecked with the profilograph in order to record a lower Profile Index.

3.12 BITUMINOUS PAVEMENT REPAIRS

Where directed, bituminous potholes, alligator cracking and wide cracks shall be removed and replaced. Prior to removal, the perimeter of the repair shall be sawcut full depth of the bituminous surface. The bituminous surface shall be removed full depth of the surface, approximately 2 inches. The removal method shall not damage the pavement to remain or the underlying aggregate base course. Damaged bituminous pavement and damaged aggregate base course shall be removed by the Contractor at no additional cost to the Contract. Removed material shall be disposed of in accordance with Section 02748A. Prepare, transport,

place and compact bituminous mixture in accordance with applicable sections of this specification. Test the bituminous repair surface in accordance with Paragraph 3.11 MATERIAL ACCEPTANCE AND PERCENT PAYMENT. The perimeter of the patch shall be sealed in accordance with Section 02975A.

-- End of Section --

SECTION 02753

CONCRETE PAVEMENT FOR AIRFIELDS AND OTHER HEAVY-DUTY PAVEMENTS

PART 1 GENERAL

1.1 REFERENCES

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

ACI INTERNATIONAL (ACI)

- ACI 211.1 (1991) Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete
- ACI 214.3R (1988; R 1997) Simplified Version of the Recommended Practice for Evaluation of Strength Test Results of Concrete
- ACI 305R (1999) Hot Weather Concreting
- ACI 306R (1988) Cold Weather Concreting

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

- AASHTO M 182 (1991; R 2000) Burlap Cloth Made from Jute or Kenaf

ASTM INTERNATIONAL (ASTM)

- ASTM A 184/A 184M (2001) Fabricated Deformed Steel Bar Mats for Concrete Reinforcement
- ASTM A 497/A 497M (2002) Steel Welded Wire Reinforcement, Deformed, for Concrete
- ASTM A 615/A 615M (2003a) Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
- ASTM A 775/A 775M (2001) Epoxy-Coated Reinforcing Steel Bars
- ASTM A 996/A 996M (2003b) Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement
- ASTM C 31/C 31M (2003a) Making and Curing Concrete Test Specimens in the Field
- ASTM C 33 (2003) Concrete Aggregates
- ASTM C 39/C 39M (2003) Compressive Strength of Cylindrical Concrete Specimens

ASTM C 78	(2002) Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)
ASTM C 94/C 94M	(2003a) Ready-Mixed Concrete
ASTM C 117	(2003) Materials Finer Than 75 micrometer (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C 123	(2003) Lightweight Particles in Aggregate
ASTM C 131	(2003) Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C 136	(2001) Sieve Analysis of Fine and Coarse Aggregates
ASTM C 142	(1997) Clay Lumps and Friable Particles in Aggregates
ASTM C 143/C 143M	(2000) Slump of Hydraulic Cement Concrete
ASTM C 150	(2002ae1) Portland Cement
ASTM C 172	(1999) Sampling Freshly Mixed Concrete
ASTM C 174/C 174M	(1997) Measuring Thickness of Concrete Elements Using Drilled Concrete Cores
ASTM C 192/C 192M	(2000) Making and Curing Concrete Test Specimens in the Laboratory
ASTM C 231	(2003) Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C 260	(2001) Air-Entraining Admixtures for Concrete
ASTM C 294	Ref Title
ASTM C 295	(2003) Petrographic Examination of Aggregates for Concrete
ASTM C 494/C 494M	(1999ae1) Chemical Admixtures for Concrete
ASTM C 618	(2003) Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete
ASTM C 881/C 881M	(2002) Epoxy-Resin-Base Bonding Systems for Concrete
ASTM C 989	(1999) Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars
ASTM C 1017/C 1017M	(1998) Chemical Admixtures for Use in

Producing Flowing Concrete

ASTM C 1064/C 1064M (2003) Temperature of Freshly Mixed Portland Cement Concrete

ASTM C 1077 (2003) Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation

ASTM C 1260 (2001) Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)

ASTM D 75 (2003) Sampling Aggregates

ASTM D 1751 (1999) Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)

ASTM D 1752 (1984; R 1996e1) Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction

ASTM D 2995 (1999) Determining Application Rate of Bituminous Distributors

ASTM D 3665 (2002) Random Sampling of Construction Materials

ASTM D 4791 (1999) Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate

STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION (CDT)

CDT Test 526 (2002) Test Method for Operation of California Profilograph and Evaluation of Profiles

U.S. ARMY CORPS OF ENGINEERS (USACE)

COE CRD-C 55 (1992) Test Method for Within-Batch Uniformity of Freshly Mixed Concrete

COE CRD-C 114 (1997) Test Method for Soundness of Aggregates by Freezing and Thawing of Concrete Specimens

COE CRD-C 130 (1989) Standard Recommended Practice for Estimating Scratch Hardness of Coarse Aggregates Particles

COE CRD-C 143 (1962) Specifications for Meters for Automatic Indication of Moisture in Fine Aggregate

COE CRD-C 300 (1990) Specifications for Membrane-Forming Compounds for Curing Concrete

COE CRD-C 521 (1981) Standard Test Method for Frequency and Amplitude of Vibrators for Concrete

NATIONAL READY-MIXED CONCRETE ASSOCIATION (NRMCA)

NRMCA QC 3 (2002) Quality Control Manual: Section 3, Plant Certifications Checklist: Certification of Ready Mixed Concrete Production Facilities

DEPARTMENT OF DEFENSE

MIL-DTL-24441/20 (Rev. A) Paint, Epoxy-Polyamide, Green Primer, Formula 150, Type III

1.2 SYSTEM DESCRIPTION

This section is intended to stand alone for construction of concrete pavement. However, where the construction covered herein interfaces with other sections, the construction at each interface shall conform to the requirements of both this section and the other section, including tolerances for both.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Equipment

- a. Details and data on the batching and mixing plant prior to plant assembly including manufacturer's literature showing that the equipment meets all requirements specified herein.
- b. A certified copy of the NRMCA QC Manual Section 3 Concrete Plant Certification Checklist and Calibration documentation on all measuring and weighing devices, submitted prior to uniformity testing.
- c. A description of the equipment proposed for transporting concrete mixture from the central mixing plant to the paving equipment.
- d. A description of the equipment proposed for the machine and hand placing, consolidating and curing of the concrete mixture, method of control, and manufacturer's literature on the paver and finisher, together with the manufacturer's written instructions on adjustments and operating procedures necessary to assure a tight, smooth surface on the concrete pavement. The literature shall show that the equipment meets all details of these specifications. Detailed information on automatic laser controlled systems shall be submitted if proposed for use.

Proposed Techniques; G, RO

Placing and protection methods; paving sequence; jointing pattern; data on curing equipment and profilographs; demolition of existing pavements; as specified.

Materials; RO

Quick-setting patching material, including performance history; primer for patch material.

SD-05 Design Data

Proportioning Studies; G, ED

The results of the mixture proportioning studies shall be signed and stamped by the registered professional engineer having technical responsibility for the mix design study and submitted at least 30 days prior to commencing concrete placing operations. The results shall include a statement giving the maximum nominal coarse aggregate size and the weights and volumes of each ingredient proportioned on a one cubic yard basis. Aggregate quantities shall be based on the mass in a saturated surface dry condition. The recommended mixture proportions shall be accompanied by test results demonstrating that the proportions selected will produce concrete of the qualities indicated. The submittal shall include:

- a. Coarse and fine aggregate gradations and plots.
- b. Combined aggregate gradation and coarseness/workability plots.
- c. Coarse aggregate quality test results, including deleterious materials.
- d. Fine aggregate quality test results.
- e. Mill certificates for cement, pozzolan, and GGBF slag.
- f. Certified test results for air entraining, water reducing, retarding, non-chloride accelerating, and Lithium Nitrate admixtures.
- g. Specified flexural strength, slump, and air content.
- h. Documentation for average CQC flexural strength increase.
- i. Recommended proportions/volumes for proposed mixture and each of three trial water-cementitious materials ratios.
- j. Individual beam and cylinder breaks.
- k. Flexural and compressive strength summaries and plots.
- l. Correlation ratios for acceptance testing and CQC testing.
- m. Historical record of test results, documenting production standard deviation (if available).

SD-06 Test Reports

Sampling and Testing; G, ED

Certified copies of laboratory test reports and sources for cement, pozzolan, GGBF, aggregates, admixtures, curing compound, epoxy, and proprietary patching materials proposed for use on this project. All aggregate tests shall have been performed no earlier than 6 months prior to contract award.

Spall Repair Locations; G, RO

Prior to repairing any spalls, Contractor shall mark out spall repair locations, and tabulate type and length and shall summarize all quantities. Spall repair shall not be allowed until all spall repair quantities are approved.

Pavement Removal and Replacement Locations; G, RO

Prior to removing any PCC pavement, Contractor shall mark out panel removal locations, and tabulate type and amount, and shall summarize all quantities. Removal shall not be allowed until all removal quantities are approved.

SD-07 Certificates

Contractor Quality Control Staff; G, ED

American Concrete Institute certification for Contractor Quality Control staff. Qualifications and resumes for petrographer, surveyor, concrete batch plant operator, and profilograph operator.

Laboratory Accreditation; G, ED

Accreditation of the commercial laboratory by an independent evaluation authority, indicating conformance to ASTM C 1077, including all applicable test procedures.

Commercial Laboratory; G, ED

USACE validation letter for commercial laboratory.

1.4 MEASUREMENT AND PAYMENT

1.4.1 Measurements

1.4.1.1 P.C Concrete for Airfield Pavement

The quantity of P.C. concrete for airfield pavement to be paid for will be the volume of concrete in cubic yards including thickened edges , where required, placed in the completed and accepted pavement. Concrete will be measured in place in the completed and accepted pavement only within the neat line dimensions shown in the plan and cross section. No deductions will be made for rounded or beveled edges or the space occupied by pavement reinforcement, dowel bars, tie bars, or electrical conduits, nor for any void, or other structure extending into or through the pavement slab, measuring 3 cubic feet or less in volume. No other allowance for concrete will be made unless placed in specified locations in accordance with written instructions previously issued by the Contracting Officer. The quantity of other materials specified herein, and used in the construction of the work covered by this section, will not be measured for payment, but will be considered a subsidiary obligation of the Contractor, covered under the price per cubic yard for concrete. Joint sealing materials are covered in Section 02760A FIELD MOLDED SEALANTS FOR SEALING JOINTS IN RIGID PAVEMENTS.

1.4.1.2 Partial Depth Spall Repair

The quantity of partial depth spall repair to be paid for will be the number of square feet of spall repairs, constructed and accepted by the Contracting Officer.

1.4.1.3 Removal and Replacement of P.C. Pavement

The quantity of removal and replacement of P.C. pavement to be paid for will be the number of cubic yards of removal and replacement of P.C. pavement, full panel and partial panel, constructed and accepted by the Contracting Officer. Removal and replacement of P.C. pavement for directional boring operations will not be measured for payment, but shall be considered incidental to the cost of directional boring.

1.4.2 Payments

1.4.2.1 P.C. Concrete for Airfield Pavements

The quantity of P.C. concrete for airfield pavement, measured as specified above, will be paid for at the contract unit price when placed in completed and accepted pavements. Payment shall be made at the contract price for cubic yard for the scheduled item, with necessary adjustments as specified in paragraph ACCEPTABILITY OF WORK AND PAYMENT ADJUSTMENTS. Payment will constitute full compensation for furnishing all materials, equipment, plant and tools, and for all labor and other incidentals necessary to complete the concrete pavement, except for other items specified herein for separate payment.

1.4.2.2 Partial Depth Spall Repair

Partial depth spall repair, measured as specified, will be paid for at the contract unit price per square foot when completed and accepted, which shall constitute full compensation for the construction and completion of the partial depth spall repair, including saw cuts, pavement removal, supplying and installing quick set patching material, finishing and for all labor, equipment, tools and incidentals necessary to complete the item.

1.4.2.3 Removal and Replacement of P.C. Pavement

Removal and replacement of P.C. pavement, measured as specified, will be paid for at the contract unit price per cubic yard when completed and accepted, which shall constitute full compensation for the construction and completion of the removal and replacement of P.C. pavement, both full panel and partial panel, including saw cuts, pavement removal, repair of the bituminous bond breaker or aggregate base course, supplying and installing P.C. concrete, finishing and for all labor, equipment, tools and incidentals necessary to complete the item. Removal and replacement of P.C. pavement for directional boring operations will not be paid for, but shall be considered incidental to the cost of directional boring.

1.5 ACCEPTABILITY OF WORK AND PAYMENT ADJUSTMENTS

1.5.1 Pavement Lots

A lot will be that quantity of construction that will be evaluated for acceptance with specification requirements. A lot will be equal to one shift of production not to exceed 1000 cubic yards. In order to evaluate thickness, each lot will be divided into four equal sublots. Grade

determinations will be made on the lot as a whole. Surface smoothness determinations will be made on every 0.1 mile segment in each lot. Location of all samples shall be selected on a random basis in accordance with ASTM D 3665. When operational conditions cause a lot to be terminated before the specified four sublots have been completed, the following procedure shall be used to adjust the lot size and number of tests for the lot. Where three sublots have been completed, they shall constitute a lot. Where one or two sublots have been completed, they shall be incorporated into the next lot (except for the last lot), and the total number of sublots shall be used and acceptance criteria adjusted accordingly.

1.5.2 Acceptance of Lots

When a lot of material fails to meet the specification requirements, that lot will be accepted at a reduced price or shall be removed and replaced. The lowest computed percent payment determined for any pavement characteristic (i.e., thickness, grade, and surface smoothness) discussed below shall be the actual percent payment for that lot. The actual percent payment will be applied to the bid price and the measured quantity of concrete in the lot to determine actual payment. Results of strength tests shall be used to control concreting operations. Strength will be evaluated, but will not be considered for payment adjustment. Any pavement not meeting the required 'specified strength' shall be removed and replaced at no additional cost to the Government.

1.5.3 Evaluation

The Contractor shall provide all sampling and testing required for acceptance and payment adjustment at the Contractor's expense. Individuals performing sampling, testing and inspection duties shall meet the requirements of paragraph: QUALIFICATIONS.

1.5.4 Additional Sampling and Testing

The Contracting Officer reserves the right to direct additional samples and tests for any area which appears to deviate from the specification requirements. Testing in these areas will be in addition to the subplot or lot testing, and the requirements for these areas will be the same as those for a subplot or lot. The Contractor shall provide facilities for and, where directed, personnel to assist in obtaining samples for any Government testing.

1.5.5 Surface Smoothness

The profilograph method shall be used for all longitudinal testing, except for paving lanes less than 200 feet in length. The straightedge method shall be used for transverse testing, for longitudinal testing where the length of each pavement lane is less than 200 feet, and at the ends of the paving limits for the project. Where drawings show required deviations from a plane surface (crowns, drainage inlets, etc.), the surface shall be finished to meet the approval of the Contracting Officer. Detailed notes shall be kept of the results of the testing and a copy furnished to the Government after each day's testing.

1.5.5.1 Smoothness Requirements

- a. Straightedge Testing: The finished surfaces of the pavements shall have no abrupt change of 1/4 inch or more, and all pavements shall be within the limits specified hereinafter when checked with an approved

12 foot straightedge. Runways and taxiways shall have a variation from the specified straight edge not greater than 1/8 inch in the longitudinal direction and not greater than 1/4 inch in the transverse direction. All other airfield areas shall have a variation from a straight edge not greater than 1/4 inch in either the longitudinal or transverse direction.

b. Profilograph Testing: The finished surfaces of the pavements shall have no abrupt change of 1/4 inch or more, and each 0.1 mile segment of each pavement lot shall have a Profile Index not greater than specified hereinafter when tested with an approved California-type profilograph. Runways and taxiways shall have a Profile index not greater than 7 inches per mile in the longitudinal direction. Runway and taxiway transverse smoothness shall be measured with the straight edge method and the straight edge requirements shall apply. All other airfield areas shall have a Profile Index not greater than 9 inches per mile in the longitudinal direction.

1.5.5.2 Testing Method

After the concrete has hardened sufficiently to permit walking thereon, but not later than 48 hours after placement, the entire surface of the pavement in each lot shall be tested by the Contractor in such a manner as to reveal all surface irregularities exceeding the tolerances specified above. If any pavement areas are ground, these areas shall be retested immediately after diamond grinding. The entire area of the pavement shall be tested in both a longitudinal and a transverse direction on parallel lines. The transverse lines shall be 15 feet or less apart, as directed. The longitudinal lines shall be at the centerline of each paving lane shown on the drawings, regardless of whether the Contractor is allowed to pave two lanes at a time, and at the 1/8th point in from each side of the lane. Other areas having obvious deviations shall also be tested. Longitudinal testing lines shall be continuous across all joints. Transverse testing lines for pilot lanes shall be carried to construction joint lines and for fill-in lanes shall be carried 24 inches across construction joints, and the readings in this area applied to the fill-in lane. Straightedge testing of the longitudinal edges of slipformed pilot lanes shall also be performed before paving fill-in lanes as specified in paragraph "Edge Slump and Joint Face Deformation".

a. Straightedge Testing: The straightedge shall be held in contact with the surface and moved ahead one-half the length of the straightedge for each successive measurement. The amount of surface irregularity shall be determined by placing the freestanding (unleveled) straightedge on the pavement surface and measuring the maximum gap between the straightedge and the pavement surface. Measurements shall be determined along the entire length of the straight edge.

b. Profilograph Testing: Profilograph testing shall be performed using approved equipment and procedures described in CDT Test 526. The equipment shall utilize electronic recording and automatic computerized reduction of data to indicate "must-grind" bumps and the Profile Index for each 0.1 mile segment of the pavement lot. Grade breaks on aprons shall be accommodated by breaking the profile segment into short sections and repositioning the blanking band on each section. The "blanking band" shall be 0.2 inches wide and the "bump template" shall span 1 inch with an offset of 0.4 inch. The profilograph testing of the last 30 feet of a paving lane in the longitudinal direction from

each day's paving operation shall be counted on the following day's continuation lane. The profile index shall be computed for each pass of the profilograph (3 per lane) in each 0.1 mile segment. The profile index for each segment shall be the average of the profile indices for each pass in each segment. Profilographs of unequal lengths shall be scaled and proportioned to an equivalent 0.1 mile as outlined in the CDT Test 526. A copy of the reduced tapes shall be furnished the Government at the end of each day's testing.

1.5.5.3 Payment Adjustment for Smoothness

a. Straightedge Testing: Location and deviation from straightedge for all measurements shall be recorded. When between 5.0 and 10.0 percent of all measurements made within a lot exceed the tolerance specified in paragraph "Smoothness Requirements" above, after any reduction of high spots or removal and replacement, the computed percent payment based on surface smoothness will be 95 percent. When more than 10.0 percent and less than 15.0 percent of all measurements exceed the tolerance, the computed percent payment will be 90 percent. When between 15.0 and 20.0 percent of all measurements exceed the tolerance, the computed percent payment will be 75 percent. When 20.0 percent or more of the measurements exceed the tolerance, the lot shall be removed and replaced at no additional cost to the Government.

b. Profilograph Testing: Location and data from all profilograph measurements shall be recorded. When the Profile Index of a 0.1 mile segment of a lot exceeds the tolerance specified in paragraph "Smoothness Requirements" above by 1.0 inch per mile but less than 2.0 inches per mile, after any reduction of high spots or removal and replacement, the computed percent payment based on surface smoothness will be 95 percent. When the Profile Index exceeds the tolerance by 2.0 inches per mile but less than 3.0 inches per mile, the computed percent payment will be 90 percent. When the Profile Index exceeds the tolerance by 3.0 inches per mile but less than 4.0 inches per mile, the computed percent payment will be 75 percent. When the Profile Index exceeds the tolerance by 4.0 inches per mile or more, the lot shall be removed and replaced at no additional cost to the Government.

c. Bumps ("Must Grind" Areas): Any bumps ("must grind" areas) shown on the profilograph trace which exceed 0.4 inch in height shall be reduced by diamond grinding in accordance with subparagraph "Areas Defective In Plan Grade Or Smoothness" until they do not exceed 0.3 inch when retested. Such grinding shall be tapered in all directions to provide smooth transitions to areas not requiring grinding.

1.5.6 Edge Slump and Joint Face Deformation

1.5.6.1 Edge Slump

When slip-form paving is used, not more than 15.0 percent of the total free edge of each pavement lot shall have an edge slump exceeding 1/4 inch and none of the free edge of the pavement lot shall have an edge slump exceeding 3/8 inch as determined in accordance with the measurements specified in paragraph: "Determination of Edge Slump". (The total free edge of the pavement will be considered to be the cumulative total linear measurement of pavement edge originally constructed as non-adjacent to any existing pavement; i.e., 100 feet of pilot lane originally constructed as a separate lane, will have 200 feet of free edge; 100 feet of fill-in lane will have no free edge, etc.,). The area affected by the downward movement

of the concrete along the pavement edge shall not exceed 18 inches back from the edge.

1.5.6.2 Joint Face Deformation

In addition to the edge slump limits specified above, the vertical joint face shall have a surface within the maximum limits shown below:

Offset from Straightedge Applied Longitudinally To Pavement Surface	Offset from Straightedge Applied Longitudinally To Vertical Face	Offset From Straightedge Applied Top to Bottom Against the Joint Face	Abrupt Offset in Any Direction	Offset of Joint Face From True Vertical
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Airfield Pavement

1/8 in 1/4 in 3/8 in 1/8 in 1 in 1/2 in

All other Pavement

1/4 in All other items same as airfield pavement

1.5.6.3 Determination of Edge Slump and Joint Face Deformation

Immediately after the concrete has hardened sufficiently to permit walking thereon, the pavement surface of each lot shall be tested by the Contractor. Testing shall be performed with a minimum 4 foot straightedge to reveal irregularities exceeding the edge slump tolerance specified above. The edge slump shall be determined at each free edge of each slipformed paving lane constructed. The straightedge shall be placed transverse to the direction of paving and the end of the straightedge located at the edge of the paving lane. Measurements shall be made at 5 to 15 foot spacings, as directed, commencing at the header where paving was started. Initially measurements shall be made at 5 foot intervals in each lane. When no deficiencies are present, the Contracting Officer may approve an increase in the interval. When any deficiencies exist, the interval will be returned to 5 feet. In no case shall the interval exceed 15 feet. In addition to the transverse edge slump determination above, the Contractor, at the same time, shall check the longitudinal surface smoothness of the joint on a continuous line 1 inch back from the joint line using the 12 foot straightedge advanced one-half its length for each reading. Other tests of the exposed joint face shall be made to ensure that a uniform, true vertical joint face is attained. The measurements shall be made by the Contractor, shall be properly referenced in accordance with paving lane identification and stationing, and a report given to the Contracting Officer within 24 hours after measurement is made. The report shall also identify areas requiring replacement in accordance with paragraph: "Excessive Edge Slump".

1.5.6.4 Excessive Edge Slump

When edge slump exceeding the limits specified above is encountered on either side of the paving lane, additional straightedge measurements shall be made, if required, to define the linear limits of the excessive slump. The concrete slabs having excessive edge slump or joint deformation shall be removed and replaced to the next transverse joint in conformance with

paragraph: REPAIR, REMOVAL, REPLACEMENT OF NEWLY CONSTRUCTED SLABS. Use of slip-form paving equipment and procedures that fail to consistently provide edges within the specified tolerances on edge slump and joint face deformation shall be discontinued and the pavements shall be constructed by means of standard paving procedures using fixed forms.

1.5.7 Plan Grade

1.5.7.1 Grade Conformance Tests

Within 5 days after paving of each lot, the finished surface of the pavement area shall be tested by the Contractor, by running lines of levels at intervals corresponding with every longitudinal and transverse joint to determine the elevation at each joint intersection. The results of this survey shall be recorded and a copy given to the Government at the completion of the survey of each lot. The finished surfaces of airfield runway, taxiway, and apron pavements shall vary not more than 1/2 inch above or below the plan grade line or elevation indicated. The surfaces of other pavements shall vary not more than 3/4 inch.

1.5.7.2 Payment Adjustment for Plan Grade

When more than 5.0 and less than 10.0 percent of all measurements made within a lot are outside the specified tolerance, the computed percent payment for that lot will be 95 percent. When more than 10.0 percent are outside the specified tolerances, the computed percent payment for the lot will be 75 percent. However, in any areas where the deviation from grade exceeds the specified tolerances by 50 percent or more, the deficient area shall be removed and replaced at no additional cost to the Government. The above deviations from the approved grade line and elevation will not be permitted in areas where closer conformance with the planned grade and elevation is required for the proper functioning of appurtenant structures. The finished surfaces of new abutting pavements shall coincide at their juncture.

1.5.8 Flexural Strength

Each lot of pavement will be evaluated for acceptance in accordance with the following procedures.

1.5.8.1 Sampling and Testing

For acceptance, one composite sample of concrete from each subplot shall be obtained in accordance with ASTM C 172 from one batch or truckload. Test cylinders 6 x 12 inches shall be fabricated and cured in accordance with ASTM C 31/C 31M, and tested in accordance with ASTM C 39/C 39M. Two test cylinders per subplot (8 per lot) shall be tested at 14 days.

1.5.8.2 Computations

Average the eight 14-day strength tests for the lot. The average strength shall be used in accordance with paragraph "Concrete Strength for Final Acceptance".

1.5.9 Thickness

Each lot of pavement will be evaluated for acceptance and payment adjustment in accordance with the following procedure. The Contractor

shall be responsible for drilling the cores, measuring the cores, and for filling the core holes with a non-shrink concrete, as approved.

1.5.9.1 Drilling, Measuring, and Computations

Two cores, between 4 and 6 inches in diameter, shall be drilled from the pavement, per subplot (8 per lot). Eight measurements of thickness shall be made around the circumference of each core and one in the center, in accordance with ASTM C 174/C 174M, using calibrated calipers for specimens longer than 10 inches. The pavement thickness from the 8 cores for the lot shall be averaged and shall be evaluated as described below.

1.5.9.2 Evaluation and Payment Adjustment for Thickness

Using the Average Thickness of the lot, the computed percent payment for thickness shall be determined by entering the following table:

Deficiency in Thickness Determined by Cores Inches	Computed Percent Payment for Thickness	
	Pavements Over 8 Inches Thick	Pavements Less than 8 Inches Thick
0.00 to 0.24	100	100
0.25 to 0.49	75	65
0.50 to 0.74	50	0
0.75 or greater	0	-

Where 0 percent payment is indicated, the entire lot shall be removed and replaced at no additional cost to the Government. Where either of the two cores from a subplot show a thickness deficiency of 0.75 inch or greater, two more cores shall be drilled in the subplot and the average thickness of the four cores computed. If this average shows a thickness deficiency of 0.75 inch or more the entire subplot shall be removed.

1.5.10 Areas Defective in Plan Grade or Smoothness

In areas not meeting the specified limits for surface smoothness and plan grade, high areas shall be reduced to attain the required smoothness and grade, except as depth is limited below. High areas shall be reduced by grinding the hardened concrete with an approved diamond grinding machine after the concrete is 14 days or more old. The area corrected by grinding the surface of the hardened concrete shall not exceed 5 percent of the area of any integral slab, and shall not exceed 1 percent of the total area of any subplot. The depth of diamond grinding shall not exceed 1/4 inch. All pavement areas requiring plan grade or surface smoothness corrections in excess of the limits specified above, shall be removed and replaced in conformance with paragraph REPAIR, REMOVAL, REPLACEMENT OF NEWLY CONSTRUCTED SLABS. All areas in which diamond grinding has been performed will be subject to the thickness tolerances specified in paragraph: Thickness. Any diamond grinding performed on individual slabs with excessive deficiencies shall be performed at the Contractor's own decision without entitlement to additional compensation if eventual removal of the slab is required.

1.6 ACCEPTABILITY OF WORK

The materials and the pavement itself will be accepted on the basis of tests made by the Contractor. The Government may, at its discretion, make check tests to validate the results of the Contractor's testing. If the results of the Contractor tests vary by less than 2.0 percent of the Government's test results, the results of the Contractor's tests will be used. If the results of the Government and Contractor tests vary by 2.0 percent or more, but less than 4.0 percent, the average of the two will be considered the value to be used. If these vary by 4.0 percent or more, each sampling and testing procedure shall be carefully evaluated and both the Government and the Contractor shall take another series of tests on duplicate samples of material. If these vary by 4.0 percent or more, the results of the tests made by the Government shall be used and the Government will continue check testing of this item on a continuous basis until the two sets of tests agree within less than 4.0 percent on a regular basis. Testing performed by the Government will in no way at any time relieve the Contractor from the specified testing requirements.

1.7 PRECONSTRUCTION TESTING OF MATERIALS

All sampling and testing shall be performed by, and at the expense of, the Contractor, using an approved commercial laboratory or, for cementitious materials and chemical admixtures, a laboratory maintained by the manufacturer of the material. No material shall be used until notice of acceptance has been given. The Contractor shall not be entitled to any additional payment or extension of time because of delays caused by sampling and testing additional materials, necessitated by failure of any materials. Additional tests may be performed by the Government at the discretion of the Contracting Officer; such Government testing will not relieve the Contractor of any testing responsibilities.

1.7.1 Aggregates

Aggregates shall be sampled by the Contractor in the presence of a Government representative. Samples shall be obtained in accordance with ASTM D 75 and shall be representative of the materials to be used for the project. Test results shall be submitted 7 days before commencing mixture proportioning studies.

1.7.2 Chemical Admixtures, Curing Compounds and Epoxies

At least 30 days before the material is used, the Contractor shall submit certified copies of test results for the specific lots or batches to be used on the project. Chemical admixtures that have been in storage at the project site for longer than 6 months or that have been subjected to freezing will be retested at the expense of the Contractor and shall be rejected if test results are not satisfactory.

1.7.3 Cement, Pozzolan, and GGBF Slag

Cement, ground granulated blast furnace (GGBF) slag, and pozzolan will be accepted on the basis of manufacturer's certification of compliance, accompanied by mill test reports showing that the material in each shipment meets the requirements of the specification under which it is furnished. No cementitious material shall be used until notice of acceptance has been given by the Contracting Officer. Cementitious material may be subjected to check testing by the Government from samples obtained at the mill, at transfer points, or at the project site. If tests prove that a

cementitious material that has been delivered is unsatisfactory, it shall be promptly removed from the site of the work. Cementitious material that has not been used within 6 months after testing shall be retested at the Contractor's expense and shall be rejected if test results are not satisfactory.

1.8 TESTING DURING CONSTRUCTION

During construction, the Contractor shall be responsible for sampling and testing aggregates, cementitious materials, and concrete as specified herein. The Government will sample and test concrete and ingredient materials as considered appropriate. The Contractor shall provide facilities and labor as may be necessary for procurement of representative test samples. Testing by the Government will in no way relieve the Contractor of the specified testing requirements.

1.9 QUALIFICATIONS

1.9.1 Contractor Quality Control Staff

All Contractor Quality Control personnel assigned to concrete construction shall be American Concrete Institute (ACI) certified in the following grade (or shall have written evidence acceptable to the Contracting Officer's representative of having completed similar qualification programs):

1. CQC personnel responsible for inspection of concrete paving operations: ACI Concrete Transportation Inspector.
2. Lead Foreman or Journeyman of the Concrete Placing, Finishing, and Curing Crews: ACI Concrete Flatwork Technician/Finisher.
3. Field Testing Technicians: ACI Concrete Field Testing Technician, Grade I.
4. Laboratory Testing Technicians: ACI Concrete Strength Testing Technician and Laboratory Testing Technician, Grade I or II.

1.9.2 Other Staff

Submit for approval, the qualifications and resumes for the following staff:

1. Petrographer: Bachelor of Science degree in geology or petrography, trained in petrographic examination of concrete aggregate according to ASTM C 294 and ASTM C 295 and trained in identification of the specific deleterious materials and tests identified in this specification. Resume shall detail the education, training and experience related to the project-specific test methods and deleterious materials and shall be submitted at least 20 days before petrographic and deleterious materials examination is to commence.
2. Licensed Surveyor: All survey work shall be performed under the supervision of a Licensed Surveyor.
3. Concrete Batch Plant Operator: National Ready Mix Concrete Association (NRMCA) Level 2.
4. Profilograph Operator: Certification by equipment manufacturer or a state Department of Transportation.

1.9.3 Laboratory Accreditation

Laboratory and testing facilities shall be provided by and at the expense of the Contractor. The laboratories performing the tests shall be accredited in accordance with ASTM C 1077, including ASTM C 78 and ASTM C 1260. The accreditation shall be current and shall include the required and optional test methods, as specified throughout this SECTION. Onsite temperature-controlled concrete curing facilities shall be provided.

1. Aggregate Testing and Mix Proportioning: Aggregate testing and mixture proportioning studies shall be performed by a commercial laboratory.
2. Acceptance Testing: The Contractor shall furnish all materials, labor, and facilities required for molding, curing, testing, and protecting test specimens at the site and in the laboratory. Steel molds shall be used for molding the beam specimens. The Contractor shall furnish and maintain boxes or other facilities suitable for storing and curing the specimens at the site while in the mold within the temperature range stipulated by ASTM C 31/C 31M. Flexural loading equipment shall be in accordance with ASTM C 78.
3. Contractor Quality Control: All sampling and testing shall be performed by an approved, onsite, independent, commercial laboratory, or for cementitious materials and admixtures, the manufacturer's laboratory.
4. Laboratory Inspection: The Government will inspect the laboratory equipment and test procedures prior to the start of concreting operations for conformance to ASTM C 1077. This inspection is valid for 36 months.

1.10 TEST SECTION

At least 10 days but not more than 60 days prior to construction of the concrete pavement, a test section shall be constructed near the job site, but not as part of the production pavement area. The Contractor shall use the test section to develop and demonstrate to the satisfaction of the Contracting Officer the proposed techniques of mixing, hauling, placing, consolidating, finishing, curing, initial saw cutting, start-up procedures, testing methods, plant operations, and the preparation of the construction joints. The test section shall consist of one paving lane at least 400 feet long and shall be constructed to the same thickness as the thickest portion of pavement shown on the Drawings. The lane width shall be the same as that required for use in the project. The test section shall contain at least one transverse construction joint. If doweled longitudinal construction joints are required in any of the production pavements, they shall be installed full length along one side of the test strip throughout the test section. Two separate days shall be used for construction of the test section. Variations in mixture proportions other than water shall be made if directed. The Contractor shall vary the water content, as necessary, to arrive at the appropriate content. The mixing plant shall be operated and calibrated prior to start of placing the test section. The Contractor shall use the same equipment, materials, and construction techniques on the test section as will be used in all subsequent work. Base course preparation, concrete production, placing, consolidating, curing, construction of joints, and all testing shall be in accordance with applicable provisions of this specification. Three days after completion of the test section, the Contractor shall provide eight

cores at least 6 inch diameter by full depth cut from points selected in the test section by the Government. The cores will be evaluated for homogeneity, consolidation and segregation. The Contractor shall construct the test section meeting all specification requirements and being acceptable to the Contracting Officer in all aspects, including surface texture. Failure to construct an acceptable test section will necessitate construction of additional test sections at no additional cost to the Government. Test sections allowed to be constructed as part of the production paving which do not meet specification requirements shall be removed at the Contractor's expense. If the Contractor proposes to use slipform paving and is unable to construct an acceptable test section, or if the slipform paving equipment and procedures are found to be unable to produce acceptable pavement at any time, the slipform paving equipment shall be removed from the job and the construction completed using stationary side forms and equipment compatible with them. Production paving may be started immediately after the results on aggregates and concrete, including evaluation of the cores, and all pavement measurements for edge slump, joint face deformation, actual plan grade, surface smoothness and thickness have been submitted and approved.

1.11 DAILY "POUR AGREEMENT"

The Contractor, or designated representative, the Government, and the QC LAB representative shall sign a pour agreement at the close of each day of concrete placement. The agreement shall state that the procedures and the materials used for the days placement meet or exceed the performance demonstrated at the test strip and that the next days placement may proceed. Any one of the signatory persons may elect to not sign. All signatory members have equal authority. When a signatory member does not sign the reasons shall be stated and the deficiency corrected or agreement shall be made on the corrective action. Those people executing the pour agreement shall participate at the test section construction.

1.12 DELIVERY, STORAGE, AND HANDLING OF MATERIALS

1.12.1 Bulk Cementitious Materials

All cementitious material shall be furnished in bulk. The temperature of the cementitious material, as delivered to storage at the site, shall not exceed 150 degrees F. Sufficient cementitious materials shall be in storage to sustain continuous operation of the concrete mixing plant while the pavement is being placed. Separate facilities shall be provided which will prevent any intermixing during unloading, transporting, storing, and handling of each type of cementitious material.

1.12.2 Aggregate Materials

Aggregate shall be stored at the site of the batching and mixing plant avoiding breakage, segregation, intermixing or contamination by foreign materials. Each size of aggregate from each source shall be stored separately in free-draining stockpiles. Aggregate stored on ground shall have a minimum 24 inch thick sacrificial layer left undisturbed. Fine aggregate and the smallest size coarse aggregate shall remain in free-draining storage for at least 24 hours immediately prior to use. Sufficient aggregate shall be maintained at the site at all times to permit continuous uninterrupted operation of the mixing plant at the time concrete pavement is being placed. Tracked equipment shall not be allowed on coarse aggregate stockpiles.

1.12.3 Other Materials

Reinforcing bars and accessories shall be stored above the ground on supports. All materials shall be stored avoiding contamination and deterioration.

1.13 EQUIPMENT

All plant, equipment, tools, and machines used in the work shall be maintained in satisfactory working conditions at all times.

1.13.1 Batching and Mixing Plant

1.13.1.1 Location of Batching and Mixing Plant

The batching and mixing plant shall be located on project site as indicated on the drawings . There shall be operable telephonic or radio communication between the plant and the placing site at all times concreting is taking place.

1.13.1.2 Type and Capacity of Batching and Mixing Plant

The batching and mixing plant shall be a stationary-type central mix plant. The plant shall be designed and operated to produce concrete within the specified tolerances, and shall have a capacity of at least 250 cubic yards per hour. The batching and mixing plant shall conform to the requirements of NRMCA QC 3 including provisions addressing:

- 1. Material Storage and Handling
- 2. Batching Equipment
- 3. Central Mixer
- 4. Ticketing System
- 5. Delivery System

1.13.1.3 Batching Tolerances

The following tolerances shall apply.

Materials	Percentage of Required Mass
Cementitious Materials	plus or minus 1
Aggregate	plus or minus 2
Water	plus or minus 1
Admixture	plus or minus 3

For volumetric batching equipment for water and admixtures, the above numeric tolerances shall apply to the required volume of material being batched. Concentrated admixtures shall be uniformly diluted, if necessary, to provide sufficient volume per batch to ensure that the batchers will consistently operate within the above tolerance.

1.13.1.4 Moisture Control

The plant shall be capable of ready adjustment to compensate for the varying moisture contents of the aggregates and to change the quantities of the materials being batched. An electric moisture meter complying with the provisions of COE CRD-C 143 shall be provided for measuring of moisture in the fine aggregate. The sensing element shall be arranged so that measurement is made near the batcher charging gate of the fine aggregate

bin or in the fine aggregate batcher.

1.13.2 Concrete Mixers

Mixers shall be stationary mixers. Truck mixers shall not be used for mixing or transporting slipformed paving concrete. Mixers shall be capable of combining the materials into a uniform mixture and of discharging this mixture without segregation. The mixers shall not be charged in excess of the capacity recommended by the manufacturer. The mixers shall be operated at the drum or mixing blade speed designated by the manufacturer. The mixers shall be maintained in satisfactory operating condition, and the mixer drums shall be kept free of hardened concrete. Mixer blades or paddles shall be replaced when worn down more than 10 percent of their depth when compared with the manufacturer's dimension for new blades or paddles.

1.13.2.1 Stationary, Central Plant, Mixers

Stationary mixers shall be drum mixers of tilting type. Mixers shall be provided with an acceptable device to lock the discharge mechanism until the required mixing time has elapsed.

1.13.2.2 Mixing Time and Uniformity

a. Stationary Mixers: For stationary mixers, before uniformity data are available, the mixing time for each batch after all solid materials are in the mixer, provided that all of the mixing water is introduced before one-fourth of the mixing time has elapsed, shall be 1 minute for mixers having a capacity of 1 cubic yard. For mixers of greater capacity, this minimum time shall be increased 20 seconds for each additional 1.33 cubic yard or fraction thereof. After results of uniformity tests are available, the mixing time may be reduced to the minimum time required to meet uniformity requirements; but if uniformity requirements are not being met, the mixing time shall be increased as directed. The mixing time for full batch production shall be a minimum of 75 seconds. Mixer performance tests at new mixing times shall be performed immediately after any change in mixing time. When regular testing is performed, the concrete shall meet the limits of any five of the six uniformity requirements listed in Table 1 below. When abbreviated testing is performed, the concrete shall meet only those requirements listed for abbreviated testing. The concrete proportions used for uniformity tests shall be as used on the project. Regular testing shall consist of performing all six tests on three batches of concrete. The range for regular testing shall be the average of the ranges of the three batches. Abbreviated testing shall consist of performing the three required tests on a single batch of concrete. The range for abbreviated testing shall be the range for one batch. If more than one mixer is used and all are identical in terms of make, type, capacity, condition, speed of rotation, etc., the results of tests on one of the mixers shall apply to the others, subject to the approval of the Contracting Officer. All mixer performance (uniformity) testing shall be performed in accordance with COE CRD-C 55 and with paragraph titled TESTING AND INSPECTION FOR CONTRACTOR QUALITY CONTROL.

TABLE 1
UNIFORMITY REQUIREMENTS--STATIONARY MIXERS

Parameter	Regular Tests Allowable Maximum Range for Average of 3 Batches	Abbreviated Tests Allowable Maximum Range for 1 Batch
Unit weight of air-free mortar	2.0 lbs/cubic ft	2.0 lbs/cubic ft
Air content	1.0 percent	--
m Slump	1.0 inch	1.0 inch
Coarse aggregate	6.0 percent	6.0 percent
Compressive strength at 7 days,	10.0 percent	0.0 percent
Water content	1.5 percent	--

1.13.3 Transporting Equipment

Concrete shall be transported to the paving site in nonagitating equipment conforming to ASTM C 94/C 94M or in approved agitators. All transporting equipment shall be designed and operated to deliver and discharge the required concrete mixture completely without segregation.

1.13.4 Transfer and Spreading Equipment

Equipment for transferring concrete from the transporting equipment to the paving lane in front of the paver shall be specially manufactured, self-propelled transfer equipment which will accept the concrete outside the paving lane and will transfer and spread it evenly across the paving lane in front of the paver and strike off the surface evenly to a depth which permits the paver to operate efficiently.

1.13.5 Paver-Finisher

The paver-finisher shall be a heavy-duty, self-propelled machine designed specifically for paving and finishing high quality pavement. The paver-finisher shall weigh at least 2200 lb/foot of lane width, and shall be powered by an engine having at least 6.0 horsepower/foot of lane width. The paver-finisher shall spread, consolidate, and shape the plastic concrete to the desired cross section in one pass. The mechanisms for forming the pavement shall be easily adjustable in width and thickness and for required crown. In addition to other spreaders required by paragraph Transfer and Spreading Equipment, the paver-finisher shall be equipped with a full width knock-down auger or paddle mechanism, capable of operating in both directions, which will evenly spread the fresh concrete in front of the screed or extrusion plate. Immersion vibrators shall be gang mounted at the front of the paver on a frame equipped with suitable controls so that all vibrators can be operated at any desired depth within the slab or completely withdrawn from the concrete, as required. The vibrators shall be automatically controlled so that they will be immediately stopped as

forward motion of the paver ceases. The spacing of the immersion vibrators across the paving lane shall be as necessary to properly consolidate the concrete, but the clear distance between vibrators shall not exceed 30 inches. The outside vibrators shall not be more than 12 inches from the lane edge. Spud vibrators shall operate at a frequency of not less than 8000 impulses/minute and an amplitude of not less than 0.03 inch and tube vibrators at a frequency of not less than 5000 impulses/minute and an amplitude of not less than 0.03 inch, as determined by COE CRD-C 521.

The paver-finisher shall be equipped with a transversely oscillating screed or an extrusion plate to shape, compact, and smooth the surface and shall so finish the surface that no significant amount of hand finishing, except use of cutting straightedges, is required. The screed or extrusion plate shall be constructed to provide adjustment for crown in the pavement.

The entire machine shall provide adjustment for variation in lane width or thickness and to prevent more than 8 inches of the screed or extrusion plate extending over previously placed concrete on either end when paving fill-in lanes. Machines that cause displacement of properly installed forms or cause ruts or indentations in the prepared underlying materials and machines that cause frequent delays due to mechanical failures shall be replaced as directed.

1.13.5.1 Paver-Finisher with Fixed Forms

The paver-finisher shall be equipped with wheels designed to ride the forms, keep it aligned with the forms, and spread the load so as to prevent deformation of the forms.

1.13.5.2 Slipform Paver-Finisher

The slipform paver-finisher shall be automatically controlled and crawler mounted with four padded tracks so as to be completely stable under all operating conditions. The paver-finisher shall finish the surface and edges so that no edge slump beyond allowable tolerance occurs. Suitable moving side forms shall be provided that are adjustable and will produce smooth, even edges, perpendicular to the top surface and meeting specification requirements for alignment and freedom from edge slump.

1.13.5.3 Longitudinal Mechanical Float

A longitudinal mechanical float shall be specially designed and manufactured to smooth and finish the pavement surface without working excess paste to the surface. It shall be rigidly attached to the rear of the paver-finisher or to a separate self-propelled frame spanning the paving lane. The float plate shall be at least 5 feet long by 8 inches wide and shall automatically be oscillated in the longitudinal direction while slowly moving from edge to edge of the paving lane, with the float plate in contact with the surface at all times.

1.13.5.4 Nonrotating Pipe Float

A pipe float if used, shall be a nonrotating pipe 6 to 10 inches in diameter and sufficiently long to span the full paving width when oriented at an angle of approximately 60 degrees with the centerline. The pipe float shall be mounted on a self-propelled frame that spans the paving lane. No means of applying water to the surface shall be incorporated in the pipe float.

1.13.5.5 Other Types of Finishing Equipment

Clary screeds, other rotating tube floats, or bridge deck finishers shall not be allowed on mainline paving, but may be allowed on irregular or odd-shaped slabs, and near buildings or trench drains, subject to the Contracting Officer's approval. Bridge deck finishers shall have a minimum operating weight of 9000 pounds and shall have a transversely operating carriage containing a knock-down auger and a minimum of two immersion vibrators. Vibrating screeds or pans shall be used only for isolated slabs where hand finishing is permitted as specified, and only where specifically approved. Concrete finishing equipment of types other than specified above may be demonstrated on a test section outside the production pavement if approved in writing.

1.13.6 Curing Equipment

Equipment for applying membrane-forming curing compound shall be mounted on a self-propelled frame that spans the paving lane. The reservoir for curing compound shall be constantly mechanically (not air) agitated during operation and shall contain means for completely draining the reservoir. The spraying system shall consist of a mechanically powered pump which will maintain constant pressure during operation, an operable pressure gauge, and either a series of spray nozzles evenly spaced across the lane to give uniformly overlapping coverage or a single spray nozzle which is mounted on a carriage which automatically traverses the lane width at a speed correlated with the forward movement of the overall frame. All spray nozzles shall be protected with wind screens. Calibrate the spraying system in accordance with ASTM D 2995, Method A, for the rate of application required in paragraph: Membrane Curing. Any hand-operated sprayers allowed by paragraph: Membrane Curing shall be compressed air supplied by a mechanical air compressor. If the curing equipment fails to apply an even coating of compound at the specified rate, it shall immediately be replaced.

1.13.7 Texturing Equipment

Texturing equipment shall be as specified below. Before use, the texturing equipment shall be demonstrated on a test section, and the equipment shall be modified as necessary to produce the texture directed.

1.13.7.1 Burlap Drag

A burlap drag shall consist of a piece of material as long as the lane width securely attached to a separate wheel mounted frame spanning the paving lane or to one of the other similar pieces of equipment. Width of the material shall provide 24 to 36 inches dragging flat on the pavement surface. Length shall be at least equal to the width of the slab. The material shall be clean, reasonably new burlap, completely saturated with water before attachment to the frame, always resaturated before start of use, and kept clean and saturated during use. Burlap shall conform to AASHTO M 182, Class 3 or 4.

1.13.8 Sawing Equipment

Equipment for sawing joints and for other similar sawing of concrete shall be standard diamond-type concrete saws mounted on a wheeled chassis which can be easily guided to follow the required alignment. Blades shall be diamond tipped. If demonstrated to operate properly, abrasive blades may be used. Provide spares as required to maintain the required sawing rate.

Wheel saws used in the removal of concrete shall be saws with large diameter tungsten carbide tipped blades mounted on a heavy-duty chassis which will produce a saw kerf at least 1-1/2 inch wide. All saws shall be capable of sawing to the full depth required. Early-entry saws may be used, subject to demonstration and approval of the Contracting Officer. No change to the initial sawcut depth shall be permitted.

1.13.9 Straightedge

The Contractor shall furnish and maintain at the job site, in good condition, one 12 foot straightedge for each paving train for testing the hardened portland cement concrete surfaces. These straightedges shall be constructed of aluminum or magnesium alloy and shall have blades of box or box-girder cross section with flat bottom, adequately reinforced to insure rigidity and accuracy. Straightedges shall have handles for operation on the pavement.

PART 2 PRODUCTS

2.1 CEMENTITIOUS MATERIALS

Cementitious materials shall be portland cement, or only portland cement in combination with natural pozzolan or fly ash or ground granulated blast furnace slag and shall conform to appropriate specifications listed below.

2.1.1 Portland Cement

Portland cement shall conform to ASTM C 150, Type I, low alkali. Low alkali cement is not required only if it is not readily available and if the proposed aggregates are found to be non-Alkali-Silica reactive, when tested in accordance with paragraph: AGGREGATES.

2.1.2 Pozzolan

2.1.2.1 Fly Ash

Fly ash shall conform to ASTM C 618, Class F, including the optional requirements for drying shrinkage, uniformity, and effectiveness in controlling Alkali-Silica reaction and shall have a loss on ignition not exceeding 3 percent. Class F fly ash shall have a Calcium Oxide (CaO) content of less than 8 percent.

2.1.2.2 Raw or Calcined Natural Pozzolan

Natural pozzolan shall be raw or calcined and conform to ASTM C 618, Class N, including the optional requirements for drying shrinkage, uniformity, and effectiveness in controlling Alkali-Silica reaction and shall have a loss on ignition not exceeding 3 percent. Class N pozzolan shall have a Calcium Oxide (CaO) content of less than 5 percent.

2.1.3 Ground Granulated Blast-Furnace (GGBF) Slag

Ground Granulated Blast-Furnace Slag shall conform to ASTM C 989, Grade 100 or Grade 120.

2.2 AGGREGATES

2.2.1 Aggregate Sources

2.2.1.1 Durability

Aggregate shall have a satisfactory service record in freezing and thawing of at least 5 years successful service in three concrete paving projects. The service record shall include a condition survey of the existing concrete and a review of the concrete-making materials, including coarse and fine aggregates, cement, and mineral admixtures. This review should consider the previous aggregate source and test results, cement mill certificate data, mineral admixture chemical and physical composition, and the mix design (cement factor and water-cementitious material ratio). Aggregate not having a satisfactory demonstrable service record shall have a durability factor of 50 or more when subjected to freezing and thawing in concrete in accordance with COE CRD-C 114.

2.2.1.2 Alkali-Silica Reactivity

Fine and coarse aggregates to be used in all concrete shall be evaluated and tested by the Contractor for alkali-aggregate reactivity in accordance with ASTM C 1260. Both coarse aggregate size groups shall be tested if from different sources. The fine and coarse aggregates shall be evaluated separately and in combination, which matches the Contractor's proposed mix design proportioning. Test results of the combination shall have a measured expansion equal to or less than 0.08 percent at 16 days after casting. Should the test data indicate an expansion of greater than 0.08 percent, the aggregate(s) shall be rejected or additional testing, using a modified version of ASTM C 1260 shall be performed using one of the following options:

a. Utilize the Contractor's proposed low alkali portland cement and Class F fly ash or Class N pozzolan in combination with the proposed aggregate percentage for the test proportioning. Class F fly ash or Class N pozzolan shall be used in the range of 25 percent to 40 percent of the total cementitious material by mass. The quantity shall be determined that will meet all the requirements of these specifications and that which will lower the expansion equal to or less than 0.08 percent at 16 days after casting.

b. Utilize the Contractor's proposed low alkali portland cement and ground granulated blast furnace (GGBF) slag in combination with the proposed aggregate percentage for the test proportioning. GGBF slag shall be used in the range of 40 percent to 50 percent of the total cementitious material by mass. The quantity shall be determined that will meet all the requirements of these specifications and that which will lower the expansion equal to or less than 0.08 percent at 16 days.

If any of the above options does not lower the expansion to less than 0.08 percent at 16 days after casting, the aggregate(s) shall be rejected and the contractor shall submit new aggregate sources for retesting. The results of testing shall be submitted to the Contracting Officer for evaluation and acceptance.

2.2.1.3 Combined Aggregate Gradation

In addition to the grading requirements specified for coarse aggregate and

for fine aggregate, the combined aggregate grading shall meet the following requirement.

a. The materials selected and the proportions used shall be such that when the Coarseness Factor (CF) and the Workability Factor (WF) are plotted on a diagram as described in d. below, the point thus determined shall fall within the parallelogram described therein.

b. The Coarseness Factor (CF) shall be determined from the following equation:

$$CF = (\text{cumulative percent retained on the } 3/8 \text{ in. sieve}) (100) / (\text{cumulative percent retained on the No. 8 sieve})$$

c. The Workability Factor WF is defined as the cumulative percent passing the No. 8 sieve. However, WF shall be adjusted, upwards only, by 2.5 percentage points for each 94 pounds of cementitious material per cubic yard greater than 564 pounds per cubic yard.

d. A diagram shall be plotted using a rectangular scale with WF on the Y-axis with units from 20 (bottom) to 45 (top), and with CF on the X-axis with units from 80 (left side) to 30 (right side). On this diagram a parallelogram shall be plotted with corners at the following coordinates (CF-75, WF-28), (CF-75, WF-40), (CF-45, WF-32.5), and (CF-45, WF-44.5. If the point determined by the intersection of the computed CF and WF does not fall within the above parallelogram, the grading of each size of aggregate used and the proportions selected shall be changed as necessary.)

e. A blending aggregate shall be used to meet the required combined grading. This blending aggregate shall be batched separately. The combined grading of all aggregates used, in the proportions selected, shall be computed on the basis of cumulative percent retained on each sieve specified for fine and coarse aggregate.

2.2.2 Coarse Aggregate

2.2.2.1 Material Composition

Coarse aggregate shall consist of crushed stone. Aggregates as delivered to the mixers shall consist of clean, hard, uncoated particles meeting the requirements of ASTM C 33 except as specified herein. Coarse aggregate shall be washed. Washing shall be sufficient to remove dust and other coatings. . Coarse aggregate shall not show more than 40 percent loss when subjected to the Los Angeles abrasion test in accordance with ASTM C 131.

2.2.2.2 Particle Shape Characteristics

Particles of the coarse aggregate shall be generally spherical or cubical in shape. The quantity of flat and elongated particles in any size group shall not exceed 20 percent by weight as determined by the Flat Particle Test and the Elongated Particle Test of ASTM D 4791. A flat particle is defined as one having a ratio of width to thickness greater than 3; an elongated particle is one having a ratio of length to width greater than 3.

2.2.2.3 Size and Grading

The nominal maximum size of the coarse aggregate shall be 3/4 inches.

2.2.2.4 Deleterious Materials - Airfield Pavements

The amount of deleterious material in each size group of coarse aggregate shall not exceed the limits shown in Table 5 below, determined in accordance with the test methods shown.

TABLE 5
LIMITS OF DELETERIOUS MATERIALS IN COARSE AGGREGATE
FOR AIRFIELD PAVEMENTS
Percentage by Mass

Materials ^(h)	Weather	Severe
Clay lumps and friable particles (ASTM C 142)		0.2
Shale (a) (ASTM C 295)		0.1
Material finer than 0.075 mm (No. 200 sieve) (b) (ASTM C 117)		0.5
Lightweight particles (c) (ASTM C 123)		0.2
Clay ironstone (d) (ASTM C 295)		0.1
Chert and cherty stone (less than 2.40 Mg/cubic meter density SSD (2.40 Sp. Gr.)) (e) ASTM C 123 followed by ASTM C 295)		0.1
Claystone, mudstone, and siltstone (f) (ASTM C 295)		0.1
Shaly and argillaceous limestone (g) (ASTM C 295)		0.2
Other soft particles COE CRD-C 130		1.0
Total of all deleterious substances exclusive of material finer than 0.075 mm (No. 200 sieve)		1.0

a. Shale is defined as a fine-grained, thinly laminated or fissile sedimentary rock. It is commonly composed of clay or silt or both. It has been indurated by compaction or by cementation, but not so much as to have become slate.

b. Limit for material finer than 0.075 mm (No. 200 sieve) will be increased to 1.5 percent for crushed aggregates if the fine material consists of crusher dust that is essentially free from clay or shale.

c. The separation medium shall have a density of 2.0 Mg/cubic meter

(Sp. Gr. of 2.0). This limit does not apply to coarse aggregate manufactured from blast-furnace slag unless contamination is evident.

d. Clay ironstone is defined as an impure variety of iron carbonate, iron oxide, hydrous iron oxide, or combinations thereof, commonly mixed with clay, silt, or sand. It commonly occurs as dull, earthy particles, homogeneous concretionary masses, or hard-shell particles with soft interiors. Other names commonly used for clay ironstone are "chocolate bars" and limonite concretions.

e. Chert is defined as a rock composed of quartz, chalcedony or opal, or any mixture of these forms of silica. It is variable in color. The texture is so fine that the individual mineral grains are too small to be distinguished by the unaided eye. Its hardness is such that it scratches glass but is not scratched by a knife blade. It may contain impurities such as clay, carbonates, iron oxides, and other minerals. Cherty stone is defined as any type of rock (generally limestone) that contains chert as lenses and nodules, or irregular masses partially or completely replacing the original stone.

f. Claystone, mudstone, or siltstone, is defined as a massive fine-grained sedimentary rock that consists predominantly of indurated clay or silt without laminations or fissility. It may be indurated either by compaction or by cementation.

g. Shaly limestone is defined as limestone in which shale occurs as one or more thin beds or laminae. These laminae may be regular or very irregular and may be spaced from a few inches down to minute fractions of an inch. Argillaceous limestone is defined as a limestone in which clay minerals occur disseminated in the stone in the amount of 10 to 50 percent by weight of the rock; when these make up from 50 to 90 percent, the rock is known as calcareous (or dolomitic) shale (or claystone, mudstone, or siltstone).

h. Testing shall be performed in accordance with the referenced test methods, except that the minimum sample size shall be as specified in Paragraph: Testing Deleterious Materials-Airfields Only.

2.2.2.5 Testing Sequence Deleterious Materials -- Airfields Only

The Contractor will not be entitled to any extension of time or additional payment due to any delays caused by the testing, evaluation, or personnel requirements. The size of the sample shall be at least 200 pounds for the 3/4 to 1-1/2 inch size and 25 pounds for the No. 4 to 3/4 inch coarse aggregate and 10 pounds for the fine aggregate. The Contractor shall provide facilities for the ready procurement of representative test samples. The testing procedure on each sample of coarse aggregate for compliance with limits on deleterious materials shall be as follows:

Step 1: Test full sample for material finer than the No. 200 sieve. Discard material finer than the No. 200 sieve.

Step 2: Test remaining full sample for clay lumps and friable particles and remove.

Step 3: Test remaining full sample for lightweight particles (Sp.Gr.2.0) and remove.

Step 4. Test remaining full sample for chert and/or cherty stone with

SSD density of less than 2.40 Mg/cubic meter (Sp. Gr. 2.40). Remove lightweight chert and/or cherty stone. Restore other materials less than 2.40 to the sample.

Step 5: Test remaining sample for clay-ironstone, shale, claystone, mudstone, siltstone, shaly and/or argillaceous limestone, and remove.

Step 6: Test approximately one-fifth of remaining full sample for other soft particles.

2.2.3 Fine Aggregate

2.2.3.1 Composition

Fine aggregate shall consist of natural sand, manufactured sand, or a combination of the two, and shall be composed of clean, hard, durable particles. Irrespective of the source from which it is obtained, all fine aggregate shall be composed of clean, hard, durable particles meeting the requirements of ASTM C 33. Each type of fine aggregate shall be stockpiled and batched separately. Particles of the fine aggregate shall be generally spherical or cubical in shape.

2.2.3.2 Grading

Grading of the fine aggregate, as delivered to the mixer, shall conform to the requirements of ASTM C 33 and shall have a fineness modulus of not less than 2.50 nor more than 3.00.

2.2.3.3 Deleterious Material

The amount of deleterious material in the fine aggregate shall not exceed the following limits by mass:

<u>Material</u>	<u>Percentage by Mass</u>
Clay lumps and friable particles ASTM C 142	1.0
Material finer than 0.075 mm (No. 200 sieve) ASTM C 117	3.0
Lightweight particles ASTM C 123 using a medium with a density of 2.0 Mg/cubic meter (Sp. Gr. of 2.0))	0.5
Total of all above	3.0

2.3 CHEMICAL ADMIXTURES

2.3.1 General Requirements

Chemical admixtures may only be used when the specific admixture type and manufacturer is the same material used in the mixture proportioning studies. The air-entraining admixture shall conform to ASTM C 260. An accelerator conforming to ASTM C 494/C 494M, Type C, may be used only when specified in paragraph: SPECIFIED CONCRETE STRENGTH AND OTHER PROPERTIES and shall not be used to reduce the amount of cementitious material used. Calcium chloride and admixtures containing calcium chloride shall not be used. Retarding or water-reducing admixture shall meet the requirements of ASTM C 494/C 494M, Type A, B, or D, except that the 6-month and 1-year compressive strength tests are waived. ASTM C 494/C 494M, Type F and G

high range water reducing admixtures and ASTM C 1017/C 1017M admixtures shall not be used.

2.4 MEMBRANE FORMING CURING COMPOUND

Membrane forming curing compound shall be a white pigmented compound conforming to COE CRD-C 300. .

2.5 WATER

Water for mixing and curing shall be fresh, clean, potable, and free of injurious amounts of oil, acid, salt, or alkali, except that non-potable water may be used if it meets the requirements of ASTM C 94/C 94M.

2.6 JOINT MATERIALS

2.6.1 Expansion Joint Material

Expansion joint filler shall be a preformed material conforming to ASTM D 1751 or ASTM D 1752 Type II . Expansion joint filler shall be 3/4 inch thick, and shall be furnished in a single full depth piece.

2.6.2 Slip Joint Material

Slip joint material shall be 1/4 inch thick expansion joint filler conforming to para: Expansion Joint Material.

2.7 REINFORCING

All reinforcement shall be free from loose, flaky rust, loose scale, oil, grease, mud, or other coatings that might reduce the bond with concrete. Removal of thin powdery rust and tight rust is not required. However, reinforcing steel which is rusted to the extent that it does not conform to the required dimensions or mechanical properties shall not be used.

2.7.1 Reinforcing Bars and Bar Mats

Reinforcing bars shall conform to ASTM A 615/A 615M, billet-steel , Grade 60 . Bar mats shall conform to ASTM A 184/A 184M. The bar members shall be billet steel.

2.7.2 Deformed Welded Wire Reinforcement

Deformed Welded Wire Reinforcement shall conform to ASTM A 497/A 497M, and shall be furnished in flat sheets.

2.8 DOWELS AND TIE BARS

2.8.1 Dowels

Dowels shall be single piece bars fabricated or cut to length at the shop or mill before delivery to the site. Dowels shall be free of loose, flaky rust and loose scale and shall be clean and straight. Dowels may be sheared to length provided that the deformation from true shape caused by shearing does not exceed 0.04 inch on the diameter of the dowel and does not extend more than 0.04 inch from the end of the dowel. Dowels shall be plain (non-deformed) steel bars conforming to ASTM A 615/A 615M, Grade 40 or 60; ASTM A 996/A 996M, Grade 50 or 60. Paint for dowels shall conform to MIL-DTL-24441/20. As an alternate to paint, epoxy coatings conforming

to ASTM A 775/A 775M may be used. Grout retention rings shall be fully circular metal or plastic devices capable of supporting the dowel until the epoxy hardens.

2.8.2 Dowel Bar Assemblies

Dowel bar assemblies shall consist of a framework of metal bars or wires arranged to provide rigid support for the dowels throughout the paving operation, with a minimum of four continuous bars or wires extending along the joint line. The dowels shall be welded to the assembly or held firmly by mechanical locking arrangements that will prevent them from rising, sliding out, or becoming distorted during paving operations.

2.8.3 Tie Bars

Tie bars shall be deformed steel bars conforming to ASTM A 615/A 615M, or ASTM A 996/A 996M, Grade 60, and of the sizes and dimensions indicated. Deformed rail steel bars and high-strength billet or axle steel bars, Grade 50 or higher, shall not be used for bars that are bent and straightened during construction.

2.9 EPOXY RESIN

All epoxy-resin materials shall be two-component materials conforming to the requirements of ASTM C 881/C 881M, Class as appropriate for each application temperature to be encountered, except that in addition, the materials shall meet the following requirements:

- a. Material for use for embedding dowels and anchor bolts shall be Type IV, Grade 3.
- b. Material for use as patching materials for complete filling of spalls and other voids and for use in preparing epoxy resin mortar shall be Type III, Grade as approved.
- c. Material for use for injecting cracks shall be Type IV, Grade 1.
- d. Material for bonding freshly mixed portland cement concrete or mortar or freshly mixed epoxy resin concrete or mortar to hardened concrete shall be Type V, Grade as approved.

2.10 SPECIFIED CONCRETE STRENGTH AND OTHER PROPERTIES

2.10.1 Specified Flexural Strength

Specified flexural strength, R , for concrete is 650 psi at 28 days, as determined by equivalent flexural strength, as specified in paragraph: Mixture Proportioning for Flexural Strength. Maximum allowable water-cementitious material ratio is 0.45. The water-cementitious material ratio will be the equivalent water-cement ratio as determined by conversion from the weight ratio of water to cement plus pozzolan, and ground granulated blast furnace slag by the mass equivalency method described in ACI 211.1. The concrete shall be air-entrained with a total air content of 6 plus or minus 1.5 percentage points, at the point of placement. Air content shall be determined in accordance with ASTM C 231. The maximum allowable slump of the concrete at the point of placement shall be 2 inches for pavement constructed with fixed forms. For slipformed pavement, at the start of the project, the Contractor shall select a maximum allowable slump which will produce in-place pavement meeting the specified tolerances for

control of edge slump. The selected slump shall be applicable to both pilot and fill-in lanes.

2.10.2 Concrete Temperature

The temperature of the concrete as delivered shall conform to the requirements of paragraphs, Paving in Hot Weather and Paving in Cold Weather. Temperature of concrete shall be determined in accordance with ASTM C 1064/C 1064M.

2.10.3 Concrete Strength for Final Acceptance

The strength of the concrete will be considered acceptable when the average equivalent 28-day flexural strengths for each lot are above the 'Specified Flexural Strength' as determined by correlation with 14-day compressive strength tests specified in paragraph: Mixture Proportioning for Flexural Strength, and no individual set (2 specimens per subplot) in the lot are 25 psi or more below the equivalent 'Specified Flexural Strength'. If any lot or subplot, respectively, fails to meet the above criteria, the lot or subplot shall be removed and replaced at no additional cost to the Government. This is in addition to and does not replace the average strength required for day-to-day CQC operations as specified in paragraph: Average CQC Flexural Strength Required for Mixtures.

2.11 MIXTURE PROPORTIONS

2.11.1 Composition

Concrete shall be composed of cementitious material, water, fine and coarse aggregates, and admixtures. Class F flyash or Class N Pozzolan, if used with non alkali reactive aggregates, shall consist of not less than 15 percent of the cementitious material by mass and not more than 35 percent. GGBF slag, if used with non alkali reactive aggregates, shall consist of not less than 20 percent of the cementitious material by mass and not more than 50 percent. If Class F fly ash, Class N pozzolan, or GGBF slag is required to mitigate potential alkali-aggregate reactivity, the percentage by mass, as determined from the modified ASTM C 1260 testing shall be used in the mixture proportioning studies. The total cementitious material content shall be at least 517 lb./cu. yd.. Admixtures shall consist of air entraining admixture and may also include, as approved accelerator or retarder .

2.11.2 Proportioning Studies

Trial design batches, mixture proportioning studies, and testing requirements shall be the responsibility of the Contractor. Trial mixtures having proportions, slumps, and air content suitable for the work shall be based on methodology described in ACI 211.1, modified as necessary to accommodate flexural strength.

2.11.2.1 Water-Cement Ratio

At least three different water-cement ratios, which will produce a range of strength encompassing that required on the project, shall be used. The maximum allowable water-cement ratio required in paragraph: Specified Flexural Strength will be the equivalent water-cement ratio as determined by conversion from the mass ratio of water to cement plus pozzolan, and ground granulated blast furnace (GGBF) slag by the weight equivalency method as described in ACI 211.1. In the case where GGBF slag is used, the

mass of the GGBF slag shall be included in the equations in ACI 211.1 for the term P, which is used to denote the mass of pozzolan. Laboratory trial mixtures shall be proportioned for maximum permitted slump and air content.

2.11.2.2 Trial Mixture Studies

Separate sets of trial mixture studies shall be made for each combination of cementitious materials and each combination of admixtures proposed for use. No combination of either shall be used until proven by such studies, except that, if approved in writing and otherwise permitted by these specifications, an accelerator or a retarder may be used without separate trial mixture study. Separate trial mixture studies shall also be made for concrete for each placing method proposed. The temperature of concrete in each trial batch shall be reported. Each mixture shall be designed to promote easy and suitable concrete placement, consolidation and finishing, and to prevent segregation and excessive bleeding.

2.11.2.3 Mixture Proportioning for Flexural Strength

The following step by step procedure shall be followed:

- a. Fabricate all beams and cylinders for each mixture from the same batch or blend of batches. Fabricate and cure all beams and cylinders in accordance with ASTM C 192/C 192M, using 6 x 6 inch steel beam forms and 6 x 12 inch steel cylinder forms.
- b. Test beams in accordance with ASTM C 78, cylinders in accordance with ASTM C 39/C 39M.
- c. Fabricate and cure test beams from each mixture for 3, 7, 14, and 28 -day flexural tests; 6 beams to be tested per age.
- d. Fabricate and cure test cylinders from each mixture for 3, 7, 14, and 28 -day compressive strength tests; 6 cylinders to be tested per age.
- e. Using the average strength for each w/c at each age, plot all results from each of the three mixtures on separate graphs for w/c versus:
 - 3-day flexural strength
 - 7-day flexural strength
 - 14-day flexural strength
 - 28-day flexural strength

 - 3-day compressive strength
 - 7-day compressive strength
 - 14-day compressive strength
 - 28-day compressive strength
- f. From these graphs select a w/c that will produce a mixture giving a 28 -day flexural strength equal to the required strength determined in accordance with paragraph "Average CQC Flexural Strength Required for Mixtures".
- g. Using the above selected w/c, select from the graphs the expected 3, 7, 14, 28 -day flexural strengths and the expected 3, 7, 14, 28 -day compressive strengths for the mixture.

- h. From the above expected strengths for the selected mixture determine the following Correlation Ratios:
 - (1) Ratio of the 14-day compressive strength of the selected mixture to the 28 -day flexural strength of the mixture (for acceptance).
 - (2) Ratio of the 7-day compressive strength of the selected mixture to the 28 -day flexural strength of the mixture (for CQC control).
- i. If there is a change in materials, additional mixture design studies shall be made using the new materials and new Correlation Ratios shall be determined.
- j. No concrete pavement shall be placed until the Contracting Officer has approved the Contractor's mixture proportions.

2.11.3 Contractor Quality Control for Average Flexural Strength

The Contractor's day to day production shall be controlled (CQC) in accordance with the criteria herein, in the following subparagraphs, and in paragraph: Concrete Strength Testing for CQC. This is entirely different from the acceptance requirements of paragraph: Concrete Strength for Final Acceptance, and it is mandatory that both sets of requirements must be met.

In order to ensure meeting the strength requirements specified in paragraph: SPECIFIED CONCRETE STRENGTH AND OTHER PROPERTIES, during production, the mixture proportions selected during mixture proportioning studies and used during construction shall produce a required average CQC flexural strength exceeding the specified strength, R, by the amount indicated below. This required average CQC flexural strength, Ra, will be used only for CQC operations as specified in paragraph: TESTING AND INSPECTION FOR CONTRACTOR QUALITY CONTROL and as specified in the previous paragraph. During production, the required Ra shall be adjusted, as appropriate and as approved, based on the standard deviation of equivalent 28 -day strengths being attained during paving.

- a. From Previous Test Records: Where a concrete production facility has previous test records current to within 18 months, a standard deviation shall be established in accordance with the applicable provisions of ACI 214.3R. Test records from which a standard deviation is calculated shall represent materials, quality control procedures, and conditions similar to those expected, shall represent concrete produced to meet a specified flexural strength or strengths within 150 psi of the 28 -day flexural strength specified for the proposed work, and shall consist of at least 30 consecutive tests. The Contractor shall perform verification testing, as directed by the Contracting Officer, to document the current strength. A strength test shall be the average of the strengths of two specimens made from the same sample of concrete and tested at 28 days. Required average CQC flexural strength, Ra, used as the basis for selection of concrete proportions shall be the value from the equation that follows, using the standard deviation as determined above:

$$R_a = R + 1.34S$$

Where: S = standard deviation
R = specified flexural strength

Ra = required average flexural strength

Where a concrete production facility does not have test records meeting the requirements above but does have a record based on 15 to 29 consecutive tests, a standard deviation shall be established as the product of the calculated standard deviation and a modification factor from the following table:

NUMBER OF TESTS	MODIFICATION FACTOR FOR STANDARD DEVIATION
15	1.16
20	1.08
25	1.03
30 or more	1.00

- b. Without Previous Test Records: When a concrete production facility does not have sufficient field strength test records for calculation of the standard deviation, the required average strength, Ra, shall be determined by adding 15 percent to the specified flexural strength, R.

2.12 QUICK SETTING PATCH MATERIAL

2.12.1 Material

The quick setting patch material shall be a flexible concrete repair material with high tensile strength and strong bonding with existing PCC. Patch material shall remain flexible throughout anticipated temperature extremes to avoid cracking, delaminating and premature material loss due to thermal climatic changes and traffic loadings. Patch material shall be capable of supporting aircraft loads (250 psi tires), with 1 hour of placement. Patch material shall be gray in color. Patch material shall not be adversely affected by jet fuel or de-icing fluids.

Patch material shall have a documented history of successful performance at an airfield for a minimum of 3 years.

Acceptable products include:

- a. Delpatch Elastomeric Concrete, manufactured by The D.S. Brown Company.
- b. PERCOL Elastic Cement, manufactured by GeoCHEM Incorporated.
- c. TechCrete, manufactured by CrafcO, Incorporated.

2.12.2 Primer

Primer material shall be as recommended by the manufacturer of the quick setting patch material.

PART 3 EXECUTION

3.1 PREPARATION FOR PAVING

Before commencing paving, the following shall be performed. If used, forms shall be in place, cleaned, coated, and adequately supported. Any reinforcing steel needed shall be at the paving site. All transporting and transfer equipment shall be ready for use, clean, and free of hardened concrete and foreign material. Equipment for spreading, consolidating, screeding, finishing, and texturing concrete shall be at the paving site,

clean and in proper working order. All equipment and material for curing and for protecting concrete from weather or mechanical damage shall be at the paving site, in proper working condition, and in sufficient amount for the entire placement.

3.1.1 Weather Prevention

When windy conditions during paving appear probable, equipment and material shall be at the paving site to provide windbreaks, shading, fogging, or other action to prevent plastic shrinkage cracking or other damaging drying of the concrete.

3.1.2 Proposed Techniques

The Contractor shall submit for approval the following items:

a. A description of the placing and protection methods proposed when concrete is to be placed in or exposed to hot, cold, or rainy weather conditions.

b. A detailed paving sequence plan and proposed paving pattern showing all planned construction joints; transverse and longitudinal dowel bar spacing; and identifying pilot lanes and hand placement areas. No deviation from the jointing pattern shown on the drawings shall be made without written approval of the design engineer .

c. Plan and equipment proposed to control alignment of sawn joints within the specified tolerances.

d. Data on the curing equipment, media and methods to be used.

e. Data on profilograph and methods to measure pavement smoothness.

f. Pavement demolition work plan, presenting the proposed methods and equipment to remove existing pavement and protect pavement to remain in place.

3.2 CONDITIONING OF UNDERLYING MATERIAL

3.2.1 General Procedures

Underlying material, upon which concrete is to be placed shall be clean, damp, and free from debris, waste concrete or cement, frost, ice, and standing or running water. Prior to setting forms or placement of concrete, the underlying material shall be well drained and shall have been satisfactorily graded and uniformly compacted in accordance with the applicable Section of these specifications. The surface of the underlying material shall be tested as to crown, elevation, and density in advance of setting forms or of concrete placement using slip-form techniques. High areas shall be trimmed to proper elevation. Low areas shall be filled and compacted to a condition similar to that of surrounding grade, or filled with concrete monolithically with the pavement. Low areas filled with concrete shall not be cored for thickness to avoid biasing the average thickness used for evaluation and payment adjustment. Any underlying material disturbed by construction operations shall be reworked and recompacted to specified density immediately in front of the paver. If a slipform paver is used, the same underlying material under the paving lane

shall be continued beyond the edge of the lane a sufficient distance and shall be thoroughly compacted and true to grade to provide a suitable trackline for the slipform paver and firm support for the edge of the paving lane.

3.2.1.1 Bituminous Bond Breaker

The existing bituminous bond breaker shall be repaired prior to placement of the PCC pavement in accordance with Section 02575. The surface of the existing bituminous bond breaker shall be sprayed with a double application of a membrane forming white pigmented curing compound. Each application shall cure for a minimum of 24 hours prior to placement of the next application and placement of PCC pavement.

3.2.2 Traffic on Underlying Material

After the underlying material has been prepared for concrete placement, no equipment shall be permitted thereon. Subject to specific approval, crossing of the prepared underlying material at specified intervals for construction purposes may be permitted, provided rutting or indentations do not occur. The surface shall be reworked and reprepared to the satisfaction of the Contracting Officer before concrete is placed. No transporting equipment shall be allowed to operate on the prepared and compacted underlying material in front of the paver-finisher.

3.3 WEATHER LIMITATIONS

3.3.1 Placement and Protection During Inclement Weather

The Contractor shall not commence placing operations when heavy rain or other damaging weather conditions appear imminent. At all times when placing concrete, the Contractor shall maintain on-site sufficient waterproof cover and means to rapidly place it over all unhardened concrete or concrete that might be damaged by rain. Placement of concrete shall be suspended whenever rain, high winds, or other damaging weather commences to damage the surface or texture of the placed unhardened concrete, washes cement out of the concrete, or changes the water content of the surface concrete. All unhardened concrete shall be immediately covered and protected from the rain or other damaging weather. Any slab damaged by rain or other weather shall be completely removed full depth, by full slab width, to the nearest original joint, and replaced at the Contractor's expense as specified in paragraph: REPAIR, REMOVAL AND REPLACEMENT OF NEWLY CONSTRUCTED SLABS,

3.3.2 Paving in Hot Weather

When the ambient temperature during paving is expected to exceed 90 degrees F, the concrete shall be properly placed and finished in accordance with procedures previously submitted, approved, and as specified herein. The concrete temperature at time of delivery to the forms shall not exceed the temperature shown in the table below when measured in accordance with ASTM C 1064/C 1064M. Cooling of the mixing water or aggregates or placing in the cooler part of the day may be required to obtain an adequate placing temperature. Steel forms and reinforcing shall be cooled as needed to maintain steel temperatures below 120 degrees F. Transporting and placing equipment shall be cooled or protected if necessary to maintain proper concrete placing temperature. The finished surfaces of the newly laid pavement shall be kept damp by applying a fog spray (mist) with approved spraying equipment until the pavement is covered by the curing medium.

Maximum Allowable Concrete Placing Temperature

Relative Humidity, Percent, During Time of Concrete Placement	Maximum Allowable Concrete Temperature in Degrees F
Greater than 60	90
40-60	85
Less than 40	80

3.3.3 Prevention of Plastic Shrinkage Cracking

During weather with low humidity, and particularly with high temperature and appreciable wind, the Contractor shall develop and institute measures to prevent plastic shrinkage cracks from developing. If plastic shrinkage cracking occurs, further placement of concrete shall be halted until protective measures are in place to prevent further cracking. Periods of high potential for plastic shrinkage cracking can be anticipated by use of Fig. 2.1.5 of ACI 305R. In addition to the protective measures specified in the previous paragraph, the concrete placement shall be further protected by erecting shades and windbreaks and by applying fog sprays of water, the addition of monomolecular films, or wet covering. When such water treatment is stopped, curing procedures shall be immediately commenced. Plastic shrinkage cracks that occur shall be repaired in accordance with paragraph: REPAIR, REMOVAL, REPLACEMENT OF NEWLY CONSTRUCTED SLABS. Plastic shrinkage cracks shall never be troweled over or filled with slurry.

3.3.4 Paving in Cold Weather

Cold weather paving shall conform to ACI 306R. Special protection measures, as specified herein, shall be used if freezing temperatures are anticipated before the expiration of the specified curing period. Placement of concrete shall not begin unless the ambient temperature is at least 35 degrees F and rising. Thereafter, placement of concrete shall be halted whenever the ambient temperature drops below 40 degrees F. When the ambient temperature is less than 50 degrees F, the temperature of the concrete when placed shall be not less than 50 degrees F nor more than 75 degrees F. Heating of the mixing water or aggregates will be required to regulate the concrete placing temperature. Materials entering the mixer shall be free from ice, snow, or frozen lumps. Salt, chemicals or other materials shall not be incorporated in the concrete to prevent freezing. If allowed under paragraph: MIXTURE PROPORTIONS, an accelerating admixture may be used when the ambient temperature is below 50 degrees F. Covering and other means shall be provided for maintaining the concrete at a temperature of at least 50 degrees F for not less than 72 hours after placing, and at a temperature above freezing for the remainder of the curing period. Pavement slabs damaged by freezing shall be removed full depth, by full slab width, to the nearest original joint, and replaced at the Contractor's expense as specified in paragraph: REPAIR, REMOVAL, REPLACEMENT OF NEWLY CONSTRUCTED SLABS.

3.4 CONCRETE PRODUCTION

Batching, mixing, and transporting equipment shall have a capacity sufficient to maintain a continuous, uniform forward movement of the paver of not less than 2.5 feet per minute. Concrete shall be deposited in front of the paver within 45 minutes from the time cement has been charged into

the mixing drum, except that if the ambient temperature is above 90 degrees F, the time shall be reduced to 30 minutes. Every load of concrete delivered to the paving site shall be accompanied by a batch ticket from the operator of the batching plant. Tickets shall be on approved forms and shall show at least the mass, or volume, of all ingredients in each batch delivered, and the time of day. Tickets shall be delivered to the placing foreman who shall keep them on file and deliver them to the Government weekly.

3.4.1 Batching and Mixing Concrete

Scale pivots and bearings shall be kept clean and free of rust. Any equipment which fails to perform as specified shall immediately be removed from use until properly repaired and adjusted, or replaced.

3.4.2 Transporting and Transfer - Spreading Operations

Non-agitating equipment shall be used only on smooth roads and for haul time less than 15 minutes. Concrete shall be deposited as close as possible to its final position in the paving lane. All equipment shall be operated to discharge and transfer concrete without segregation. In no case shall dumping of concrete in discrete piles be permitted. No transfer or spreading operation which requires the use of front-end loaders, dozers, or similar equipment to distribute the concrete will be permitted. All batching and mixing, transporting, transferring, paving, and finishing shall be properly coordinated and controlled such that the paver-finisher has a continuous forward movement at a reasonably uniform speed from beginning to end of each paving lane, except for inadvertent equipment breakdown. Failure to achieve this shall require the Contractor to halt operations, regroup, and modify operations to achieve this requirement.

3.5 PAVING

3.5.1 General Requirements

Pavement shall be constructed with paving and finishing equipment utilizing rigid fixed forms or by use of slipform paving equipment. Paving and finishing equipment and procedures shall be capable of constructing paving lanes of the required width at a rate of at least 100 feet of paving lane per hour on a routine basis. Paving equipment and its operation shall be controlled, and coordinated with all other operations, such that the paver-finisher has a continuous forward movement, at a reasonably uniform speed, from beginning to end of each paving lane, except for inadvertent equipment breakdown. Workmen with foreign material on their footwear or construction equipment that might deposit foreign material shall not be permitted to walk or operate in the plastic concrete. Where an open-graded granular base is required under the concrete, the Contractor shall select paving equipment and procedures which will operate properly on the base course without causing displacement or other damage.

3.5.2 Consolidation

Concrete shall be consolidated with the specified type of lane-spanning, gang-mounted, mechanical, immersion type vibrating equipment mounted in front of the paver, supplemented, in rare instances as specified, by hand-operated vibrators. The vibrators shall be inserted into the concrete to a depth that will provide the best full-depth consolidation but not closer to the underlying material than 2 inches. Excessive vibration shall not be permitted. If the vibrators cause visible tracking in the paving

lane, the paving operation shall be stopped and equipment and operations modified to prevent it. Concrete in small, odd-shaped slabs or in isolated locations inaccessible to the gang-mounted vibration equipment shall be vibrated with an approved hand-operated immersion vibrator operated from a bridge spanning the area. Vibrators shall not be used to transport or spread the concrete. Hand-operated vibrators shall not be operated in the concrete at one location for more than 20 seconds. For each paving train, at least one additional vibrator spud, or sufficient parts for rapid replacement and repair of vibrators shall be maintained at the paving site at all times. Any evidence of inadequate consolidation (honeycomb along the edges, large air pockets, or any other evidence) shall require the immediate stopping of the paving operation and approved adjustment of the equipment or procedures.

3.5.3 Operation

When the paver approaches a header at the end of a paving lane, a sufficient amount of concrete shall be maintained ahead of the paver to provide a roll of concrete which will spill over the header. The amount of extra concrete shall be sufficient to prevent any slurry that is formed and carried along ahead of the paver from being deposited adjacent to the header. The spud vibrators in front of the paver shall be brought as close to the header as possible before they are lifted. Additional consolidation shall be provided adjacent to the headers by hand-manipulated vibrators. When the paver is operated between or adjacent to previously constructed pavement (fill-in lanes), provisions shall be made to prevent damage to the previously constructed pavement. Screeds or extrusion plates shall be electronically controlled from the previously placed pavement so as to prevent them from applying pressure to the existing pavement and to prevent abrasion of the pavement surface. The overlapping area of existing pavement surface shall at all times be kept completely free of any loose or bonded foreign material as the paver-finisher operates across it. When the paver travels on existing pavement, approved provisions shall be made to prevent damage to the existing pavement. Pavers using transversely oscillating screeds shall not be used to form fill-in lanes that have widths less than a full width for which the paver was designed or adjusted.

3.5.4 Required Results

The paver-finisher, and its gang-mounted vibrators, together with its operating procedures shall be adjusted and operated and coordinated with the concrete mixture being used to produce a thoroughly consolidated slab throughout, true to line and grade within specified tolerances. The paver-finishing operation shall produce a surface finish free of irregularities, tears, voids of any kind, and any other discontinuities. The paver-finisher shall make only one pass across the pavement; multiple passes will not be permitted. The equipment and its operation shall produce a finished surface requiring no hand finishing other than the use of cutting straightedges, except in very infrequent instances. If any equipment or operation fails to produce the above results, the paving shall be stopped, the equipment shall be replaced or properly adjusted, the operation shall be appropriately modified, or the mixture proportions modified, in order to produce the required results before recommencing paving. No water, other than fog sprays (mist) as specified in paragraph: Prevention of Plastic Shrinkage Cracking, shall be applied to the concrete or the concrete surface during paving and finishing.

3.5.5 Fixed Form Paving

Paving equipment for fixed-form paving and the operation thereof shall conform to the requirements of paragraph EQUIPMENT, all requirements specified above under paragraph PAVING and as specified herein.

3.5.5.1 Forms for Fixed-Form Paving

- a. Straight forms shall be made of steel and shall be furnished in sections not less than 10 feet in length. Flexible or curved forms of proper radius shall be used for curves of 100-foot radius or less. Wood forms for curves and fillets shall be made of well-seasoned, surfaced plank or plywood, straight, and free from warp or bend. Wood forms shall be adequate in strength and rigidly braced. Forms shall have a depth equal to the pavement thickness at the edge. Where the project requires several different slab thicknesses, forms may be built up by bolting or welding a tubular metal section or by bolting wood planks to the bottom of the form to completely cover the underside of the base of the form and provide an increase in depth of not more than 25 percent. Maximum vertical deviation of top of any side form, including joints, shall not vary from a true plane more than 1/8 inch in 10 feet, and the upstanding leg shall not vary more than 1/4 inch.
- b. Form sections shall be tightly locked and shall be free from play or movement in any direction. Forms shall be provided with adequate devices for secure settings so that when in place they will withstand, without visible spring or settlement, the impact and vibration of the consolidating and finishing equipment.
- c. Set forms for full bearing on foundation for entire length and width and in alignment with edge of finished pavement. Support forms during entire operation of placing, compaction, and finishing so that forms will not deviate vertically more than 0.01 foot from required grade and elevations indicated. Conformity to the alignment and grade elevations shown on the drawings shall be checked and necessary corrections shall be made immediately prior to placing the concrete. The forms shall be cleaned and oiled each time before concrete is placed. No concrete shall be placed until setting of forms has been checked and approved by the CQC team.
- d. Forms for overlay pavements and for other locations where forms must be set on existing pavements shall be held securely in place with stakes or by other approved methods. Holes in existing pavements for form stakes shall be carefully drilled by methods which will not crack or spall the existing pavement. After use, the holes shall be filled flush with the surrounding surface using approved material, prior to overlying materials being placed. Any method which does not hold the form securely or which damages the existing pavement shall be immediately discontinued. Prior to setting forms for paving operations, the Contractor shall demonstrate his proposed form setting procedures at an approved location and shall not proceed further until the proposed method is approved by the Contracting Officer.

3.5.5.2 Form Removal

Forms shall remain in place at least 12 hours after the concrete has been placed. When conditions are such that the early strength gain of the concrete is delayed, the forms shall be left in place for a longer time, as directed. Forms shall be removed by procedures that do not injure the concrete. Bars or heavy metal tools shall not be used directly against the concrete in removing the forms. Any concrete found to be defective after form removal shall be repaired promptly, using procedures specified hereinafter or as directed.

3.5.6 Slipform Paving

3.5.6.1 General

Paving equipment for slipform paving and the operation thereof shall conform to the requirement of paragraph EQUIPMENT, all requirements specified above in subparagraphs, General, Consolidation, Operation, and Required Results, and as specified herein. The slipform paver shall shape the concrete to the specified and indicated cross section, meeting all tolerances, in one pass. The slipform paver shall finish the surface and edges so that only a very minimum isolated amount of hand finishing is required. If the paving operation does not meet the above requirements and the specified tolerances, the operation shall be immediately stopped, and the Contractor shall regroup and replace or modify any equipment as necessary, modify paving procedures or modify the concrete mix, in order to resolve the problem. The slipform paver shall be automatically electronically controlled from a taut wire guideline for horizontal alignment and on both sides from a taut wire guideline for vertical alignment, except that electronic control from a ski operating on a previously constructed adjoining lane shall be used where applicable for either or both sides. Automatic, electronic controls for vertical alignment shall always be used on both sides of the lane. Control from a slope-adjustment control or control operating from the underlying material shall never be used. Side forms on slipform pavers shall be properly adjusted so that the finished edge of the paving lane meets all specified tolerances. Dowels in longitudinal construction joints shall be installed as specified below. The installation of these dowels by dowel inserters attached to the paver or by any other means of inserting the dowels into the plastic concrete shall not be permitted.

3.5.6.2 Guideline for Slipform Paving

Guidelines shall be accurately and securely installed well in advance of concrete placement. Supports shall be provided at necessary intervals to eliminate all sag in the guideline when properly tightened. The guideline shall be high strength wire set with sufficient tension to remove all sag between supports. Supports shall be securely staked to the underlying material or other provisions made to ensure that the supports will not be displaced when the guideline is tightened or when the guideline or supports are accidentally touched by workmen or equipment during construction. The appliances for attaching the guideline to the supports shall be capable of easy adjustment in both the horizontal and vertical directions. When it is necessary to leave gaps in the guideline to permit equipment to use or cross underlying material, provisions shall be made for quickly and accurately replacing the guideline without any delay to the forward progress of the paver. Supports on either side of the gap shall be secured in such a manner as to avoid disturbing the remainder of the guideline when the portion across the gap is positioned and tightened. The guideline

across the gap and adjacent to the gap for a distance of 200 feet shall be checked for horizontal and vertical alignment after the guideline across the gap is tightened. Vertical and horizontal positioning of the guideline shall be such that the finished pavement shall conform to the alignment and grade elevations shown on the drawings within the specified tolerances for grade and smoothness. The specified tolerances are intended to cover only the normal deviations in the finished pavement that may occur under good supervision and do not apply to setting of the guideline. The guideline shall be set true to line and grade.

3.5.6.3 Laser Controls

If the Contractor proposes to use any type of automatic laser controls, a detailed description of the system shall be submitted and a trial field demonstration shall be performed in the presence of the Contracting Officer at least one week prior to start of paving. Approval of the control system will be based on the results of the demonstration and on continuing satisfactory operation during paving.

3.5.7 Placing Reinforcing Steel

The type and amount of steel reinforcement shall be as shown on the drawings. For pavement thickness of 12 inches or more, the reinforcement steel shall be installed by the strike-off method wherein a layer of concrete is deposited on the underlying material, consolidated, and struck to the indicated elevation of the steel reinforcement. The reinforcement shall be laid upon the prestruck surface, and the remaining concrete shall then be placed and finished in the required manner. When placement of the second lift causes the steel to be displaced horizontally from its original position, provisions shall be made for increasing the thickness of the first lift and depressing the reinforcement into the unhardened concrete to the required elevation. The increase in thickness shall be only as necessary to permit correct horizontal alignment to be maintained. Any portions of the bottom layer of concrete that have been placed more than 30 minutes without being covered with the top layer shall be removed and replaced with newly mixed concrete without additional cost to the Government. For pavements less than 12 inches thick, the reinforcement shall be positioned on suitable chairs securely fastened to the subgrade prior to concrete placement. Concrete shall be vibrated after the steel has been placed. Regardless of placement procedure, the reinforcing steel shall be free from coatings which could impair bond between the steel and concrete, and laps in the reinforcement shall be as indicated. In lieu of the above, automatic reinforcement depressing attachments may be used to position the reinforcement provided the entire operation is approved by the Contracting Officer. Regardless of the equipment or procedures used for installing reinforcement, the Contractor shall ensure that the entire depth of concrete is adequately consolidated.

3.5.8 Placing Dowels and Tie Bars

The method used in installing and holding dowels in position shall ensure that the error in alignment of any dowel from its required horizontal and vertical alignment after the pavement has been completed will not be greater than 1/8 in. per ft. Except as otherwise specified below, horizontal spacing of dowels shall be within a tolerance of plus or minus 5/8 inch. The vertical alignment of the dowels shall be measured parallel to the designated top surface of the pavement, except for those across the crown or other grade change joints. Dowels across crowns and other joints at grade changes shall be measured to a level surface. Horizontal

alignment shall be checked perpendicular to the joint edge. The horizontal alignment shall be checked with a framing square. Dowels and tie bars shall not be placed closer than 0.6 times the dowel bar or tie bar length to the planned joint line. If the last regularly spaced dowel or tie bar is closer than that dimension, it shall be moved away from the joint to a location 0.6 time the dowel bar or tie bar length. Dowels shall be installed as specified in the following subparagraphs.

3.5.8.1 Contraction Joints

Dowels and tie bars in longitudinal and transverse contraction joints within the paving lane shall be held securely in place, as indicated, by means of rigid metal frames or basket assemblies of an approved type. The basket assemblies shall be held securely in the proper location by means of suitable pins or anchors. At the Contractor's option, in lieu of the above, dowels and tie bars in contraction joints shall be installed near the front of the paver by insertion into the plastic concrete using approved equipment and procedures. Approval will be based on the results of a preconstruction demonstration which the Contractor shall conduct, showing that the dowels and tie bars are installed within specified tolerances.

3.5.8.2 Construction Joints-Fixed Form Paving

Installation of dowels and tie bars shall be by the bonded-in-place method. Installation by removing and replacing in preformed holes will not be permitted. Dowels and tie bars shall be prepared and placed across joints where indicated, correctly aligned, and securely held in the proper horizontal and vertical position during placing and finishing operations, by means of devices fastened to the forms. The spacing of dowels and tie bars in construction joints shall be as indicated, except that, where the planned spacing cannot be maintained because of form length or interference with form braces, closer spacing with additional dowels or tie bars shall be used.

3.5.8.3 Dowels Installed in Hardened Concrete

Dowels installed in hardened concrete shall be installed by bonding the dowels into holes drilled into the hardened concrete. The concrete shall have cured for 7 days or reached a minimum compressive strength of 2500 psi before drilling commences. Holes approximately 1/8 inch greater in diameter than the dowels shall be drilled into the hardened concrete. Any damage to the concrete face during drilling shall be repaired as directed; continuing damage shall require modification of the equipment and operation. Dowels shall be bonded in the drilled holes using epoxy resin. Epoxy resin shall be injected at the back of the hole before installing the dowel and extruded to the collar during insertion of the dowel so as to completely fill the void around the dowel. Application by buttering the dowel will not be permitted. The dowels shall be held in alignment at the collar of the hole, after insertion and before the grout hardens, by means of a suitable metal or plastic grout retention ring fitted around the dowel. Dowels required to be installed in any joints between new and existing concrete shall be grouted in holes drilled in the existing concrete, all as specified above.

3.5.8.4 Painting Dowel Bars

The portion of each dowel intended to move within the concrete or expansion cap shall be painted with one coat of the specified paint or coated with

epoxy. When dry, the painted portion shall be wiped clean and coated with a thin, even film of lubricating oil before the concrete is placed.

3.6 FINISHING

Finishing operations shall be a continuing part of placing operations starting immediately behind the strike-off of the paver. Initial finishing shall be provided by the transverse screed or extrusion plate. The sequence of operations shall be transverse finishing, longitudinal machine floating if used, straightedge finishing, texturing, and then edging of joints. Finishing shall be by the machine method. The hand method shall be used only on isolated areas of odd slab widths or shapes and in the event of a breakdown of the mechanical finishing equipment. Supplemental hand finishing for machine finished pavement shall be kept to an absolute minimum. Any machine finishing operation which requires appreciable hand finishing, other than a moderate amount of straightedge finishing, shall be immediately stopped and proper adjustments made or the equipment replaced. Every effort shall be made to prevent bringing excess paste to the surface and any operations which produce more than 1/8 inch of paste (mortar, water, laitance, etc.) over the top layer of coarse aggregate shall be halted immediately and the equipment, mixture, or procedures modified as necessary. Compensation shall be made for surging behind the screeds or extrusion plate and settlement during hardening and care shall be taken to ensure that paving and finishing machines are properly adjusted so that the finished surface of the concrete (not just the cutting edges of the screeds) will be at the required line and grade. Finishing equipment and tools shall be maintained clean and in an approved condition. At no time shall water be added to the surface of the slab with the finishing equipment or tools, or in any other way, except for fog (mist) sprays specified to prevent plastic shrinkage cracking.

3.6.1 Machine Finishing With Fixed Forms

The machine shall be designed to ride the forms and shall be operated to screed and consolidate the concrete. Machines that cause displacement of the forms shall be replaced. The machine shall make only one pass over each area of pavement. If the equipment and procedures do not produce a surface of uniform texture, true to grade, in one pass, the operation shall be immediately stopped and the equipment, mixture, and procedures adjusted as necessary.

3.6.2 Machine Finishing with Slipform Pavers.

The slipform paver shall be operated so that only a very minimum of additional finishing work is required to produce pavement surfaces and edges meeting the specified tolerances. Any equipment or procedure that fails to meet these specified requirements shall immediately be replaced or modified as necessary. A self-propelled nonrotating pipe float may be used while the concrete is still plastic, to remove minor irregularities and score marks. Only one pass of the pipe float shall be allowed. If there is concrete slurry or fluid paste on the surface that runs over the edge of the pavement, the paving operation shall be immediately stopped and the equipment, mixture, or operation modified to prevent formation of such slurry. Any slurry which does run down the vertical edges shall be immediately removed by hand, using stiff brushes or scrapers. No slurry, concrete or concrete mortar shall be used to build up along the edges of the pavement to compensate for excessive edge slump, either while the concrete is plastic or after it hardens.

3.6.3 Surface Correction and Testing

After all other finishing is completed but while the concrete is still plastic, minor irregularities and score marks in the pavement surface shall be eliminated by means of cutting straightedges. Such straightedges shall be 12 feet in length and shall be operated from the sides of the pavement and from bridges. A straightedge operated from the side of the pavement shall be equipped with a handle 3 feet longer than one-half the width of the pavement. The surface shall then be tested for trueness with a straightedge held in successive positions parallel and at right angles to the center line of the pavement, and the whole area covered as necessary to detect variations. The straightedge shall be advanced along the pavement in successive stages of not more than one-half the length of the straightedge. Depressions shall be immediately filled with freshly mixed concrete, struck off, consolidated, and refinished. Projections above the required elevation shall also be struck off and refinished. The straightedge testing and finishing shall continue until the entire surface of the concrete is free from observable departure from the straightedge and conforms to the surface requirements specified in paragraph: ACCEPTABILITY OF WORK AND PAYMENT ADJUSTMENTS. This straightedging shall not be used as a replacement for the straightedge testing of paragraph: Surface Smoothness. Long-handled, flat bull floats shall be used very sparingly and only as necessary to correct minor, scattered surface defects. If frequent use of bull floats is necessary, the paving operation shall be stopped and the equipment, mixture or procedures adjusted to eliminate the surface defects. Finishing with hand floats and trowels shall be held to the absolute minimum necessary. Extreme care shall be taken to prevent overfinishing joints and edges. The surface finish of the pavement shall be produced essentially by the finishing machine and not by subsequent hand finishing operations. All hand finishing operations shall be subject to approval and shall be modified when directed.

3.6.4 Hand Finishing

Hand finishing operations shall be used only as specified below.

3.6.4.1 Equipment

In addition to approved mechanical internal vibrators for consolidating the concrete, a strike-off and tamping template and a longitudinal float shall be provided for hand finishing. The template shall be at least 1 foot longer than the width of pavement being finished, of an approved design, and sufficiently rigid to retain its shape, and shall be constructed of metal or other suitable material shod with metal. The longitudinal float shall be at least 10 feet long, of approved design, and rigid and substantially braced, and shall maintain a plane surface on the bottom. Grate tampers (jitterbugs) shall not be used.

3.6.4.2 Finishing and Floating

As soon as placed and vibrated, the concrete shall be struck off and screeded to the crown and cross section and to such elevation above grade that when consolidated and finished, the surface of the pavement will be at the required elevation. In addition to previously specified complete coverage with handheld immersion vibrators, the entire surface shall be tamped with the strike-off and tamping template, and the tamping operation continued until the required compaction and reduction of internal and surface voids are accomplished. Immediately following the final tamping of the surface, the pavement shall be floated longitudinally from bridges

resting on the side forms and spanning but not touching the concrete. If necessary, additional concrete shall be placed and screeded, and the float operated until a satisfactory surface has been produced. The floating operation shall be advanced not more than half the length of the float and then continued over the new and previously floated surfaces.

3.6.5 Texturing

Before the surface sheen has disappeared and before the concrete hardens, the surface of the pavement shall be given a texture as described herein. After curing is complete, all textured surfaces shall be thoroughly power broomed to remove all debris.

3.6.5.1 Burlap Drag Surface

Surface texture shall be applied by dragging the surface of the pavement, in the direction of the concrete placement, with an approved burlap drag. The drag shall be operated with the fabric moist, and the fabric shall be cleaned or changed as required to keep clean. The dragging shall be done so as to produce a uniform finished surface having a fine sandy texture without disfiguring marks.

3.6.6 Edging

After texturing has been completed, the edge of the slabs along the forms, along the edges of slipformed lanes, and at the joints shall be carefully finished with an edging tool to form a smooth rounded surface of 1/8 inch radius. Tool marks shall be eliminated, and the edges shall be smooth and true to line. No water shall be added to the surface during edging. Extreme care shall be taken to prevent overworking the concrete.

3.6.7 Outlets in Pavement

Recesses for the tie-down anchors, lighting fixtures, and other outlets in the pavement shall be constructed to conform to the details and dimensions shown. The concrete in these areas shall be carefully finished to provide a surface of the same texture as the surrounding area that will be within the requirements for plan grade and surface smoothness.

3.7 CURING

3.7.1 Protection of Concrete

Concrete shall be continuously protected against loss of moisture and rapid temperature changes for at least 7 days from the completion of finishing operations. All equipment needed for adequate curing and protection of the concrete shall be on hand and ready for use before actual concrete placement begins. If any selected method of curing does not afford the proper curing and protection against concrete cracking, the damaged pavement shall be removed and replaced, and another method of curing shall be employed as directed. Curing shall be accomplished by one of the following methods .

3.7.2 Membrane Curing

A uniform coating of white-pigmented, membrane-forming, curing compound shall be applied to the entire exposed surface of the concrete as soon as the free water has disappeared from the surface after finishing . Along the formed edge faces, it shall be applied immediately after the forms are

removed. Concrete shall not be allowed to dry before the application of the membrane. If any drying has occurred, the surface of the concrete shall be moistened with a fine spray of water, and the curing compound applied as soon as the free water disappears. The curing compound shall be applied to the finished surfaces by means of an approved automatic spraying machine. The curing compound shall be applied with an overlapping coverage that will give a two-coat application at a coverage of 400 square feet per gallon, plus or minus 5.0 percent for each coat. A one-coat application may be applied provided a uniform application and coverage of 200 square feet per gallon, plus or minus 5.0 percent is obtained. The application of curing compound by hand-operated, mechanical powered pressure sprayers will be permitted only on odd widths or shapes of slabs and on concrete surfaces exposed by the removal of forms. When the application is made by hand-operated sprayers, a second coat shall be applied in a direction approximately at right angles to the direction of the first coat. If pinholes, abrasions, or other discontinuities exist, an additional coat shall be applied to the affected areas within 30 minutes. Concrete surfaces that are subjected to heavy rainfall within 3 hours after the curing compound has been applied shall be resprayed by the method and at the coverage specified above. Areas where the curing compound is damaged by subsequent construction operations within the curing period shall be immediately resprayed. Concrete surfaces to which membrane-curing compounds have been applied shall be adequately protected during the entire curing period from pedestrian and vehicular traffic, except as required for joint-sawing operations and surface tests, and from any other possible damage to the continuity of the membrane.

3.7.3 Moist Curing

Concrete to be moist-cured shall be maintained continuously wet for the entire curing period, or until curing compound is applied, commencing immediately after finishing. If forms are removed before the end of the curing period, curing shall be carried out as on unformed surfaces, using suitable materials. Surfaces shall be cured by ponding, by continuous sprinkling, by continuously saturated burlap or cotton mats, or by continuously saturated plastic coated burlap. Burlap and mats shall be clean and free from any contamination and shall be completely saturated before being placed on the concrete. Lap sheets to provide full coverage. The Contractor shall have an approved work system to ensure that moist curing is continuous 24 hours per day and that the entire surface is wet.

3.8 JOINTS

3.8.1 General Requirements for Joints

Joints shall conform to the locations and details indicated and shall be perpendicular to the finished grade of the pavement. All joints shall be straight and continuous from edge to edge or end to end of the pavement with no abrupt offset and no gradual deviation greater than 1/2 inch. Where any joint fails to meet these tolerances, the slabs adjacent to the joint shall be removed and replaced at no additional cost to the Government. No change from the jointing pattern shown on the drawings shall be made without written approval of the Contracting Officer. Joints shall be sealed immediately following curing of the concrete or as soon thereafter as weather conditions permit. Joints shall be sealed as specified in Section 02760A FIELD MOLDED SEALANTS FOR SEALING JOINTS IN RIGID PAVEMENTS .

3.8.2 Longitudinal Construction Joints

Dowels or tie bars shall be installed in the longitudinal construction joints, or the edges shall be thickened as indicated. Dowels and Tie bars shall be installed in conformance with paragraph, Placing Dowels and Tie Bars. After the end of the curing period, longitudinal construction joints shall be sawed to provide a groove at the top for sealant conforming to the details and dimensions indicated.

3.8.3 Transverse Construction Joints

Transverse construction joints shall be installed at the end of each day's placing operations and at any other points within a paving lane when concrete placement is interrupted for 30 minutes or longer. The transverse construction joint shall be installed at a planned transverse joint. Transverse construction joints shall be constructed by utilizing headers or by paving through the joint, then full-depth sawcutting the excess concrete. Pavement shall be constructed with the paver as close to the header as possible, and the paver shall be run out completely past the header. Transverse construction joints installed at a planned transverse joint shall be constructed as shown or, if not shown otherwise, shall be dowelled. Dowels shall be inserted through the header into the fresh concrete and consolidated with hand-held vibrators.

3.8.4 Expansion Joints

Expansion joints shall be formed where indicated, and about any structures and features that project through or into the pavement, using joint filler of the type, thickness, and width indicated, and shall be installed to form a complete, uniform separation between the structure and the pavement. The filler shall be attached to the original concrete placement with adhesive or other fasteners and shall extend the full slab depth. Adjacent sections of filler shall be fitted tightly together, and the filler shall extend across the full width of the paving lane or other complete distance in order to prevent entrance of concrete into the expansion space. Edges of the concrete at the joint face shall be finished with an edger with a radius of 1/8 inch. The joint filler strips shall be installed 3/4 inch below the pavement surface with a slightly tapered, dressed-and-oiled wood strip or other approved material temporarily secured to the top of the filler to form a recess to be filled with joint sealant. Expansion joints shall be constructed with dowels or thickened edges for load transfer as indicated on the drawings.

3.8.5 Slip Joints

Slip joints shall be installed where indicated using the specified materials. Preformed joint filler material shall be attached to the face of the original concrete placement with adhesive or other fasteners. A 3/4 inch deep reservoir for joint sealant shall be constructed at the top of the joint. Edges of the joint face shall be finished with an edger with a radius of 1/8 inch.

3.8.6 Contraction Joints

Transverse and longitudinal contraction joints shall be constructed by sawing an initial groove in the concrete with a 1/8 inch blade to the indicated depth. During sawing of joints, and again 24 hours later, the CQC team shall inspect all exposed lane edges for development of cracks below the saw cut, and shall immediately report results to the Contracting

Officer. If the Contracting Officer determines that there are more uncracked joints than desired, the Contractor will be directed to saw succeeding joints 25 percent deeper than originally indicated at no additional cost to the Government. The time of initial sawing shall vary depending on existing and anticipated weather conditions and shall be such as to prevent uncontrolled cracking of the pavement. Sawing of the joints shall commence as soon as the concrete has hardened sufficiently to permit cutting the concrete without chipping, spalling, or tearing. The sawed faces of joints will be inspected for undercutting or washing of the concrete due to the early sawing, and sawing shall be delayed if undercutting is sufficiently deep to cause structural weakness or excessive roughness in the joint. The sawing operation shall be carried on as required during both day and night regardless of weather conditions. The joints shall be sawed at the required spacing consecutively in the sequence of the concrete placement. A chalk line or other suitable guide shall be used to mark the alignment of the joint. Before sawing a joint, the concrete shall be examined closely for cracks, and the joint shall not be sawed if a crack has occurred near the planned joint location. Sawing shall be discontinued when a crack develops ahead of the saw cut. Immediately after the joint is sawed, the saw cut and adjacent concrete surface shall be thoroughly flushed with water and vacuumed until all waste from sawing is removed from the joint and adjacent concrete surface. The surface shall be resprayed with curing compound as soon as free water disappears. Necessary precautions shall be taken to insure that the concrete is properly protected from damage and cured at sawed joints, but that no curing compound enters the joints. The top of the joint opening and the joint groove at exposed edges shall be tightly sealed with cord backer rod before the concrete in the region of the joint is resprayed with curing compound, and shall be maintained until removed immediately before sawing joint sealant reservoir. After expiration of the curing period, the upper portion of the groove shall be widened by sawing to the width and depth indicated for the joint sealer.

3.8.7 Thickened Edge Joints

Thickened edge joints shall be constructed as indicated on the drawings. Underlying material in the transition area shall be graded as shown and shall meet the requirements for smoothness and compaction specified for all other areas of the underlying material.

3.9 REPAIR, REMOVAL, REPLACEMENT OF NEWLY CONSTRUCTED SLABS

3.9.1 General Criteria

New pavement slabs that are broken, have spalled edges, or contain cracks shall be removed and replaced or repaired, as specified hereinafter at no cost to the Government. Removal of partial slabs is not permitted. Not more than 15.0 percent of each slab's edge shall be spalled. Slabs with spalls exceeding this quantity, regardless of spall size, shall be sawn full depth to remove the spalled face, or removed, as directed. The Contracting Officer will determine whether cracks extend full depth of the pavement and may require cores to be drilled on the crack to determine depth of cracking. Such cores shall be at least 6 inch diameter, and shall be drilled and backfilled with a well consolidated concrete mixture bonded to the walls of the hole with Type V, Grade 3 epoxy resin. Drilling of cores and refilling holes shall be performed by the Contractor at no expense to the Government.

3.9.2 Slabs with Cracks

Cracks that do not exceed 25 percent of the design thickness in depth shall be cleaned and then pressure injected full depth with epoxy resin, Type IV, Grade 1. Slabs containing cracks deeper than 25 percent of the design thickness shall be removed.

3.9.3 Removal and Replacement of Full Slabs

Where it is necessary to remove full slabs, removal shall be in accordance with Section 02575 PAVEMENT REMOVAL. Removal and replacement shall be full depth, by full width of the slab, and the limit of removal shall be normal to the paving lane and extend to each original joint. Where there are no dowels, tie bars, or keys on an edge, or where they have been damaged, dowels of the size and spacing as specified for other joints in similar pavement shall be installed by epoxy grouting them into holes drilled into the existing concrete using procedures as specified in paragraph: Placing Dowels and Tie Bars. Original damaged dowels or tie bars shall be cut off flush with the joint face. Protruding portions of dowels shall be painted and lightly oiled. All four edges of the new slab shall thus contain dowels. Placement of concrete shall be as specified for original construction. Prior to placement of new concrete, the underlying material shall be recompacted and shaped as specified in the appropriate section of these specifications, and the surfaces of all four joint faces shall be cleaned of all loose material and contaminants and coated with a double application of membrane forming curing compound as bond breaker. Care shall be taken to prevent any curing compound from contacting dowels or tie bars. The resulting joints around the new slab shall be prepared and sealed as specified for original construction. In lieu of protecting existing tie bars, tie bars may be cut off, and replaced by epoxying new tie bars into drilled holes to match design plans.

3.9.4 Repairing Spalls Along Joints and Cracks

Where directed, spalls along joints of new slabs, along edges of adjacent existing concrete, and along parallel cracks shall be repaired by first making a vertical saw cut at least 3 inches outside the spalled areas and to a depth of at least 3 inches for PCC pavement less than 10 inches in thickness and at least 5 inches for PCC pavement 10 inches or greater. Saw cut shall be straight lines forming rectangular areas. The concrete between the saw cut and the joint, or crack, shall be chipped out to remove all unsound concrete and into at least 1/2 inch of visually sound concrete or to the depth of saw cut, whichever is greater. Spall along joints to be sealed shall be sawn, chipped out, and repaired to a depth to restore the full joint-face support. The existing concrete joint or crack shall be saw cut 1/2 inch in width, to a depth 1 inch greater in depth than the depth of removal. Fiber board with expansion joint cap shall be inserted into the saw cut. The cavity formed by chipping shall be thoroughly cleaned with high pressure water jets supplemented with oil-free compressed air to remove all loose material and thoroughly dry the cavity. Prior to installing patch materials, areas showing traces of oils or greases shall be cleaned by sandblasting. Sawcut overcuts shall be cleaned and filled with a self-leveling adhesive epoxy. Immediately before filling the cavity, the primer shall be applied to the dry cleaned surface of all sides and bottom of the cavity, except any joint face. The primer shall be applied in accordance with the manufacturer's recommendation. Allow the primer to dry before applying the quick setting patch material. Prepare (mix, heat, etc.) and place the patch material in accordance with the manufacturer's directions. The surface of the PCC pavement in the patch

shall be dried with a hot air lance prior to application of the patch material. The perimeter of the repair area shall be masked with tape to ensure no excess material will remain on the surface of the pavement. Apply texturing or surface finish to achieve a non-slip surface. Follow all safety precautions recommended by the patch material manufacturer. The patch shall be cured in accordance with the patch material manufacturer's directions. The finished surfaces of partial depth repair shall meet the grade of the adjoining pavements and shall not deviate more than 1/8 inch within the patched area. Any repair material on the surrounding surfaces of the existing concrete shall be removed before it hardens. After the patch material has hardened, remove the expansion joint cap and seal the joint or crack in accordance with Section 02760A.

3.10 NOT USED

3.11 PAVEMENT PROTECTION

The Contractor shall protect the pavement against all damage prior to final acceptance of the work by the Government. Aggregates, rubble, or other similar construction materials shall not be piled on airfield pavements. Traffic shall be excluded from the new pavement by erecting and maintaining barricades and signs until the concrete is at least 14 days old, or for a longer period if so directed. As a construction expedient in paving intermediate lanes between newly paved pilot lanes, operation of the hauling equipment will be permitted on the new pavement after the pavement has been cured for 7 days and the joints have been sealed or otherwise protected. Also, the subgrade planer, concrete paving and finishing machines, and similar equipment may be permitted to ride upon the edges of previously constructed slabs when the concrete has attained a minimum field cured flexural strength of 550 psi and approved means are furnished to prevent damage to the slab edge. All new and existing pavement carrying construction traffic or equipment shall be continuously kept completely clean, and spillage of concrete or other materials shall be cleaned up immediately upon occurrence. Special care shall be used where Contractor's traffic uses or crosses active airfield pavement. Other existing pavements used by the Contractor shall be power broomed at least daily when traffic operates. For fill-in lanes, equipment shall be used that will not damage or spall the edges or joints of the previously constructed pavement.

3.12 TESTING AND INSPECTION FOR CONTRACTOR QUALITY CONTROL

3.12.1 Testing and Inspection by Contractor

During construction, the Contractor shall be responsible for sampling and testing aggregates, cementitious materials (cement, GGBF and pozzolan), and concrete to determine compliance with the specifications. The Contractor shall provide facilities and labor as may be necessary for procurement of representative test samples. The Contractor shall furnish sampling platforms and belt templates to obtain representative samples of aggregates from charging belts at the concrete plant. Samples of concrete shall be obtained at the point of delivery to the paver. Testing by the Government will in no way relieve the Contractor of the specified testing requirements. The Contractor shall perform the inspection and tests described below, and based upon the results of these inspections and tests, shall take the action required and submit reports as required. This testing shall be performed by the Contractor regardless of any other testing performed by the Government, either for pay adjustment purposes or for any other reason.

3.12.2 Testing and Inspection Requirements

Contractor CQC sampling, testing, inspection and reporting shall be in accordance with the following Table.

TABLE 6
CONTRACTOR TESTING AND INSPECTION REQUIREMENTS

<u>Frequency</u>	<u>Test Method</u>	<u>Control Limit/Corrective Action</u>
<u>Fine Aggregate Gradation and Fineness Modulus</u>		
2 per lot	ASTM C 136 sample at belt	9 of 10 tests vary <0.15 from average Outside limits on any sieve-retest 2nd failure-stop, repair, retest
<u>Coarse Aggregate Gradation</u>		
2 per lot	ASTM C 136 sample at belt	Outside limits on any sieve-retest 2nd failure-report to COR, correct 2 consecutive avgs of 5 tests out-report to COR, stop ops, repair, retest
<u>Aggregate Deleterious Materials</u>		
Every 30 days	see paragraph: AGGREGATES	Stop production, retest, replace aggregate Increase testing interval to 90 days if previous 2 tests pass
<u>Plant - Scales, Weighing Accuracy</u>		
Monthly	NRMCA QC 3	Stop plant ops, repair, recalibrate
<u>Plant - Batching and Recording Accuracy</u>		
Weekly	Record/Report	Record required/recorded/actual batch mass Stop plant ops, repair, recalibrate
<u>Plant - Batch Plant Control</u>		
Every lot	Record/Report	Record type/amt of each material per lot
<u>Plant - Mixer Uniformity - Stationary Mixers</u>		
Every 4 months during paving	COE CRD-C 55	After initial approval, use abbreviated method. Increase mixing time, change batching sequence, reduce batch size to bring into compliance. Retest
<u>Concrete Mixture - Air Content</u>		
When test specimens prepared + 2 random	ASTM C 231 sample at paving site	Individual test control chart: Warning +/-1.0 - adjust AEA, retest Action +/-1.5 - halt ops, repair, retest Range between 2 consecutive tests: Warning +2.0 - recalibrate AEA dispenser Action +3.0 - halt ops, repair, retest
<u>Concrete Mixture - Slump</u>		
When test specimens prepared + 4 random	ASTM C 143/C 143M sample at paving site	Individual test control chart: Upper Warning - 1/2 inch below max-adjust batch masses within max W/C ratio Upper Action - maximum allowable slump stop operations, adjust, retest

<u>Frequency</u>	<u>Test Method</u>	<u>Control Limit/Corrective Action</u>
		Range between each consecutive test: 1-1/2 inches stop operations, repair, retest
		<u>Concrete Mixture - Temperature</u>
When test specimens prepared	ASTM C 1064/C 1064M sample at paving site	See paragraph: WEATHER LIMITATIONS
		<u>Concrete Mixture - Strength</u>
8 per lot	ASTM C 31/C 31M sample at paving site	See Paragraph: Concrete Strength Testing for CQC
		<u>Paving - Inspection Before Paving</u>
Prior to each paving operation	Report	Inspect underlying materials, construction joint faces, forms, reinforcing, dowels, and embedded items
		<u>Paving - Inspection During Paving</u>
During each paving operation		Monitor and control paving operation, including placement, consolidation, finishing, texturing, curing, and joint sawing.
		<u>Paving - Vibrators</u>
Weekly, during paving	COE CRD-C 521	Test frequency (in concrete), and amplitude (in air), measure at tip/head and average. Repair or replace defective vibrators.
		<u>Moist Curing</u>
2 per lot, min 4 per day	Visual	Repair defects, extend curing by 1 day
		<u>Membrane Compound Curing</u>
Daily	Visual	Calculate coverage based on quantity/area Respray areas where coverage defective Recalibrate equipment
		<u>Cold Weather Protection</u>
Once per	Visual	Repair defects, report conditions to COR

3.12.3 Concrete Strength Testing for Contractor CQC

Contractor Quality Control operations for concrete strength shall consist of the following steps:

- a. Take samples for strength tests at the paving site. Fabricate and cure test cylinders in accordance with ASTM C 31/C 31M; test them in accordance with ASTM C 39/C 39M.
- b. Fabricate and cure 2 test cylinders per subplot from the same batch or truckload and at the same time acceptance cylinders are fabricated and test them for compressive strength at 7-day age.
- c. Average all 8 compressive tests per lot. Convert this average

7-day compressive strength per lot to equivalent 28 -day flexural strength using the Correlation Ratio determined during mixture proportioning studies.

- d. Compare the equivalent 28 -day flexural strength from the conversion to the Average Flexural Strength Required for Mixtures from paragraph of same title.
- e. If the equivalent average 28-day strength for the lot is below the Average Flexural Strength Required for Mixtures by 20 psiflexural strength or more, at any time, adjust the mixture to increase the strength, as approved.
- f. Fabricate and cure two beams for every 2000 cubic yards of concrete placed. Fabricate and cure in accordance with ASTM C 31/C 31M; test at 14-days of age in accordance with ASTM C 78.
- g. The Contractor's CQC testing agency shall maintain up-to-date control charts for strength, showing the 7-day CQC compressive strength, the 14-day compressive strength (from acceptance tests) and the 28 -day equivalent flexural strength of each of these for each lot.

3.12.4 Reports

- a. All results of tests or inspections conducted shall be reported informally as they are completed and in writing daily. A weekly report shall be prepared for the updating of control charts covering the entire period from the start of the construction season through the current week. During periods of cold-weather protection, reports of pertinent temperatures shall be made daily. These requirements do not relieve the Contractor of the obligation to report certain failures immediately as required in preceding paragraphs. Such reports of failures and the action taken shall be confirmed in writing in the routine reports. The Contracting Officer has the right to examine all contractor quality control records.

-- End of Section --

SECTION 02760A

FIELD MOLDED SEALANTS FOR SEALING JOINTS IN RIGID PAVEMENTS

PART 1 GENERAL

1.1 REFERENCES

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

ASTM INTERNATIONAL (ASTM)

- ASTM C 509 (2000) Elastomeric Cellular Preformed Gasket and Sealing Material
- ASTM D 3569 (1995; R 2000) Joint Sealant, Hot-Applied, Elastomeric, Jet-Fuel-Resistant-Type for Portland Cement Concrete Pavements
- ASTM D 5893 (1996) Cold Applied, Single Component, Chemically Curing Silicone Joint Sealant for Portland Cement Concrete Pavements
- ASTM D 789 (1998) Determination of Relative Viscosity and Moisture Content of Polyamide (PA)

U.S. ARMY CORPS OF ENGINEERS (USACE)

- COE CRD-C 525 (1989) Test Method for Evaluation of Hot-Applied Joint Sealants for Bubbling Due to Heating

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Manufacturer's Recommendations; G, RO.

Where installation procedures, or any part thereof, are required to be in accordance with the manufacturer's recommendations, printed copies of these recommendations, 15 days prior to use on the project. Installation of the material will not be allowed until the recommendations are received. Failure to furnish these recommendations can be cause for rejection of the material.

Equipment; G, RO.

List of proposed equipment to be used in performance of construction work including descriptive data, 15 days prior to use on the project.

SD-04 Samples

Materials; G, RO.

Samples of the materials (sealant, primer if required, and backup material), in sufficient quantity for testing and approval 15 days prior to the beginning of work. No material will be allowed to be used until it has been approved.

1.3 TEST REQUIREMENTS

The joint sealant and backup or separating material shall be tested for conformance with the referenced applicable material specification. The materials will be tested by the Government. No material shall be used at the project prior to receipt of written notice that the materials meet the laboratory requirements. The cost of the first test of samples shall be borne by the Government. If the samples fail to meet specification requirements, the materials represented by the sample shall be replaced and the new materials tested at the Contractor's expense. Conformance with the requirements of the laboratory tests specified will not constitute final acceptance of the materials. Final acceptance will be based on the performance of the in-place materials.

1.4 EQUIPMENT

Machines, tools, and equipment used in the performance of the work required by this section shall be approved before the work is started and shall be maintained in satisfactory condition at all times.

1.4.1 Joint Cleaning Equipment

1.4.1.1 Tractor-Mounted Routing Tool

The routing tool used for removing old sealant from the joints shall be of such shape and dimensions and so mounted on the tractor that it will not damage the sides of the joints. The tool shall be designed so that it can be adjusted to remove the old material to varying depths as required. The use of V-shaped tools or rotary impact routing devices will not be permitted. Hand-operated spindle routing devices may be used to clean and enlarge random cracks.

1.4.1.2 Concrete Saw

A self-propelled power saw with water-cooled diamond or abrasive saw blades will be provided for cutting joints to the depths and widths specified or for refacing joints or cleaning sawed joints where sandblasting does not provide a clean joint.

1.4.1.3 Sandblasting Equipment

Sandblasting equipment shall include an air compressor, hose, and long-wearing venturi-type nozzle of proper size, shape and opening. The

maximum nozzle opening should not exceed 1/4 inch. The air compressor shall be portable and shall be capable of furnishing not less than 150 cfm and maintaining a line pressure of not less than 90 psi at the nozzle while in use. Compressor capability under job conditions must be demonstrated before approval. The compressor shall be equipped with traps that will maintain the compressed air free of oil and water. The nozzle shall have an adjustable guide that will hold the nozzle aligned with the joint approximately 1 inch above the pavement surface. The height, angle of inclination and the size of the nozzle shall be adjusted as necessary to secure satisfactory results.

1.4.1.4 Hand Tools

Hand tools may be used, when approved, for removing defective sealant from a crack and repairing or cleaning the crack faces.

1.4.2 Sealing Equipment

1.4.2.1 Hot-Poured Sealing Equipment

The unit applicators used for heating and installing ASTM D 3569 joint sealant materials shall be mobile and shall be equipped with a double-boiler, agitator-type kettle with an oil medium in the outer space for heat transfer; a direct-connected pressure-type extruding device with a nozzle shaped for inserting in the joint to be filled; positive temperature devices for controlling the temperature of the transfer oil and sealant; and a recording type thermometer for indicating the temperature of the sealant. The applicator unit shall be designed so that the sealant will circulate through the delivery hose and return to the inner kettle when not in use.

1.4.2.2 Cold-Applied, Single-Component Sealing Equipment

The equipment for installing ASTM D 5893 single component joint sealants shall consist of an extrusion pump, air compressor, following plate, hoses, and nozzle for transferring the sealant from the storage container into the joint opening. The dimension of the nozzle shall be such that the tip of the nozzle will extend into the joint to allow sealing from the bottom of the joint to the top. The initially approved equipment shall be maintained in good working condition, serviced in accordance with the supplier's instructions, and shall not be altered in any way without obtaining prior approval. Small hand-held air-powered equipment (i.e., caulking guns) may be used for small applications.

1.5 TRIAL JOINT SEALANT INSTALLATION

Prior to the cleaning and sealing of the joints for the entire project, a test section of at least 200 feet long shall be prepared using the specified materials and approved equipment, so as to demonstrate the proposed joint preparation and sealing of all types of joints in the project. Following the completion of the test section and before any other joint is sealed, the test section shall be inspected to determine that the materials and installation meet the requirements specified. If it is determined that the materials or installation do not meet the requirements, the materials shall be removed, and the joints shall be recleaned and resealed at no cost to the Government. When the test section meets the requirements, it may be incorporated into the permanent work and paid for at the contract unit price per linear foot for sealing items scheduled. All other joints shall be prepared and sealed in the manner approved for

sealing the test section.

1.6 DELIVERY AND STORAGE

Materials delivered to the job site shall be inspected for defects, unloaded, and stored with a minimum of handling to avoid damage. Storage facilities shall be provided by the Contractor at the job site for maintaining materials at the temperatures and conditions recommended by the manufacturer.

1.7 ENVIRONMENTAL CONDITIONS

The ambient air temperature and the pavement temperature within the joint wall shall be a minimum of 50 degrees F and rising at the time of application of the materials. Sealant shall not be applied if moisture is observed in the joint.

PART 2 PRODUCTS

2.1 SEALANTS

Materials for sealing cracks in the various paved areas indicated on the drawings shall be as follows:

Area	Sealing Material
Longitudinal & Transverse Joints	ASTM D 5893
Expansion Joints	ASTM D 5893
Joints Between Rigid & Flexible Pavements	ASTM D 5893 and COE CRD-C 525

2.2 PRIMERS

When primers are recommended by the manufacturer of the sealant, their use shall be in accordance with the recommendation of the manufacturer.

2.3 BACKUP MATERIALS

The backup material shall be a compressible, nonshrinking, nonstaining, nonabsorbing material and shall be nonreactive with the joint sealant. The material shall have a melting point at least 5 degrees F greater than the pouring temperature of the sealant being used when tested in accordance with ASTM D 789. The material shall have a water absorption of not more than 5 percent of the sample weight when tested in accordance with ASTM C 509. The backup material shall be 25 plus or minus 5 percent larger in diameter than the nominal width of the crack.

2.4 BOND BREAKING TAPES

The bond breaking tape or separating material shall be a flexible, nonshrinkable, nonabsorbing, nonstaining, and nonreacting adhesive-backed tape. The material shall have a melting point at least 5 degrees F greater than the pouring temperature of the sealant being used when tested in accordance with ASTM D 789. The bond breaker tape shall be approximately 1/8 inch wider than the nominal width of the joint and shall not bond to

the joint sealant.

PART 3 EXECUTION

3.1 PREPARATION OF JOINTS

Immediately before the installation of the sealant, the joints shall be thoroughly cleaned to remove all laitance, curing compound, filler, protrusions of hardened concrete, and old sealant from the sides and upper edges of the joint space to be sealed.

3.1.1 Sawing

3.1.1.1 Refacing of Joints

Facing of joints shall be accomplished using a concrete saw as specified in paragraph EQUIPMENT. The blade shall be stiffened with a sufficient number of suitable dummy (used) blades or washers. Immediately following the sawing operation, the joint opening shall be thoroughly cleaned using a water jet to remove all saw cuttings and debris.

3.1.2 Sandblasting

The newly exposed concrete joint faces and the pavement surfaces extending a minimum of 1/2 inch from the joint edges shall be sandblasted clean. A multiple-pass technique shall be used until the surfaces are free of dust, dirt, curing compound, filler, old sealant residue, or any foreign debris that might prevent the bonding of the sealant to the concrete. After final cleaning and immediately prior to sealing, the joints shall be blown out with compressed air and left completely free of debris and water.

3.1.3 Back-Up Material

When the joint opening is of a greater depth than indicated for the sealant depth, the lower portion of the joint opening shall be plugged or sealed off using a back-up material to prevent the entrance of the sealant below the specified depth. Care shall be taken to ensure that the backup material is placed at the specified depth and is not stretched or twisted during installation.

3.1.4 Bond Breaking Tape

Where inserts or filler materials contain bitumen, or the depth of the joint opening does not allow for the use of a backup material, a bond breaker separating tape will be inserted to prevent incompatibility with the filler materials and three-sided adhesion of the sealant. The tape shall be securely bonded to the bottom of the joint opening so it will not float up into the new sealant.

3.1.5 Rate of Progress of Joint Preparation

The stages of joint preparation which include sandblasting, air pressure cleaning and placing of the back-up material shall be limited to only that lineal footage that can be sealed during the same day.

3.2 PREPARATION OF SEALANT

3.2.1 Hot-Poured Sealants

Sealants conforming to ASTM D 3569 shall not be heated in excess of the safe heating temperature recommended by the manufacturer as shown on the sealant containers. Sealant that has been overheated or subjected to application temperatures for over 4 hours or that has remained in the applicator at the end of the day's operation shall be withdrawn and wasted.

3.2.2 Single-Component, Cold-Applied Sealants

The ASTM D 5893 sealant and containers shall be inspected prior to use. Any materials that contain water, hard caking of any separated constituents, nonreversible jell, or materials that are otherwise unsatisfactory shall be rejected. Settlement of constituents in a soft mass that can be readily and uniformly remixed in the field with simple tools will not be cause for rejection.

3.3 INSTALLATION OF SEALANT

3.3.1 Time of Application

Joints shall be sealed immediately following final cleaning of the joint walls and following the placement of the separating or backup material. Open joints that cannot be sealed under the conditions specified, or when rain interrupts sealing operations shall be recleaned and allowed to dry prior to installing the sealant.

3.3.2 Sealing Joints

Immediately preceding, but not more than 50 feet ahead of the joint sealing operations, a final cleaning with compressed air shall be performed. The joints shall be filled from the bottom up to 1/4 inch plus or minus 1/16 inch below the pavement surface. Excess or spilled sealant shall be removed from the pavement by approved methods and shall be discarded. The sealant shall be installed in such a manner as to prevent the formation of voids and entrapped air. In no case shall gravity methods or pouring pots be used to install the sealant material. Traffic shall not be permitted over newly sealed pavement until authorized by the Contracting Officer. When a primer is recommended by the manufacturer, it shall be applied evenly to the joint faces in accordance with the manufacturer's instructions. Joints shall be checked frequently to ensure that the newly installed sealant is cured to a tack-free condition within the time specified.

3.4 INSPECTION

3.4.1 Joint Cleaning

Joints shall be inspected during the cleaning process to correct improper equipment and cleaning techniques that damage the concrete pavement in any manner. Cleaned joints shall be approved prior to installation of the separating or back-up material and joint sealant.

3.4.2 Joint Sealant Application Equipment

The application equipment shall be inspected to ensure conformance to temperature requirements, proper proportioning and mixing (if two-component

sealant) and proper installation. Evidences of bubbling, improper installation, failure to cure or set shall be cause to suspend operations until causes of the deficiencies are determined and corrected.

3.4.3 Joint Sealant

The joint sealant shall be inspected for proper rate of cure and set, bonding to the joint walls, cohesive separation within the sealant, reversion to liquid, entrapped air and voids. Sealants exhibiting any of these deficiencies at any time prior to the final acceptance of the project shall be removed from the joint, wasted, and replaced as specified herein at no additional cost to the Government.

3.5 CLEAN-UP

Upon completion of the project, all unused materials shall be removed from the site and the pavement shall be left in a clean condition.

-- End of Section --

SECTION 02763A
PAVEMENT MARKINGS

PART 1 GENERAL

1.1 REFERENCES

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

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS TT-B-1325 (Rev C) Beads (Glass Spheres)
Retro-Reflective (Metric)

FS TT-P-1952 (Rev D; Notice 1) Paint, Traffic and
Airfield Marking, Waterborne (Metric)

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Equipment; G, RO

Lists of proposed equipment, including descriptive data, and notifications of proposed Contractor actions as specified in this section. List of removal equipment shall include descriptive data indicating area of coverage per pass, pressure adjustment range, tank and flow capacities, and safety precautions required for the equipment operation.

Composition Requirements; G, RO

Manufacturer's current printed product description and Material Safety Data Sheets (MSDS) for each type paint/color proposed for use.

Qualifications

Documentation on personnel qualifications, as specified.

SD-06 Test Reports

Sampling and Testing; G, RO

Certified copies of the test reports, prior to the use of the materials at the jobsite. Testing shall be performed in an

approved independent laboratory.

SD-07 Certificates

Volatile Organic Compound (VOC)

Certificate stating that the proposed pavement marking paint meets the VOC regulations of the local Air Pollution Control District having jurisdiction over the geographical area in which the project is located.

1.3 DELIVERY AND STORAGE

All materials shall be delivered and stored in sealed containers that plainly show the designated name, formula or specification number, batch number, color, date of manufacture, manufacturer's name, and directions, all of which shall be plainly legible at time of use.

1.4 EQUIPMENT

All machines, tools and equipment used in the performance of the work shall be approved and maintained in satisfactory operating condition. Equipment operating on roads and runways shall display low speed traffic markings and traffic warning lights.

1.4.1 Paint Application Equipment

1.4.1.1 Self-Propelled or Mobile-Drawn Pneumatic Spraying Machines

The equipment to apply paint to pavements shall be a self-propelled or mobile-drawn pneumatic spraying machine with suitable arrangements of atomizing nozzles and controls to obtain the specified results. The machine shall have a speed during application not less than 5 mph, and shall be capable of applying the stripe widths indicated, at the paint coverage rate specified in paragraph APPLICATION, and of even uniform thickness with clear-cut edges. The equipment used to apply the paint binder to airfield pavements shall be a self-propelled or mobile-drawn pneumatic spraying machine with an arrangement of atomizing nozzles capable of applying a line width at any one time in multiples of 6 inches, from 6 inches to 36 inches. The paint applicator shall have paint reservoirs or tanks of sufficient capacity and suitable gauges to apply paint in accordance with requirements specified. Tanks shall be equipped with suitable air-driven mechanical agitators. The spray mechanism shall be equipped with quick-action valves conveniently located, and shall include necessary pressure regulators and gauges in full view and reach of the operator. Paint strainers shall be installed in paint supply lines to ensure freedom from residue and foreign matter that may cause malfunction of the spray guns. The paint applicator shall be readily adaptable for attachment of an air-actuated dispenser for the reflective media approved for use. Pneumatic spray guns shall be provided for hand application of paint in areas where the mobile paint applicator cannot be used.

1.4.1.2 Hand-Operated, Push-Type Machines

All machines, tools, and equipment used in performance of the work shall be approved and maintained in satisfactory operating condition. Hand-operated push-type machines of a type commonly used for application of paint to pavement surfaces will be acceptable for marking small streets and parking areas. Applicator machine shall be equipped with the necessary paint tanks

and spraying nozzles, and shall be capable of applying paint uniformly at coverage specified. Sandblasting equipment shall be provided as required for cleaning surfaces to be painted. Hand-operated spray guns shall be provided for use in areas where push-type machines cannot be used.

1.4.2 Reflective Media Dispenser

The dispenser for applying the reflective media shall be attached to the paint dispenser and shall operate automatically and simultaneously with the applicator through the same control mechanism. The dispenser shall be capable of adjustment and designed to provide uniform flow of reflective media over the full length and width of the stripe at the rate of coverage specified in paragraph APPLICATION, at all operating speeds of the applicator to which it is attached.

1.4.3 Surface Preparation Equipment

1.4.3.1 Sandblasting Equipment

Sandblasting equipment shall include an air compressor, hoses, and nozzles of proper size and capacity as required for cleaning surfaces to be painted. The compressor shall be capable of furnishing not less than 150 cfm of air at a pressure of not less than 90 psi at each nozzle used, and shall be equipped with traps that will maintain the compressed air free of oil and water.

1.4.3.2 Waterblast Equipment

The water pressure shall be specified at 2600 psi at 140 degrees F in order to adequately clean the surfaces to be marked.

1.4.4 Marking Removal Equipment

Equipment shall be mounted on rubber tires and shall be capable of removing markings from the pavement without damaging the pavement surface or joint sealant. Waterblasting equipment shall be capable of producing an adjustable, pressurized stream of water. Sandblasting equipment shall include an air compressor, hoses, and nozzles. The compressor shall be equipped with traps to maintain the air free of oil and water.

1.4.4.1 Shotblasting Equipment

Shotblasting equipment shall not be used.

1.4.4.2 Chemical Equipment

Chemical equipment shall not be used for removal.

1.4.5 Traffic Controls

Suitable warning signs shall be placed near the beginning of the worksite and well ahead of the worksite for alerting approaching traffic from both directions. Small markers shall be placed along newly painted lines or freshly placed raised markers to control traffic and prevent damage to newly painted surfaces or displacement of raised pavement markers. Painting equipment shall be marked with large warning signs indicating slow-moving painting equipment in operation.

1.5 MAINTENANCE OF TRAFFIC

1.5.1 Airfield

The performance of work in the controlled zones of airfields shall be coordinated with the Contracting Officer and with the Flight Operations Officer. Verbal communications shall be maintained with the control tower before and during work in the controlled zones of the airfield. The control tower shall be advised when the work is completed. A radio for this purpose shall be provided by the Contractor and approved by the Contracting Officer.

1.6 WEATHER LIMITATIONS FOR REMOVAL

Pavement surface shall be free of snow, ice, or slush. Surface temperature shall be at least 40 degrees F and rising at the beginning of operations, except those involving shot or sand blasting. Operation shall cease during thunderstorms. Operation shall cease during rainfall, except for waterblasting and removal of previously applied chemicals. Waterblasting shall cease where surface water accumulation alters the effectiveness of material removal.

1.7 QUALIFICATIONS

The Contractor shall submit documentation certifying that pertinent personnel are qualified for equipment operation and handling of chemicals.

PART 2 PRODUCTS

2.1 PAINT

The paint shall be homogeneous, easily stirred to smooth consistency, and shall show no hard settlement or other objectionable characteristics during a storage period of 6 months. Paints for airfields, roads, parking areas, and streets shall conform to FS TT-P-1952 Type I, color as indicated on the plans. Use the following color chip numbers: White-37925, Yellow-33538 and Black-37038. Pavement marking paints shall comply with applicable state and local laws enacted to ensure compliance with Federal Clean Air Standards. Paint materials shall conform to the restrictions of the local Air Pollution Control District.

2.2 REFLECTIVE MEDIA

Reflective media for airfields shall conform to FS TT-B-1325, Type I, Gradation A.

2.3 SAMPLING AND TESTING

Materials proposed for use shall be stored on the project site in sealed and labeled containers, or segregated at source of supply, sufficiently in advance of needs to allow 60 days for testing. Upon notification by the Contractor that the material is at the site or source of supply, a sample shall be taken by random selection from sealed containers by the Contractor in the presence of a representative of the Contracting Officer. Samples shall be clearly identified by designated name, specification number, batch number, manufacturer's formulation number, project contract number, intended use, and quantity involved. Testing shall be performed in an approved independent laboratory. If materials are approved based on reports furnished by the Contractor, samples will be retained by the

Government for possible future testing should the material appear defective during or after application.

PART 3 EXECUTION

3.1 SURFACE PREPARATION

Surfaces to be marked shall be thoroughly cleaned before application of the pavement marking material. Dust, dirt, and other granular surface deposits shall be removed by sweeping, blowing with compressed air, rinsing with water or a combination of these methods as required. Rubber deposits, surface laitance, existing paint markings, and other coatings adhering to the pavement shall be completely removed with scrapers, wire brushes, sandblasting, approved chemicals, or mechanical abrasion as directed. Areas of old pavement affected with oil or grease shall be scrubbed with several applications of trisodium phosphate solution or other approved detergent or degreaser, and rinsed thoroughly after each application. After cleaning, oil-soaked areas shall be sealed with cut shellac to prevent bleeding through the new paint. Pavement surfaces shall be allowed to dry, when water is used for cleaning, prior to striping or marking. Surfaces shall be recleaned, when work has been stopped due to rain.

3.1.1 Pretreatment for Early Painting

Where early painting is required on rigid pavements, a pretreatment with an aqueous solution containing 3 percent phosphoric acid and 2 percent zinc chloride shall be applied to prepared pavement areas prior to painting.

3.1.2 Cleaning Existing Pavement Markings

In general, markings shall not be placed over existing pavement marking patterns. Existing pavement markings, which are in good condition but interfere or conflict with the newly applied marking patterns, shall be removed. Deteriorated or obscured markings that are not misleading or confusing or interfere with the adhesion of the new marking material do not require removal. New preformed and thermoplastic pavement markings shall not be applied over existing preformed or thermoplastic markings. Whenever grinding, scraping, sandblasting or other operations are performed the work must be conducted in such a manner that the finished pavement surface is not damaged or left in a pattern that is misleading or confusing. When these operations are completed the pavement surface shall be blown off with compressed air to remove residue and debris resulting from the cleaning work.

3.1.3 Cleaning Concrete Curing Compounds

On new Portland cement concrete pavements, cleaning operations shall not begin until a minimum of 30 days after the placement of concrete. All new concrete pavements shall be cleaned by either sandblasting or water blasting. When water blasting is performed, thermoplastic and preformed markings shall be applied no sooner than 24 hours after the blasting has been completed. The extent of the blasting work shall be to clean and prepare the concrete surface as follows:

- a. There is no visible evidence of curing compound on the peaks of the textured concrete surface.
- b. There are no heavy puddled deposits of curing compound in the valleys of the textured concrete surface.

- c. All remaining curing compound is intact; all loose and flaking material is removed.
- d. The peaks of the textured pavement surface are rounded in profile and free of sharp edges and irregularities.
- e. The surface to be marked is dry.

3.2 APPLICATION

All pavement markings and patterns shall be placed as shown on the plans.

3.2.1 Paint

Paint shall be applied to clean, dry surfaces, and only when air and pavement temperatures are above 40 degrees F and less than 95 degrees F. Paint temperature shall be maintained within these same limits. New asphalt pavement surfaces and new Portland concrete cement shall be allowed to cure for a period of not less than 30 days before applications of paint.

Paint shall be applied pneumatically with approved equipment at rate of coverage specified. The Contractor shall provide guide lines and templates as necessary to control paint application. Special precautions shall be taken in marking numbers, letters, and symbols. Edges of markings shall be sharply outlined.

3.2.1.1 Rate of Application

- a. Reflective Markings: Pigmented binder shall be applied evenly to the pavement area to be coated at a rate of 105 plus or minus 5 square feet per gallon. Glass spheres shall be applied uniformly to the wet paint on airfield pavement at a rate of 8 plus or minus 0.5 pounds of glass spheres per gallon of paint.
- b. Nonreflective Markings: Paint shall be applied evenly to the pavement surface to be coated at a rate of 105 plus or minus 5 square feet per gallon.
- c. Temporary Markings: Paint shall be applied at an application rate of 50 to 55 square feet per gallon.

3.2.1.2 Drying

The maximum drying time requirements of the paint specifications will be strictly enforced to prevent undue softening of bitumen, and pickup, displacement, or discoloration by tires of traffic. If there is a delay in drying of the markings, painting operations shall be discontinued until cause of the slow drying is determined and corrected.

3.2.2 Raised Reflective Markers

Prefabricated markers shall be aligned carefully at the required spacing and permanently fixed in place by means of epoxy resin adhesives. To insure good bond, pavement in areas where markers will be set shall be thoroughly cleaned by sandblasting and use of compressed air prior to applying adhesive.

3.2.3 Reflective Media

Application of reflective media shall immediately follow application of

pigmented binder. Drop-on application of glass spheres shall be accomplished to insure that reflective media is evenly distributed at the specified rate of coverage. Should there be malfunction of either paint applicator or reflective media dispenser, operations shall be discontinued immediately until deficiency is corrected.

3.3 MARKING REMOVAL

Pavement marking, shall be removed in the areas shown on the drawings. Removal of marking shall be as complete as possible without damage to the surface. Aggregate shall not be exposed by the removal process. After the markings are removed, the cleaned pavement surfaces shall exhibit adequate texture for remarking as specified in paragraph SURFACE PREPARATION. Contractor shall demonstrate removal of pavement marking in an area designated by the Contracting Officer. The demonstration area will become the standard for the remainder of the work.

3.3.1 Equipment Operation

Equipment shall be controlled and operated to remove markings from the pavement surface, prevent dilution or removal of binder from underlying pavement, and prevent emission of blue smoke from asphalt or tar surfaces. Removal equipment may be accompanied by an independent vacuum/sweeper device or shall have an internal vacuum device.

3.3.2 Amount of Removal

Paint marking removal shall be defined as the removal of at least 90 percent of the existing marking. The 90 percent removal shall be determined by the Contracting Officer by visual inspection. In addition to the visual determination, the 90 percent removal level is defined such that there shall not be any remaining surface of undisturbed paint or individual contiguous areas larger than one square inch where the surface of the pavement material is not clearly exposed.

3.3.3 Damage to Existing Pavement

The method used shall not materially change the structural integrity of the pavement. Any damage caused by the Contractor's operations shall be corrected at the Contractor's expense and in a manner approved by the Contracting Officer. The Contractor shall take precautions to protect the public from any damage due to these operations.

3.3.4 Removal Pattern

The Contractor shall not follow the outside edge of the pavement marking to be removed, but shall waterblast/sandblast in a wavy pattern, scarring both painted and non-painted P.C.C.

3.3.5 Cleanup and Waste Disposal

The worksite shall be kept clean of debris and waste from the removal operations. Cleanup shall immediately follow removal operations in areas subject to air traffic. Debris shall be disposed of at approved sites.

3.4 Temporary Markings

Where shown on the plans, temporary paint shall be applied to the pavement, color as indicated on the plans. Temporary paint shall meet the

requirements of Section 2.1 PAINT. Reflective media is not required.

3.4.1 Remarking Temporary Paint

If during the use of the temporary marking more than 10 percent of the temporary marking flakes off or otherwise removed and becomes missing, the Contractor shall re-mark the temporary marking at no additional cost to the Contractor. The 10 percent level shall be determined by the Contracting Officer by visual inspection.

-- End of Section --

SECTION 02785

BITUMINOUS SEAL AND FOG COATS

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO T 40 (2002) Sampling Bituminous Materials

ASTM INTERNATIONAL (ASTM)

ASTM D 5 (1997) Test Method for Penetration of Bituminous Materials

ASTM D 75 (2003) Sampling Aggregates

ASTM D 140 (2001) Sampling Bituminous Materials

ASTM D 451 (2002) Test Method for Sieve Analysis of Surfacing for Asphalt Roofing Products

ASTM D 2007 (2002) Test Method For Characteristics Groups in Rubber Extender and Processing Oils and Other Petroleum-Derived Oils by the Clay-Gel Absorption Chromatographic Method

ASTM D 2042 (2001) Test Method for Solubility of Asphalt Materials in Trichlorethylene

ASTM D 2995 (1999) Determining Application Rate of Bituminous Distributors

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Bituminous Emulsion Concentrate

Details and data including manufacture's literature showing that the material meets all requirements specified herein.

Equipment List

List of equipment used in the project along with calibration reports.

Inspection Reports

Reports of climatic temperature during application of fog seal, emulsion temperature and rate.

SD-04 Samples

Bituminous Materials Aggregates

From each source of supply, a one gallon sample of bituminous material and a 50 pound sample of aggregate for each aggregate size.

SD-06 Test Reports

Sampling and Testing; G, RO

Copies of the test results, within 24 hours of the completion of the test. Certified copies of the aggregate test results, not less than 30 days before the material is required in the work. Certified copies of the bituminous emulsion concentrate materials test reports indicating compliance with applicable specified requirements, not less than 30 days before the material is required in the work. A copy of the calibration test results, before the bituminous distributor and aggregate spreader are used on the job.

1.3 CONSTRUCTION EQUIPMENT

1.3.1 General Requirements

Equipment, plant and tools used in the work shall be subject to approval and shall be maintained in a satisfactory working condition at all times. The equipment shall be adequate and shall have the capability of producing the results specified. Calibrated equipment such as asphalt distributors, scales, batching equipment, spreaders and similar equipment, shall have been recalibrated by an approved calibration laboratory within 12 months prior to commencing work .

1.3.2 Bituminous Distributors

The bituminous emulsion may be applied with a standard bituminous distributed truck approved by the bituminous emulsion supplier. The equipment shall be in good working condition and contain no contaminants or dilutants in tank. The distributor shall have pneumatic tires of

sufficient size and number to prevent rutting, shoving, or otherwise damaging any part of the pavement structure. The distributor shall be designed and equipped to distribute the bituminous material in a uniform double or triple lap at the specified temperature, at readily determined and controlled rates from 0.05 to 2.0 gallons per square yard, with a pressure range of 25 to 75 pounds per square inch with an allowable variation from the specified rate of not more than plus or minus 5 percent, and at variable widths. Distributor equipment shall include a separate power unit for the bitumen pump, full-circulation spray bars, tachometer, pressure gauges, volume-measuring devices, adequate heaters for heating of materials to the proper application temperature, a thermometer for reading the temperature of tank contents, and a hand-held hose attachment suitable for applying bituminous material manually to areas inaccessible to the distributor and around taxiway edge lights. The distributor shall be equipped to circulate and agitate the bituminous material during the heating process. The distributor shall be equipped to circulate and agitate the bituminous material during the heating process. Provide distributor with an adjustable, both horizontally and vertically, spray nozzle bar. Make normal width of bar application at least 8 feet, with provisions for lesser or larger width when necessary. Equip distributor with a meter having a dial registering feet of travel per minute. Make both dials visible to the distributor driver. Provide a thermometer and well, not in contact with any heating tubes, for accurately indicating temperature of asphalt emulsion.

1.3.3 Aggregate Spreader

Sanding shall be accomplished using a drop-type spinner sander equipped to ensure even distribution of the sand. Tinkle or skip type sanders shall not be permitted. The sander must have finite controls to regulate sand distribution. Push-type hand sanders will be allowed for use around lights, signs, and other obstructions.

1.3.4 Power Brooms and Power Blowers

Power brooms and power blowers shall be suitable for cleaning surfaces to be treated.

1.3.5 Storage Tanks

Tanks shall be capable of heating the bituminous material, under effective and positive control at all times, to the required temperature. Heating shall be accomplished by steam coils, hot oil, or electricity. An armored thermometer with a range from 100 to 300 degrees F shall be affixed to the tank so that the temperature of the bituminous material may be read at all times.

1.3.6 Vacuum Sweepers for Fog Seal

Provide self-propelled, vacuum pickup sweeper capable of removing loose sand, water, and debris from pavement surface.

1.4 WEATHER LIMITATIONS

The coating shall be applied when the existing surface is dry, and when the weather is not foggy, rainy, or when the wind velocity will prevent the uniform application of the bitumen and aggregates. Apply fog seal when atmospheric temperature is above 50 degrees F and rising or when pavement temperature is above 60 degrees F, unless otherwise directed. Do not apply

the fog seal when rain is anticipated within eight hours after application.

1.5 SAMPLING AND TESTING

Sampling and testing shall be performed by an approved commercial testing laboratory or by facilities furnished by the Contractor. No work requiring testing will be permitted until the facilities have been inspected and approved. The first inspection shall be at the expense of the Government. Costs incurred for any subsequent inspection will be charged to the Contractor. Tests shall be performed in sufficient numbers and at the location and times directed to ensure that the materials meet specified requirements.

1.5.1 Samples

Aggregate samples for laboratory tests shall be taken in accordance with ASTM D 75. Samples of bituminous material shall be taken in accordance with AASHTO T 40 or ASTM D 140.

1.5.2 Aggregates Source

Sources from which aggregates are to be obtained shall be selected and notification thereof furnished the Contracting Officer within 15 days after the award of the Contract. Tests for the evaluation of aggregates shall be made by an approved commercial laboratory at no expense to the Government. Aggregate shall be in accordance with bituminous emulsion concentrate manufacturer's recommendation.

1.5.3 Bituminous Material Source

Sources from which bituminous materials are to be obtained shall be selected and notification thereof furnished the Contracting Officer within 15 days after the award of the contract.

1.5.4 Equipment Calibration

The Contractor shall furnish all equipment and materials and labor necessary to calibrate the bituminous distributor and the aggregate spreader. All calibrations shall be made with the approved job materials and prior to applying the coat materials to the prepared surface. Calibration of the bituminous distributor shall be in accordance with ASTM D 2995. Inspect all equipment prior to application of fog seal. Perform work to calibrate tank and measuring devices of the distributor. Perform inspection and calibration at the beginning of the work and at least once a day during construction.

1.6 DELIVERY, STORAGE AND HANDLING

Deliver bituminous emulsion concentrate to the site in a homogenous and undamaged condition. Inspect the materials for contamination and damage. Unload and store the materials with a minimum of handling. Protect stored aggregate from contamination and segregation. Replace defective or damaged materials.

PART 2 PRODUCTS

2.1 BITUMINOUS EMULSION CONCENTRATE

The emulsion concentrate, in the undiluted state, shall have the following

properties:

Saybolt furol viscosity: 77 Degree F (25 Degree C)20-100 seconds
 Residue by distribution or by evaporation:.....57 percent, minimum
 Sieve test:.....0.2 percent, maximum
 pH, cationic:.....2 to 6.5

The emulsion concentrate, when diluted in the proportion of one part of concentrate to one part of hot water, by volume and ready to apply, shall have the following properties:

Saybolt furol viscosity: 77 Degree F (25 Degree C).....10-15 seconds
 Residue from Distillation, or Evaporation:....18 to 42 percent, minimum
 Sieve test:.....0.1 percent, maximum
 Pumping stability test:pass
 Hot water temperature at or above 100 degrees

Tests on Residue from Distillation, or Evaporation:

Viscosity at 275 Degrees F (135 Degrees C) ASTM D 4402....1750 cts max.
 Solubility in 1,1,1 trichlorethylene ASTM D 2042.....97.5 min.
 Penetration ASTM D 5..... 50 dmm max.
 Asphaltenes ASTM D 2007..... 15% min.
 Saturates ASTM D 2007.....15% max.
 Polar Compounds ASTM D 2007.....25% min.
 Aromatics ASTM D 2007.....15% min.

(1) pH may be used in lieu of the particle charge test which is sometimes inconclusive in slow setting, bituminous emulsions.

(2) Pumping stability is tested by pumping 1 pint, (475 ml) of GSB-88 diluted 1 part concentrate to 1 part water, at 77 Degree F (25 Degree C), through a 1/4-inch gear pump operating 1750 rpm for 10 minutes with no significant separation or coagulation.

The bituminous base residue shall contain not less than 20 percent Gilsonite, and shall not contain any tall oil pitch. It shall be compatible with asphalt concrete and have a 5-year, minimum, proven performance record at a commercial airport classified as an Aircraft Approach Category D and Airplane Design Group V. Curing time, under recommended application conditions, shall not exceed 4 hours.

Material shall be GSB-88 Emulsion Sealcoat Concentrate as manufactured by Asphalt Systems, Inc., of Salt Lake City, Utah (1-800-972-2757), or pre-bid approved equal.

Contractor shall be an ASI trained and approved distributor of GSB-88, using manufacturer approved installation equipment.

2.2 SAND

The sand material shall be a dry, clean, dust-free slag with a Mohs hardness of 6-8. The material shall be angular and black in color, or shall be a silica sand meeting the same specifications.

The sanding material shall be copper slag or similar angular, black abrasive, or approved equal, and shall meet the following gradation analysis per ASTM D 451:

Sieve Size	% Retained by Weight
No. 16	0-1
No. 20	0-1
No. 30	5-20
No. 40	40-65
No. 50	20-40
No. 60	0-5
No. 100	0-3
Pan	0-0.2

2.3 WATER

Water shall be fresh, clean, and potable.

PART 3 EXECUTION

3.1 PREPARATION OF SURFACE

Vacuum and/or sweep all accessible pavement surfaces prior to applying the fog seal. The Contractor shall clean areas (i.e., around lights, signs, inlets, etc.) not accessible to the vacuum with a broom-type sweeper.

3.1.1 Crack Sealing

Seal all cracks prior to applying fog seal.

3.1.2 Cover

Cover existing runway edge lights, taxiway edge lights, centerline lights, in-pavement duct markers, retroreflective film type pavement markings, and hold lines before applying the fog seal. If the fog seal gets on any light, marker, hold line, or retroreflective marking, clean immediately. The Contractor shall replace any marking with equal material at no cost to the Government if cleaning is not satisfactory to the Contracting Officer.

3.1.3 Preseal

Pavement joints shall be presealed with 0.10 gallons per square yard, approximately 18-inches wide, using no sand before full fog seal is applied.

3.2 FOG SEAL APPLICATION

3.2.1 Mixing

The fog sealing material shall be obtained by blending bituminous concentrate material, water, and polymer. Mix one part bituminous emulsion concentrate to one part water, by volume under agitation or recirculation. Continue mixing and recirculation for at least 10 minutes prior to and during distribution.

3.2.2 Storage and Handling Instructions

Bituminous emulsion concentrate may be stored and handled like any standard asphalt emulsion. Vertical storage tanks are recommended. The storage tank should be equipped with a slow revolution mechanical agitator. Hot water heating coils, or electrical coils, or electrical heaters are required in colder climates to prevent the emulsion from freezing.

Positive displacement gear pumps should be used to transfer and apply bituminous emulsion concentrate materials. Storage and handling temperatures are 100 Degrees F (38 Degrees C) to 160 Degrees (71 Degrees C) but under no circumstances will the material be heated to temperatures above 180 Degrees F (82 Degrees C). Bituminous emulsion concentrate should be protected from freezing, or whenever outside temperature drops below 40 Degrees F (4 Degrees C) for prolonged time periods.

3.2.3 Application

3.2.3.1 Application Rate

The fog sealing product shall be applied using equipment as described in Section 1.3.2 and in accordance with the manufacturer's recommendations. Apply the emulsion only when existing surface is clean and dry. Apply in non-traffic areas (shoulders) at a target rate of 0.20 gal. per sq. yd. or as much as the pavement will hold without sever runoff. If running does occur Contractor shall broom sealer back or other measures, as approved, to prevent runoff into the grass or storm drain.

3.2.3.2 Application of Fog Seal

Maintain application temperature of emulsified asphalt as recommended by the manufacturer. To obtain uniform application of the fog seal at the junction of previous and subsequent applications, spread building paper on the surface of the applied material for a sufficient distance back from the ends of each application so that flow from the spray bar may be started and stopped on the paper, and so that all sprayers will operate at full force. Immediately after application, remove and properly dispose of the building paper. Treat spots unavoidably missed with the hand spray equipment.

3.2.3.3 Field Representative

A qualified representative shall be present in the field to assist the Contracting Officer in carrying out spot tests and/or test strips on the pavement to be sealed to determine the optimum application rate. This shall be done just prior to the application or any time there is a change in the consistency of the pavement surface. The Contracting Officer and the manufacturer's representative shall observe tests and determine that the application rates are optimum.

3.2.4 Sanding

The sanding shall be done immediately during or after application of the fog seal. The speed of the distributor shall be such that the sanding material shall be applied before the fog seal begins to break. Apply sand at the rate of 0.30 to 0.75 pounds per square yard as determined by the individual site conditions.

3.2.5 Inspection Reports

Furnish a written report citing climatic temperature during application, emulsion temperature during application, and rate of emulsion application.

3.3 SITE PROTECTION

During applications, protect adjacent buildings, structures, vehicles, manhole covers, inlet grates, and trees to prevent being spattered or marred.

3.4 TRAFFIC CONTROL

Contractor shall protect freshly placed coatings from damage by traffic. Provide sufficient warning signs and barricades to prevent traffic over freshly treated surfaces. Protect treated areas from traffic for at least 24 hours after final application of coatings, or for such time as necessary to prevent picking up. Immediately prior to opening to traffic, roll the entire treated area with a self-propelled pneumatic-tired roller.

-- End of Section --

SECTION 02821A

FENCING

PART 1 GENERAL

1.1 REFERENCES

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

ASTM INTERNATIONAL (ASTM)

ASTM A 121	(1999) Zinc-Coated (Galvanized) Steel Barbed Wire
ASTM A 153/A 153M	(2003) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 392	(2003) Zinc-Coated Steel Chain-Link Fence Fabric
ASTM A 491	(2003) Aluminum-Coated Steel Chain-Link Fence Fabric
ASTM A 585	(1997) Aluminum-Coated Steel Barbed Wire **
ASTM A 780	(2001) Repair of Damaged and Uncoated Areas of Hot-Dipped Galvanized Coatings
ASTM A 824	(2001) Metallic-Coated Steel Marcellled Tension Wire for Use With Chain Link Fence
ASTM C 94/C 94M	(2003a) Ready-Mixed Concrete
ASTM F 1043	(2000) Strength and Protective Coatings on Metal Industrial Chain-Link Fence Framework
ASTM F 1083	(1997; R 2003) Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures
ASTM F 1184	(2003) Industrial and Commercial Horizontal Slide Gates
ASTM F 626	(1996a; R 2003) Fence Fittings
ASTM F 900	(2003) Industrial and Commercial Swing Gates

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When

used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-07 Certificates

Chain Link Fence; G, RO

Statement, signed by an official authorized to certify on behalf of the manufacturer, attesting that the chain link fence and component materials meet the specified requirements.

PART 2 PRODUCTS

2.1 FENCE FABRIC

Fence fabric shall conform to the following:

2.1.1 Chain Link Fence Fabric

ASTM A 392, Class 1, zinc-coated steel wire with minimum coating weight of 1.2 ounces of zinc per square foot of coated surface, or ASTM A 491, Type I, aluminum-coated steel wire. Fabric shall be fabricated of 9 gauge wire woven in 2 inch mesh. Fabric height shall be as shown. Fabric shall be twisted and barbed on the top selvage and knuckled on the bottom selvage.

2.2 GATES

ASTM F 900 and/or ASTM F 1184. Gate shall be the type and swing shown. Gate frames shall conform to strength and coating requirements of ASTM F 1083 for Group IA, steel pipe, with external coating Type A, nominal pipe size (NPS) 1-1/2. Gate frames shall conform to strength and coating requirements of ASTM F 1043, for Group IC, steel pipe with external coating Type A or Type B, nominal pipe size (NPS) 1-1/2. Gate fabric shall be as specified for chain link fabric. Gate leaves more than 8 feet wide shall have either intermediate members and diagonal truss rods or shall have tubular members as necessary to provide rigid construction, free from sag or twist. Gate leaves less than 8 feet wide shall have truss rods or intermediate braces. Intermediate braces shall be provided on all gate frames with an electro-mechanical lock. Gate fabric shall be attached to the gate frame by method standard with the manufacturer except that welding will not be permitted. Latches, hinges, stops, keepers, rollers, and other hardware items shall be furnished as required for the operation of the gate. Latches shall be arranged for padlocking so that the padlock will be accessible from both sides of the gate. Stops shall be provided for holding the gates in the open position. For high security applications, each end member of gate frames shall be extended sufficiently above the top member to carry three strands of barbed wire in horizontal alignment with barbed wire strands on the fence.

2.3 POSTS

2.3.1 Metal Posts for Chain Link Fence

ASTM F 1083, zinc-coated. Group IA, with external coating Type A steel pipe. Group IC steel pipe, zinc-coated with external coating Type A or Type B and Group II, roll-formed steel sections, shall meet the strength and coating requirements of ASTM F 1043. Group III, ASTM F 1043 steel H-section may be used for line posts in lieu of line post shapes specified

for the other classes. Sizes shall be as shown on the drawings. Line posts and terminal (corner, gate, and pull) posts selected shall be of the same designation throughout the fence. Gate post shall be for the gate type specified subject to the limitation specified in ASTM F 900 and/or ASTM F 1184.

2.4 BRACES AND RAILS

ASTM F 1083, zinc-coated, Group IA, steel pipe, size NPS 1-1/4. Group IC steel pipe, zinc-coated, shall meet the strength and coating requirements of ASTM F 1043. Group II, formed steel sections, size 1-21/32 inch, conforming to ASTM F 1043, may be used as braces and rails if Group II line posts are furnished.

2.5 WIRE

2.5.1 Tension Wire

Tension wire shall be Type I or Type II, Class 2 coating, in accordance with ASTM A 824.

2.5.2 Barbed Wire

Barbed wire shall conform to ASTM A 121 zinc-coated, class 1, 13 gauge wire with 13-1/2 gauge 4-point barbs spaced no more than 6 inches apart.

2.6 ACCESSORIES

ASTM F 626. Ferrous accessories shall be zinc or aluminum coated. Truss rods shall be furnished for each terminal post. Truss rods shall be provided with turnbuckles or other equivalent provisions for adjustment. Barbed wire shall be 2 strand, 12-1/2 gauge wire, zinc-coated, Class 3 in accordance with ASTM A 121 or aluminum coated Type I in accordance with ASTM A 585. Barbed wire shall be four-point barbed type steel wire. Barbed wire support arms shall be the single arm type and of the design required for the post furnished. Tie wire for attaching fabric to rails, braces, and posts shall be 9 gauge steel wire and match the coating of the fence fabric. Tie wires for attaching fabric to tension wire on high security fences shall be 16 gage stainless steel. The tie wires shall be a double loop and 6.5 inches in length. Miscellaneous hardware coatings shall conform to ASTM A 153/A 153M unless modified.

2.7 CONCRETE

ASTM C 94/C 94M, using 3/4 inch maximum size aggregate, and having minimum compressive strength of 3000 psi at 28 days. Grout shall consist of one part portland cement to three parts clean, well-graded sand and the minimum amount of water to produce a workable mix.

PART 3 EXECUTION

3.1 INSTALLATION

Fence shall be installed to the lines and grades indicated. The area on either side of the fence line shall be cleared to the extent indicated. Line posts shall be spaced equidistant at intervals not exceeding 10 feet. Terminal (corner, gate, and pull) posts shall be set at abrupt changes in vertical and horizontal alignment. Fabric shall be continuous between terminal posts; however, runs between terminal posts shall not exceed 500

feet. Any damage to galvanized surfaces, including welding, shall be repaired with paint containing zinc dust in accordance with ASTM A 780.

3.2 EXCAVATION

Post holes shall be cleared of loose material. Waste material shall be spread where directed. The ground surface irregularities along the fence line shall be eliminated to the extent necessary to maintain a 1 inch clearance between the bottom of the fabric and finish grade.

3.3 POST INSTALLATION

3.3.1 Posts for Chain Link Fence

Posts shall be set plumb and in alignment. Except where solid rock is encountered, posts shall be set in concrete to the depth indicated on the drawings. Where solid rock is encountered with no overburden, posts shall be set to a minimum depth of 18 inches in rock. Where solid rock is covered with an overburden of soil or loose rock, posts shall be set to the minimum depth indicated on the drawing unless a penetration of 18 inches in solid rock is achieved before reaching the indicated depth, in which case depth of penetration shall terminate. All portions of posts set in rock shall be grouted. Portions of posts not set in rock shall be set in concrete from the rock to ground level. Posts set in concrete shall be set in holes not less than the diameter shown on the drawings. Diameters of holes in solid rock shall be at least 1 inch greater than the largest cross section of the post. Concrete and grout shall be thoroughly consolidated around each post, shall be free of voids and finished to form a dome. Concrete and grout shall be allowed to cure for 72 hours prior to attachment of any item to the posts. Group II line posts may be mechanically driven, for temporary fence construction only, if rock is not encountered. Driven posts shall be set to a minimum depth of 3 feet and shall be protected with drive caps when being set. For high security fences, fence post rigidity shall be tested by applying a 50 pound force on the post, perpendicular to the fabric, at 5 feet above ground; post movement measured at the point where the force is applied shall be less than or equal to 3/4 inch from the relaxed position; every tenth post shall be tested for rigidity; when a post fails this test, further tests on the next four posts on either side of the failed post shall be made; all failed posts shall be removed, replaced, and retested at the Contractor's expense.

3.4 RAILS

3.4.1 Top Rail

Top rail shall be supported at each post to form a continuous brace between terminal posts. Where required, sections of top rail shall be joined using sleeves or couplings that will allow expansion or contraction of the rail. Top rail, if required for high security fence, shall be installed as indicated on the drawings.

3.4.2 Bottom Rail

The bottom rail shall be bolted to double rail ends and double rail ends shall be securely fastened to the posts. Bolts shall be peened to prevent easy removal. Bottom rail shall be installed before chain link fabric.

3.5 BRACES AND TRUSS RODS

Braces and truss rods shall be installed as indicated and in conformance with the standard practice for the fence furnished. Horizontal (compression) braces and diagonal truss (tension) rods shall be installed on fences over 6 feet in height. A center brace or 2 diagonal truss rods shall be installed on 12 foot fences. Braces and truss rods shall extend from terminal posts to line posts. Diagonal braces shall form an angle of approximately 40 to 50 degrees with the horizontal. No bracing is required on fences 6 feet high or less if a top rail is installed.

3.6 TENSION WIRES

Tension wires shall be installed along the top and bottom of the fence line and attached to the terminal posts of each stretch of the fence. Top tension wires shall be installed within the top 4 inches of the installed fabric. Bottom tension wire shall be installed within the bottom 6 inches of the installed fabric. Tension wire shall be pulled taut and shall be free of sag.

3.7 CHAIN LINK FABRIC

Chain link fabric shall be installed on the side of the post indicated. Fabric shall be attached to terminal posts with stretcher bars and tension bands. Bands shall be spaced at approximately 15 inch intervals. The fabric shall be installed and pulled taut to provide a smooth and uniform appearance free from sag, without permanently distorting the fabric diamond or reducing the fabric height. Fabric shall be fastened to line posts at approximately 15 inch intervals and fastened to all rails and tension wires at approximately 12 inch intervals. Fabric shall be cut by untwisting and removing pickets. Splicing shall be accomplished by weaving a single picket into the ends of the rolls to be joined. The bottom of the installed fabric shall be 1 plus or minus 1/2 inch above the ground. For high security fence, after the fabric installation is complete, the fabric shall be exercised by applying a 50 pound push-pull force at the center of the fabric between posts; the use of a 30 pound pull at the center of the panel shall cause fabric deflection of not more than 2-1/2 inches when pulling fabric from the post side of the fence; every second fence panel shall meet this requirement; all failed panels shall be resecured and retested at the Contractor's expense.

3.8 BARBED WIRE SUPPORTING ARMS AND BARBED WIRE

3.8.1 General Requirements

Barbed wire supporting arms and barbed wire shall be installed as indicated and as recommended by the manufacturer. Supporting arms shall be anchored with 3/8 inch diameter plain pin rivets or, at the Contractor's option, with studs driven by low-velocity explosive-actuated tools for steel, wrought iron, ductile iron, or malleable iron. Studs driven by an explosive-actuated tool shall not be used with gray iron or other material that can be fractured. A minimum of two studs per support arm shall be used. Barbed wire shall be pulled taut and attached to the arms with clips or other means that will prevent easy removal.

3.9 GATE INSTALLATION

Gates shall be installed at the locations shown. Hinged gates shall be mounted to swing as indicated. Latches, stops, and keepers shall be

installed as required. Padlocks shall be attached to gates or gate posts with chains. Hinge pins, and hardware shall be welded or otherwise secured to prevent removal.

3.10 GROUNDING

Fences shall be grounded on each side of all gates, at each corner, at the closest approach to each building located within 50 feet of the fence, and where the fence alignment changes more than 15 degrees. Distance between grounding locations shall not exceed 650 feet. Each gate panel shall be bonded with a flexible bond strap to its gate post. Fences crossed by powerlines of 600 volts or more shall be grounded at or near the point of crossing and at distances not exceeding 150 feet on each side of crossing. Ground conductor shall consist of No. 8 AWG solid copper wire. Grounding electrodes shall be 3/4 inch by 10 foot long copper-clad steel rod. Electrodes shall be driven into the earth so that the top of the electrode is at least 6 inches below the grade. Where driving is impracticable, electrodes shall be buried a minimum of 12 inches deep and radially from the fence. The top of the electrode shall be not less than 2 feet or more than 8 feet from the fence. Ground conductor shall be clamped to the fence and electrodes with bronze grounding clamps to create electrical continuity between fence posts, fence fabric, and ground rods. After installation the total resistance of fence to ground shall not be greater than 25 ohms.

-- End of Section --

SECTION 02921A

SEEDING

PART 1 GENERAL

1.1 REFERENCES

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

ASTM INTERNATIONAL (ASTM)

ASTM C 602	(1995a; R 2001) Agricultural Liming Materials
ASTM D 4972	(2001) pH of Soils
ASTM D 5268	(2002) Topsoil Used for Landscaping Purposes
ASTM D 5883	(1996; R 2002) Use of Rotary Kiln Produced Expanded Shale, Clay or Slate (ESCS) as a Mineral Amendment in Topsoil Used for Landscaping and Related Purposes
ASTM D 977	(2003) Emulsified Asphalt

U.S. DEPARTMENT OF AGRICULTURE (USDA)

AMS Seed Act	(1940; R 1988; R 1998) Federal Seed Act
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1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Equipment;
Surface Erosion Control Material; G, RO
Chemical Treatment Material;

Manufacturer's literature including physical characteristics, application and installation instructions for equipment, surface erosion control material and chemical treatment material.

A listing of equipment to be used for the seeding operation.

Delivery; G, RO

Delivery schedule.

Finished Grade and Topsoil; G, RO

Finished grade status.

Topsoil; G, RO

Availability of topsoil from the stripping and stock piling operation.

Quantity Check; G, RO

Bag count or bulk weight measurements of material used compared with area covered to determine the application rate and quantity installed.

Seed Establishment Period; G, RO

Calendar time period for the seed establishment period. When there is more than one seed establishment period, the boundaries of the seeded area covered for each period shall be described.

Maintenance Record; G, RO

Maintenance work performed, area repaired or reinstalled, diagnosis for unsatisfactory stand of grass plants.

SD-04 Samples

Delivered Topsoil;

Samples taken from several locations at the source.

Soil Amendments;

A 10 pound sample.

Mulch;

A 10 pound sample.

SD-06 Test Reports

Equipment Calibration; G, RO

Certification of calibration tests conducted on the equipment used in the seeding operation.

Soil Test; G, RO

Certified reports of inspections and laboratory tests, prepared by an independent testing agency, including analysis and interpretation of test results. Each report shall be properly identified. Test methods used and compliance with recognized test standards shall be described.

SD-07 Certificates

Seed; G, RO
Topsoil; G, RO
pH Adjuster; G, RO
Fertilizer; G, RO
Organic Material; G, RO
Soil Conditioner; G, RO
Mulch; G, RO

Prior to the delivery of materials, certificates of compliance attesting that materials meet the specified requirements. Certified copies of the material certificates shall include the following:

- a. Seed. Classification, botanical name, common name, percent pure live seed, minimum percent germination and hard seed, maximum percent weed seed content, and date tested.
- b. Topsoil. Particle size, pH, organic matter content, textural class, soluble salts, chemical and mechanical analyses.
- c. pH Adjuster. Calcium carbonate equivalent and sieve analysis.
- d. Fertilizer. Chemical analysis and composition percent.
- e. Organic Material: Composition and source.
- f. Soil Conditioner: Composition and source.
- g. Mulch: Composition and source.

1.3 SOURCE INSPECTION

The source of delivered topsoil shall be subject to inspection.

1.4 DELIVERY, INSPECTION, STORAGE, AND HANDLING

1.4.1 Delivery

A delivery schedule shall be provided at least 10 calendar days prior to the first day of delivery.

1.4.1.1 Delivered Topsoil

Prior to the delivery of any topsoil, its availability shall be verified in paragraph TOPSOIL. A soil test shall be provided for topsoil delivered to the site.

1.4.1.2 Soil Amendments

Soil amendments shall be delivered to the site in the original, unopened containers bearing the manufacturer's chemical analysis. In lieu of containers, soil amendments may be furnished in bulk. A chemical analysis shall be provided for bulk deliveries.

1.4.2 Inspection

Seed shall be inspected upon arrival at the job site for conformity to species and quality. Seed that is wet, moldy, or bears a test date five months or older, shall be rejected. Other materials shall be inspected for compliance with specified requirements. The following shall be rejected: open soil amendment containers or wet soil amendments; topsoil that contains slag, cinders, stones, lumps of soil, sticks, roots, trash or other material over a minimum 1-1/2 inch diameter; and topsoil that contains viable plants and plant parts. Unacceptable materials shall be removed from the job site.

1.4.3 Storage

Materials shall be stored in designated areas. Seed, lime, and fertilizer shall be stored in cool, dry locations away from contaminants. Chemical treatment material shall be stored according to manufacturer's instructions and not with seeding operation materials.

1.4.4 Handling

Except for bulk deliveries, materials shall not be dropped or dumped from vehicles.

1.4.5 Time Limitation

Hydroseeding time limitation for holding seed in the slurry shall be a maximum 24 hours.

PART 2 PRODUCTS

2.1 SEED

2.1.1 Seed Classification

State-certified seed of the latest season's crop shall be provided in original sealed packages bearing the producer's guaranteed analysis for percentages of mixture, purity, germination, hard seed, weed seed content, and inert material. Labels shall be in conformance with AMS Seed Act and applicable state seed laws.

2.1.2 Permanent Seed Species and Mixtures

Permanent seed species and mixtures shall be proportioned by weight as follows:

Botanical Name	Common Name	Percent Pure Application Rate	Live Seed
FIELD SEED			
Festuca Arundinacea	Fescue, KY31	40 lbs/Ac	80
Lespedeza cuneata	Sericia Lespedeza	35 lbs/AC	71

Seed mixtures shall not contain millet or any other large-seed producing

grass.

2.1.3 Temporary Seed Species

Temporary seed species for surface erosion control or overseeding shall be as follows:

<u>Botanical Name</u>	<u>Common Name</u>	<u>Application Date</u>	<u>Percent Pure Live Seed</u>
Secale Cereale	Rye (Grain)	120 lbs/AC	72

Seed mixtures shall not contain millet or any other large-seed producing grass.

2.1.4 Quality

Weed seed shall be a maximum 1 percent by weight of the total mixture.

2.1.5 Seed Mixing

The mixing of seed may be done by the seed supplier prior to delivery, or on site as directed.

2.1.6 Substitutions

Substitutions will not be allowed without written request and approval from the Contracting Officer.

2.2 TOPSOIL

Topsoil shall be as defined in ASTM D 5268. When available, the topsoil shall be the existing surface soil stripped and stockpiled onsite in accordance with Section 02300 EARTHWORK. When additional topsoil is required beyond the available topsoil from the stripping operation, topsoil shall be delivered and amended as recommended by the soil test for the seed specified. Topsoil shall be free from slag, cinders, stones, lumps of soil, sticks, roots, trash or other material over a minimum 1-1/2 inch diameter. Topsoil shall be free from viable plants and plant parts.

2.3 SOIL AMENDMENTS

Soil amendments shall consist of pH adjuster, fertilizer, organic material and soil conditioners meeting the following requirements. Vermiculite shall not be used.

2.3.1 pH Adjuster

The pH adjuster shall be an agricultural liming material in accordance with ASTM C 602. These materials may be burnt lime, hydrated lime, ground limestone, sulfur, or shells. The pH adjuster shall be used to create a favorable soil pH for the plant material specified.

2.3.1.1 Limestone

Limestone material shall contain a minimum calcium carbonate equivalent of 80 percent. Gradation: A minimum 95 percent shall pass through a No. 8 sieve and a minimum 55 percent shall pass through a No. 60 sieve. To

raise soil pH, ground limestone shall be used.

2.3.1.2 Hydrated Lime

Hydrated lime shall contain a minimum calcium carbonate equivalent of 110 percent. Gradation: A minimum 100 percent shall pass through a No. 8 sieve and a minimum 97 percent shall pass through a No. 60 sieve.

2.3.1.3 Burnt Lime

Burnt lime shall contain a minimum calcium carbonate equivalent of 140 percent. Gradation: A minimum 95 percent shall pass through a No. 8 sieve and a minimum 35 percent shall pass through a No. 60 sieve.

2.3.2 Fertilizer

The nutrients ratio shall be 12 percent nitrogen, 12 percent phosphorus, and 12 percent potassium. Fertilizer shall be controlled release commercial grade, free flowing, uniform in composition, and consist of a nitrogen-phosphorus-potassium ratio. The fertilizer shall be derived from sulphur coated urea, urea formaldehyde, plastic or polymer coated pills, or isobutylenediurea (IBDU). Fertilizer shall be balanced with the inclusion of trace minerals and micro-nutrients.

2.3.3 Nitrogen Carrier Fertilizer

It shall be as recommended by the soil test . Nitrogen carrier fertilizer shall be commercial grade, free flowing, and uniform in composition. The fertilizer may be a liquid nitrogen solution.

2.3.4 Worm Castings

Worm castings shall be screened from worms and food source, and shall be commercially packaged.

2.3.5 Soil Conditioner

Soil conditioner shall be sand, super absorbent polymers, calcined clay, or gypsum for use singly or in combination to meet the requirements of the soil test.

2.3.5.1 Sand

Sand shall be clean and free of toxic materials. Gradation: A minimum 95 percent by weight shall pass a No. 10 sieve and a minimum 10 percent by weight shall pass a No. 16 sieve. Greensand shall be balanced with the inclusion of trace minerals and nutrients.

2.3.5.2 Super Absorbent Polymers

To improve water retention in soils, super absorbent polymers shall be sized and applied according to the manufacturer's recommendations. Polymers shall be added as a soil amendment and be cross-linked polyacrylamide, with an absorption capacity of 250-400 times its weight. Polymers shall also be added to the seed and be a starch grafted polyacrylonitrile, with graphite added as a tacky sticker. It shall have an absorption capacity of 100 plus times its weight.

2.3.5.3 Calcined Clay

Calcined clay shall be granular particles produced from montmorillonite clay calcined to a minimum temperature of 1200 degrees F. Gradation: A minimum 90 percent shall pass a No. 8 sieve; a minimum 99 percent shall be retained on a No. 60 sieve; and a maximum 2 percent shall pass a No. 100 sieve. Bulk density: A maximum 40 pounds per cubic foot.

2.3.5.4 Gypsum

Gypsum shall be commercially packaged, free flowing, and a minimum 95 percent calcium sulfate by volume.

2.3.5.5 Expanded Shale, Clay, or Slate (ESCS)

Rotary kiln produced ESCS material shall be in conformance with ASTM D 5883.

2.4 MULCH

Mulch shall be free from weeds, mold, and other deleterious materials. Mulch materials shall be native to the region.

2.4.1 Straw

Straw shall be stalks from oats, wheat, rye, barley, or rice, furnished in air-dry condition and with a consistency for placing with commercial mulch-blowing equipment.

2.4.2 Hay

Hay shall be native hay, sudan-grass hay, broomsedge hay, or other herbaceous mowings, furnished in an air-dry condition suitable for placing with commercial mulch-blowing equipment.

2.5 ASPHALT ADHESIVE

Asphalt adhesive shall conform to the following: Emulsified asphalt, conforming to ASTM D 977, Grade SS-1.

2.6 WATER

Water shall be the responsibility of the Contractor, unless otherwise noted. Water shall not contain elements toxic to plant life.

2.7 SURFACE EROSION CONTROL MATERIAL

Surface erosion control material shall conform to the following:

2.7.1 Surface Erosion Control Blanket

Blanket shall be machine produced mat of wood excelsior formed from a web of interlocking wood fibers; covered on one side with either knitted straw blanket-like mat construction; covered with biodegradable plastic mesh; or interwoven biodegradable thread, plastic netting, or twisted kraft paper cord netting.

2.7.2 Surface Erosion Control Fabric

Fabric shall be knitted construction of polypropylene yarn with uniform

mesh openings 3/4 to 1 inch square with strips of biodegradable paper. Filler paper strips shall have a minimum life of 6 months.

2.7.3 Surface Erosion Control Net

Net shall be heavy, twisted jute mesh, weighing approximately 1.22 pounds per linear yard and 4 feet wide with mesh openings of approximately 1 inch square.

2.7.4 Surface Erosion Control Chemicals

Chemicals shall be high-polymer synthetic resin or cold-water emulsion of selected petroleum resins.

2.7.5 Hydrophilic Colloids

Hydrophilic colloids shall be physiologically harmless to plant and animal life without phytotoxic agents. Colloids shall be naturally occurring, silicate powder based, and shall form a water insoluble membrane after curing. Colloids shall resist mold growth.

2.7.6 Erosion Control Material Anchors

Erosion control anchors shall be as recommended by the manufacturer.

PART 3 EXECUTION

3.1 INSTALLING SEED TIME AND CONDITIONS

3.1.1 Seeding Time

Seed shall be installed from February 15 to April 20 for spring establishment; and from August 15 to September 30 for fall establishment.

3.1.2 Seeding Conditions

Seeding operations shall be performed only during periods when beneficial results can be obtained. When drought, excessive moisture, or other unsatisfactory conditions prevail, the work shall be stopped when directed. When special conditions warrant a variance to the seeding operations, proposed alternate times shall be submitted for approval.

3.1.3 Equipment Calibration

Immediately prior to the commencement of seeding operations, calibration tests shall be conducted on the equipment to be used. These tests shall confirm that the equipment is operating within the manufacturer's specifications and will meet the specified criteria. The equipment shall be calibrated a minimum of once every day during the operation. The calibration test results shall be provided within 1 week of testing.

3.1.4 Soil Test

Delivered topsoil, existing soil in smooth graded areas, and stockpiled topsoil shall be tested in accordance with ASTM D 5268 and ASTM D 4972 for determining the particle size, pH, organic matter content, textural class, chemical analysis, soluble salts analysis, and mechanical analysis. Sample collection on site shall be random over the entire site. Sample collection for stockpiled topsoil shall be at different levels in the stockpile. The

soil shall be free from debris, noxious weeds, toxic substances, or other materials harmful to plant growth. The test shall determine the quantities and type of soil amendments required to meet local growing conditions for the seed species specified.

3.2 SITE PREPARATION

3.2.1 Finished Grade and Topsoil

The Contractor shall verify that finished grades are as indicated on drawings, and the placing of topsoil, smooth grading, and compaction requirements have been completed in accordance with Section 02300 EARTHWORK, prior to the commencement of the seeding operation.

3.2.2 Application of Soil Amendments

3.2.2.1 Applying pH Adjuster

The pH adjuster shall be applied as recommended by the soil test . The pH adjuster shall be incorporated into the soil to a maximum 4 inch depth or may be incorporated as part of the tillage operation.

3.2.2.2 Applying Fertilizer

The fertilizer shall be applied as recommended by the soil test . Fertilizer shall be incorporated into the soil to a maximum 4 inch depth or may be incorporated as part of the tillage or hydroseeding operation.

3.2.2.3 Applying Soil Conditioner

The soil conditioner shall be as recommended by the soil test . The soil conditioner shall be spread uniformly over the soil a minimum 1 inch depth and thoroughly incorporated by tillage into the soil to a maximum 4 inch depth.

3.2.2.4 Applying Super Absorbent Polymers

Polymers shall be spread uniformly over the soil as recommended by the manufacturer and thoroughly incorporated by tillage into the soil to a maximum 4 inch depth.

3.2.3 Tillage

Soil on slopes up to a maximum 3-horizontal-to-1-vertical shall be tilled to a minimum 4 inch depth. On slopes between 3-horizontal-to-1-vertical and 1-horizontal-to-1 vertical, the soil shall be tilled to a minimum 2 inch depth by scarifying with heavy rakes, or other method. Rototillers shall be used where soil conditions and length of slope permit. On slopes 1-horizontal-to-1 vertical and steeper, no tillage is required. Drainage patterns shall be maintained as indicated on drawings. Areas compacted by construction operations shall be completely pulverized by tillage. Soil used for repair of surface erosion or grade deficiencies shall conform to topsoil requirements. The pH adjuster, fertilizer, and soil conditioner may be applied during this procedure.

3.2.4 Prepared Surface

3.2.4.1 Preparation

The prepared surface shall be a maximum 1 inch below the adjoining grade of any surfaced area. New surfaces shall be blended to existing areas. The prepared surface shall be completed with a light raking to remove debris.

3.2.4.2 Lawn Area Debris

Debris and stones over a minimum 5/8 inch in any dimension shall be removed from the surface.

3.2.4.3 Field Area Debris

Debris and stones over a minimum 2 inch in any dimension shall be removed from the surface.

3.2.4.4 Protection

Areas with the prepared surface shall be protected from compaction or damage by vehicular or pedestrian traffic and surface erosion.

3.3 INSTALLATION

Prior to installing seed, any previously prepared surface compacted or damaged shall be reworked to meet the requirements of paragraph SITE PREPARATION. Seeding operations shall not take place when the wind velocity will prevent uniform seed distribution.

3.3.1 Installing Seed

Seeding method shall be Drill Seeding. Seeding procedure shall ensure even coverage. Gravity feed applicators, which drop seed directly from a hopper onto the prepared soil, shall not be used because of the difficulty in achieving even coverage, unless otherwise approved. Absorbent polymer powder shall be mixed with the dry seed at the rate recommended by the manufacturer.

3.3.1.1 Drill Seeding

Seed shall be uniformly drilled to a maximum 1/2 inch depth and at the rate of 5 pounds per 1000 square feet, using equipment having drills a maximum 7 inches distance apart. Row markers shall be used with the drill seeder. Half the total rate of seed application shall be drilled in 1 direction, with the remainder of the seed rate drilled at 90 degrees from the first direction. The drilling equipment shall be maintained with half full seed boxes during the seeding operations.

3.3.1.2 Rolling

The entire area shall be firmed with a roller not exceeding 90 pounds per foot roller width. Slopes over a maximum 3-horizontal-to-1 vertical shall not be rolled. Areas seeded with seed drills equipped with rollers shall not be rolled.

3.3.2 Mulching

3.3.2.1 Hay or Straw Mulch

Hay or straw mulch shall be spread uniformly at the rate of 2 tons per acre. Mulch shall be spread by hand, blower-type mulch spreader, or other approved method. Mulching shall be started on the windward side of relatively flat areas or on the upper part of steep slopes, and continued uniformly until the area is covered. The mulch shall not be bunched or clumped. Sunlight shall not be completely excluded from penetrating to the ground surface. All areas installed with seed shall be mulched on the same day as the seeding. Mulch shall be anchored immediately following spreading.

3.3.2.2 Mechanical Anchor

Mechanical anchor shall be a V-type-wheel land packer; a scalloped-disk land packer designed to force mulch into the soil surface; or other suitable equipment.

3.3.2.3 Asphalt Adhesive Tackifier

Asphalt adhesive tackifier shall be sprayed at a rate between 10 to 13 gallons per 1000 square feet. Sunlight shall not be completely excluded from penetrating to the ground surface.

3.3.2.4 Non-Asphaltic Tackifier

Hydrophilic colloid shall be applied at the rate recommended by the manufacturer, using hydraulic equipment suitable for thoroughly mixing with water. A uniform mixture shall be applied over the area.

3.3.2.5 Asphalt Adhesive Coated Mulch

Hay or straw mulch may be spread simultaneously with asphalt adhesive applied at a rate between 10 to 13 gallons per 1000 square feet, using power mulch equipment which shall be equipped with suitable asphalt pump and nozzle. The adhesive-coated mulch shall be applied evenly over the surface. Sunlight shall not be completely excluded from penetrating to the ground surface.

3.3.2.6 Protection from Tackifier

Prior to applying the tackifier, all signs, sign bases, lights, light bases, manholes, handhole and any other non-dirt object within the seeding limits and within the wind carry limits shall be covered with a non-porous material such as plastic. Covering with burlap is not acceptable. After applying the tackifier, remove the protection and clean any tackifier off object.

3.3.3 Watering Seed

Watering shall be started immediately after completing the seeding of an area. Water shall be applied to supplement rainfall at a rate sufficient to ensure moist soil conditions to a minimum 1 inch depth. Run-off and puddling shall be prevented. Watering trucks shall not be driven over turf areas, unless otherwise directed. Watering of other adjacent areas or plant material shall be prevented.

3.4 SURFACE EROSION CONTROL

3.4.1 Surface Erosion Control Material

Where indicated or as directed, surface erosion control material shall be installed in accordance with manufacturer's instructions. Placement of the material shall be accomplished without damage to installed material or without deviation to finished grade.

3.4.2 Temporary Seeding

When directed during contract delays affecting the seeding operation or when a quick cover is required to prevent surface erosion, the areas designated shall be seeded in accordance with temporary seed species listed under Paragraph SEED.

3.4.2.1 Soil Amendments

When soil amendments have not been applied to the area, the quantity of 1/2 of the required soil amendments shall be applied and the area tilled in accordance with paragraph SITE PREPARATION. The area shall be watered in accordance with paragraph Watering Seed.

3.4.2.2 Remaining Soil Amendments

The remaining soil amendments shall be applied in accordance with the paragraph Tillage when the surface is prepared for installing seed.

3.5 QUANTITY CHECK

For materials provided in bags, the empty bags shall be retained for recording the amount used. For materials provided in bulk, the weight certificates shall be retained as a record of the amount used. The amount of material used shall be compared with the total area covered to determine the rate of application used. Differences between the quantity applied and the quantity specified shall be adjusted as directed.

3.6 RESTORATION AND CLEAN UP

3.6.1 Restoration

Existing turf areas, pavements, and facilities that have been damaged from the seeding operation shall be restored to original condition at Contractor's expense.

3.6.2 Clean Up

Excess and waste material shall be removed from the seeded areas and shall be disposed offsite. Adjacent paved areas shall be cleaned. Tackifier shall be removed from signs, sign bases, lights, light bases, manholes, handhole and any other non-dirt object.

3.7 PROTECTION OF INSTALLED AREAS

Immediately upon completion of the seeding operation in an area, the area shall be protected against traffic or other use by erecting barricades and providing signage as required, or as directed.

3.8 SEED ESTABLISHMENT PERIOD

3.8.1 Commencement

The seed establishment period to obtain a healthy stand of grass plants shall begin on the first day of seeding work under this contract and shall continue through the remaining life of the contract and end 12 months after the last day of the seeding operation required by this contract. Written calendar time period shall be furnished for the seed establishment period. When there is more than 1 seed establishment period, the boundaries of the seeded area covered for each period shall be described. The seed establishment period shall be modified for inclement weather, shut down periods, or for separate completion dates of areas.

3.8.2 Satisfactory Stand of Grass Plants

Grass plants shall be evaluated for species and health when the grass plants are a minimum 1 inch high.

3.8.2.1 Field Area

A satisfactory stand of grass plants from the seeding operation for a field area shall be a minimum 100 grass plants per square foot. The total bare spots shall not exceed 2 percent of the total seeded area.

3.8.3 Maintenance During Establishment Period

Maintenance of the seeded areas shall include eradicating weeds, insects and diseases; protecting embankments and ditches from surface erosion; maintaining erosion control materials and mulch; protecting installed areas from traffic; mowing; watering; and post-fertilization.

3.8.3.1 Mowing

- a. Lawn Areas: Lawn areas shall be mowed to a minimum 3 inch height when the turf is a maximum 4 inches high. Clippings shall be removed when the amount cut prevents sunlight from reaching the ground surface.
- b. Field Areas: Field areas shall be mowed once during the season to a minimum 3 inch height. Clippings shall be removed when the amount cut prevents sunlight from reaching the ground surface.

3.8.3.2 Post-Fertilization

The fertilizer shall be applied as recommended by the soil test. A maximum 1/2 pound per 1000 square feet of actual available nitrogen shall be provided to the grass plants. The application shall be timed prior to the advent of winter dormancy and shall be made without burning the installed grass plants.

3.8.3.3 Repair or Reinstall

Unsatisfactory stand of grass plants and mulch shall be repaired or reinstalled, and eroded areas shall be repaired in accordance with paragraph SITE PREPARATION.

3.8.3.4 Maintenance Record

A record of each site visit shall be furnished, describing the maintenance work performed; areas repaired or reinstalled; and diagnosis for unsatisfactory stand of grass plants.

-- End of Section --

SECTION 02975A

SEALING OF CRACKS IN BITUMINOUS AND PCC PAVEMENTS

PART 1 GENERAL

1.1 REFERENCES

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

ASTM INTERNATIONAL (ASTM)

- ASTM C 509 (2000) Elastomeric Cellular Preformed Gasket and Sealing Material
- ASTM D 789 (1998) Determination of Relative Viscosity and Moisture Content of Polyamide (PA)
- ASTM D 3569 1985; R 1991) Joint Sealant, Hot-Applied, Elastomeric, Jet-Fuel-Resistant-Type for Portland Cement Concrete Pavements
- ASTM D 5893 (1996) Cold Applied, Single Component Chemically Curing Silicon Joint Sealant for Portland Cement Concrete Pavement

CORPS OF ENGINEERS (COE)

- COE CRD-C 525 (1989) Corps of Engineers Test Method for Evaluation of Hot-Applied Joint Sealants for Bubbling Due to Heating

1.2 DEFINITIONS

For the purposes of this specification, the following definitions apply.

1.2.1 Crack Sealing - Bituminous Pavement

Preparation of cracks in bituminous pavement for sealing and sealing of cracks in bituminous pavement using the sealant material specified.

1.2.2 Crack Sealing - PCC Pavement

Preparation of cracks in PCC pavement for sealing and sealing of cracks in PCC pavement using the sealant material specified.

1.2.3 Measurement

The quantity of each sealing item to be paid for shall be determined by actual measurement of the number of linear feet of in-place material that has been approved.

1.2.4 Payment

Payment shall be made at the contract unit bid prices per linear foot for the sealing items scheduled. The unit bid prices shall include the cost of all labor, materials, and the use of all equipment and tools required to complete the work.

1.3 SYSTEM DESCRIPTION

Machines, tools, and equipment used in the performance of the work required by this section shall be approved before the work is started and shall be maintained in satisfactory condition at all times.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Installation of Sealant; G, RO

Manufacturer's instructions 15 days prior to the use of the material on the project. Installation of the material will not be allowed until the instructions are received.

SD-04 Samples

Materials; G, RO

Samples of the materials 60 days prior to their use on the project. No material will be allowed to be used until it has been approved.

SD-06 Test Reports

Test Requirements; G, RO

Reports of all tests. Testing of the materials shall be performed in an approval independent laboratory and certified copies of the test reports shall be submitted and approved 15 days prior to the use of the materials at the job site. Samples will be retained by the Government for possible future testing should the materials appear defective during or after application.

Crack Sealing Locations; G

Prior to sealing any cracks, Contractor shall mark out crack filling locations, and tabulate type and length of crack repair,

and shall summarize all quantities. Crack sealing shall not be allowed until all crack sealing quantities are approved.

1.5 TEST REQUIREMENTS

The crack sealant and backup material, when required, shall be tested for conformance with the referenced applicable material specification. The materials will be tested by the Government. The cost of the first test of samples will be borne by the Government. If the samples fail to meet specification requirements, the Contractor shall replace the materials represented by the sample and the new materials shall be tested at the Contractor's expense. Samples of materials shall be furnished, in sufficient quantity to be tested, upon request. Conformance with the requirements of the laboratory tests specified will not constitute final acceptance of the materials. Final acceptance will be based on the performance of the in-place materials.

1.6 EQUIPMENT

Machines, tools, and equipment used in the performance of the work required by this section shall be approved before the work is started and shall be maintained in satisfactory condition at all times.

1.6.1 Crack Cleaning Equipment

1.6.1.1 Routing Equipment

The routing equipment shall be a self-powered machine operating a power driven tool or bit specifically designed for routing bituminous and/or PCC pavements. The bit shall rotate about a vertical axis at sufficient speed to cut a smooth vertical-walled reservoir in the pavement surface and shall maintain accurate cutting without damaging the sides or top edges of the reservoir. The router shall be capable of following the trace of the crack without deviation. The use of rotary impact routing devices may be permitted if vertical-sided carbide tipped bits are used.

1.6.1.2 Concrete Saw

A self-propelled power saw with small diameter (6 inches or less) water-cooled diamond or abrasive saw blades shall be provided for cutting cracks to the depths and widths specified and for removing filler that is embedded in the cracks or adhered to the crack faces. The diameter of the saw blade shall be small enough to allow the saw to closely follow the trace of the crack.

1.6.1.3 Sandblasting Equipment

Sandblasting equipment shall include an air compressor, hose, and long-wearing venturi-type nozzle of proper size, shape and opening. The maximum nozzle opening shall not exceed 1/4 inch. The air compressor shall be portable; and shall be capable of furnishing not less than 150 cfm and maintaining a line pressure of not less than 90 psi at the nozzle while in use. Compressor capability under job conditions shall be demonstrated before approval. The compressor shall be equipped with traps that will maintain the compressed air free of oil and water. The nozzle shall have an adjustable guide that will hold the nozzle aligned with the crack about 1 inch above the pavement surface. The height, angle of inclination and the size of the nozzle shall be adjusted as necessary to secure satisfactory results.

1.6.1.4 Hand Tools

Hand tools may be used, when approved, for removing defective sealant from cracks and repairing or cleaning the crack faces.

1.6.2 Crack Sealing Equipment

1.6.2.1 Hot Pour Sealing Equipment

The unit applicators used for heating and installing the ASTM D 3569 sealant materials shall be mobile and shall be equipped with a double-boiler, agitator-type kettle with an oil medium in the outer space for heat transfer; a direct-connected pressure-type extruding device with a nozzle shaped for inserting in the crack to be filled; positive temperature devices for controlling the temperature of the transfer oil and sealant; and a recording type thermometer for indicating the temperature of the sealant. The applicator unit design shall allow the sealant to circulate through the delivery hose and return to the inner kettle when not in use.

1.6.2.2 Cold Applied, Single Component Sealing Equipment

The equipment for installing ASTM D 5893 single component joint sealants shall consist of an extrusion pump, air compressor, following plate, hoses, and nozzle for transferring the sealant from the storage container into the joint opening. The dimension of the nozzle shall be such that the tip of the nozzle will extend into the joint to allow sealing from the bottom of the joint to the top. The initially approved equipment shall be maintained in good working condition, serviced in accordance with the supplier's instructions, and shall not be altered in any way without obtaining prior approval. Small hand held air powered equipment (i.e., caulking guns) may be used for small applications.

1.7 TRIAL JOINT SEALANT INSTALLATION

Prior to the cleaning and sealing of the joints for the entire project, a test section of at least 200 feet long shall be prepared using the specified materials and approved equipment, so as to demonstrate the proposed joint preparation and sealing of all types of joints in the project. Following the completion of the test section and before any other joint is sealed, the test section shall be inspected to determine that the materials and installation meet the requirements specified. If it is determined that the materials or installation do not meet the requirements, the materials shall be removed, and the joints shall be recleaned and resealed at no cost to the Government. When the test section meets the requirements, it may be incorporated into the permanent work and paid for at the contract unit price per linear foot for sealing items scheduled. All other joints shall be prepared and sealed in the manner approved for sealing the test section.

1.8 DELIVERY AND STORAGE

Materials delivered to the job site shall be inspected for defects, unloaded, and stored with a minimum of handling to avoid damage. Storage facilities shall be provided at the job site to protect materials from weather and to maintain them at the temperatures recommended by the manufacturer.

1.9 ENVIRONMENTAL CONDITIONS

The ambient air temperature and the pavement temperature within the joint wall shall be a minimum of 50 degrees F and rising at the time of application of the materials. Sealant shall not be applied if moisture is observed in the crack.

PART 2 PRODUCTS

2.1 SEALANTS

Usage of sealing materials for sealing cracks in the various paved areas indicated on the drawings shall be as follows:

Area	Sealing Material
Cracks in Bituminous Shoulders	ASTM D 3569 and COE CRD-C 525
Cracks in PCC Pavement	ASTM D 5893

2.2 PRIMERS

Primers, when their use is recommended by the manufacturer of the sealant, shall be as recommended by the manufacturer of the sealant.

2.3 BACKUP MATERIALS

Backup material shall be a compressible, nonshrinking, nonstaining, nonabsorptive material and shall be nonreactive with the crack sealant. The melting point of the backing material shall be at least 5 degrees F greater than the maximum pouring temperature of the sealant being used, when tested in accordance with ASTM D 789. The material shall have a water absorption of not more than 5 percent by weight when tested in accordance with ASTM C 509. The backup material shall be 25 percent (plus or minus 5 percent) larger in diameter than the nominal width of the crack.

2.4 BOND BREAKING TAPES

The bond breaking tape or separating material shall be a flexible, nonshrinkable, nonabsorbing, nonstaining, and nonreacting adhesive-backed tape. The material shall have a melting point at least 3 degrees C greater than the pouring temperature of the sealant being used when tested in accordance with ASTM D 789. The bond breaker tape shall be approximately 3 mm wider than the nominal width of the joint and shall not bond to the joint sealant.

PART 3 EXECUTION

3.1 PREPARATION OF CRACKS

Immediately before the installation of the crack sealant, the cracks shall be thoroughly cleaned to remove oxidized pavement, loose aggregate and foreign debris. The preparation shall be as follows:

3.1.1 Cracks

3.1.1.1 Hairline Cracks

Cracks that are less than 1/4 inch wide do not need to be sealed .

3.1.1.2 Small Cracks

Cracks that are 1/4 to 3/4 inch wide shall be routed to a nominal width 1/8 inch greater than the existing nominal width and to a depth not less than 3/4 inch, sandblasted and cleaned using compressed air.

3.1.1.3 Medium Cracks

Cracks that are 3/4 to 2 inches wide shall be sandblasted and cleaned using compressed air.

3.1.1.4 Large Cracks

Cracks that are greater than 2 inches wide shall be repaired using bituminous pavement repair techniques, Section 02749, instead of sealing.

3.1.2 Existing Sealant Removal

The in-place sealant shall be cut loose from both crack faces and to a depth shown on the drawings, using a concrete saw or hand tools as specified in paragraph EQUIPMENT. Depth shall be sufficient to accommodate any backup material that is required to maintain the depth of new sealant to be installed. Prior to further cleaning operations, all old loose sealant remaining in the crack opening shall be removed by blowing with compressed air.

3.1.3 Routing

Routing of the cracks shall be accomplished using a rotary router with a bit that is at least 1/8 inch wider than the nominal width of the crack to remove all residual old sealant (resealing), oxidized pavement and any loose aggregate in the crack wall.

3.1.4 Sawing

Sawing of the cracks shall be accomplished using a power-driving concrete saw as specified in paragraph EQUIPMENT. The blade shall be stiffened as necessary with suitable dummy (or used) blades or washers. Immediately following the sawing operation, the crack opening shall be cleaned using a water jet to remove all saw cuttings and debris.

3.1.5 Sandblasting

The crack faces and the pavement surfaces extending a minimum of 1/2 inch from the crack edges shall be sandblasted clean. A multiple-pass technique shall be used until the surfaces are free of dust, dirt, old sealant residue, or foreign debris that might prevent the sealant material from bonding to the asphalt pavement. After final cleaning and immediately prior to sealing, the cracks shall be blown out with compressed air and left completely free of debris and water. The Contractor shall ensure that sandblasting does not damage the pavement.

3.1.6 Backup Material

Backup material shall be used on all cracks that have a depth greater than 3/4 inch. The backup material shall be inserted into the lower portion of the crack as shown on the drawings. The Contractor shall ensure that the backup material is placed at the specified depth and is not stretched or twisted during installation.

3.1.7 Bond Breaking Tape

Where inserts or filler materials contain bitumen, or the depth of the joint opening does not allow for the use of a backup material, a bond breaker separating tape will be inserted to prevent incompatibility with the filler materials and three-sided adhesion of the sealant. The tape shall be securely bonded to the bottom of the joint opening so it will not float up into the new sealant.

3.1.8 Rate of Progress of Crack Preparation

The stages of crack preparation which include routing, sandblasting of the crack faces, air pressure cleaning and placing of the backup material shall be limited to only that linear footage that can be sealed during the same day.

3.2 PREPARATION OF SEALANT

3.2.1 Hot Pour Sealants

Sealants conforming to ASTM D 3569 shall not be heated in excess of the safe heating temperature recommended by the manufacturer as shown on the sealant containers. Sealant that has been overheated or subjected to application temperatures for over 4 hours or that has remained in the applicator at the end of the day's operation shall be withdrawn and wasted.

3.2.2 Single Component, Cold Applied Sealants

The ASTM D 5893 sealant and containers shall be inspected prior to use. Any materials that contain water, hard caking of any separated constituents, nonreversible jell, or materials that are otherwise unsatisfactory shall be rejected. Settlement of constituents in a soft mass that can be readily and uniformly remixed in the field with simple tools will not be cause for rejection.

3.3 INSTALLATION OF SEALANT

3.3.1 Time of Application

Cracks shall be sealed immediately following final cleaning of the crack walls and following the placement of the backup material (when required). Cracks that cannot be sealed under the conditions specified, or when rain interrupts sealing operations, shall be recleaned and allowed to dry prior to installing the sealant.

3.3.2 Sealing the Crack

Immediately preceding, but not more than 50 feet ahead of the crack sealing operations, a final cleaning with compressed air shall be performed. The cracks shall be filled from the bottom up to 1/8 inch below the pavement surface. Excess or spilled sealant shall be removed from the

pavement by approved methods and shall be discarded. The sealant shall be installed in a manner which prevents the formation of voids and entrapped air. Several passes with the applicator wand may be necessary to obtain the specified sealant depth from the pavement surface. Gravity methods or pouring pots shall not be used to install the sealant material. Traffic shall not be permitted over newly sealed pavement until authorized by the Contracting Officer. Cracks shall be checked frequently to ensure that the newly installed sealant is cured to a tack-free condition within 3 hours.

3.4 CRACK SEALANT INSTALLATION TEST SECTION

Prior to the cleaning and sealing of the cracks for the entire project, a test section at least 200 feet long shall be prepared using the specified materials and approved equipment, to demonstrate the proposed sealing of all cracks of the project. Following the completion of the test section and before any other crack is sealed, the test section will be inspected to determine that the materials and installation meet the requirements specified. If materials or installation do not meet requirements, the materials shall be removed and the cracks recleaned and resealed at no cost to the Government. When the test section meets the requirements, it may be incorporated into the permanent work and paid for at the contract unit price per linear foot for sealing items scheduled. All other cracks shall be sealed in the manner approved for sealing the test section.

3.5 CLEANUP

Upon completion of the project, unused materials shall be removed from the site and the pavement shall be left in a clean condition.

3.6 QUALITY CONTROL PROVISIONS

3.6.1 Crack Cleaning

Quality control provisions shall be provided during the crack cleaning process to correct improper equipment and cleaning techniques that damage the bituminous pavement in any manner. Cleaned cracks shall be approved prior to installation of the crack sealant.

3.6.2 Crack Seal Application Equipment

The application equipment shall be inspected to ensure conformance to temperature requirements and proper installation. Evidences of bubbling, improper installing, and failing to cure or set shall be cause to suspend operations until causes of the deficiencies are determined and corrected.

3.6.3 Crack Sealant

The crack sealant shall be inspected for proper cure and set rating, bonding to the bituminous pavement, cohesive separation within the sealant, reversion to liquid, and entrapped air and voids. Sealants exhibiting any of these deficiencies at any time prior to the final acceptance of the project shall be removed from the crack, wasted, and replaced as specified herein at no additional cost to the Government.

-- End of Section --

SECTION 02981A

GROOVING FOR AIRFIELD PAVEMENTS

PART 1 GENERAL

1.1 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Equipment; G, RO

List of proposed equipment to be used in performance of construction work, including descriptive data.

1.2 GROOVING MACHINE

The grooving machine shall be a type equipped with diamond-saw cutting blades, and capable of making at least 18 inches in width of multiple parallel grooves in one pass of the machine. Thickness of the cutting blades shall be capable of making the required width and depth of grooves in one pass of the machine. The cutting head shall not contain a mixture of new and worn blades or blades of unequal wear or diameter. The wheels on the grooving machine shall be of a design that will not scar or spall the pavement. The machine shall be provided with devices to control depth of groove and alignment within the specified tolerances.

1.3 WATER SUPPLY

Water for the grooving operation shall be provided by the Government and shall be transported by the Contractor from the source shown on the drawings to the job.

1.4 ENVIRONMENTAL REQUIREMENTS

Grooving operations will not be permitted when freezing conditions prevent the immediate removal of debris and/or drainage of water from the grooved area.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.1 PREPARATION

3.1.1 Existing Pavements

Bumps, depressed areas, bad or faulted joints, and badly cracked and/or spalled areas in the pavement shall not be grooved until such areas are

adequately repaired or replaced, as specified in Section 02753.

3.1.2 New Pavements

New portland cement concrete pavements shall be allowed to cure for a minimum of 28 days before grooving.

3.2 GROOVING

3.2.1 Procedures

Grooves shall be cut in the portland cement areas as indicated on the drawings. All reasonable precautions shall be taken to prevent damage to or roughening of the pavement between grooves. Spalling along or tearing or raveling of the groove edges shall not be allowed. The grooves shall be 1/4 inch plus or minus 1/16 inch wide by 1/4 inch plus or minus 1/16 inch deep and 1-1/2 inches plus or minus 1/8 inch center to center spacing. The transverse alignment of the grooves shall not vary more than 3 inches plus or minus on a 75 foot length of grooving.

3.2.2 Clean-Up

Clean-up shall be continuous. Debris produced by the machine must be flushed to the edge of the grooved area or shall be picked up as it forms. The dust coating remaining shall be flushed to the edge of the area if the resultant accumulation is not detrimental to the vegetation or storm drainage system. All flushing operations shall be accomplished in a manner to prevent erosion on the shoulders.

3.2.3 Repair of Damaged Pavement

Any damage that occurs to the pavement as a result of the grooving operations, which in the opinion of the Contracting Officer will be detrimental to aircraft tires, shall be repaired at the Contractor's expense as specified in Section 02753.

-- End of Section --

DIVISION 3 - CONCRETE

03307A Concrete for Minor Structures

SECTION 03307A

CONCRETE FOR MINOR STRUCTURES

PART 1 GENERAL

1.1 REFERENCES

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

ACI INTERNATIONAL (ACI)

ACI 308	(2001) Guide to Curing Concrete
ACI 318/318R	(2002) Building Code Requirements for Structural Concrete and Commentary
ACI 347R	(2001) Guide to Formwork for Concrete

ASTM INTERNATIONAL (ASTM)

ASTM A 185	(2002) Steel Welded Wire Reinforcement, Plain, for Concrete
ASTM A 615/A 615M	(2003a) Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM C 143/C 143M	(2003) Slump of Hydraulic Cement Concrete
ASTM C 150	(2002ae1) Portland Cement
ASTM C 171	(2003) Sheet Materials for Curing Concrete
ASTM C 172	(1999) Sampling Freshly Mixed Concrete
ASTM C 231	(2003) Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C 260	(2001) Air-Entraining Admixtures for Concrete
ASTM C 309	(2003) Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C 31/C 31M	(2003a) Making and Curing Concrete Test Specimens in the Field
ASTM C 39/C 39M	(2003) Compressive Strength of Cylindrical Concrete Specimens
ASTM C 494/C 494M	(1999ae1) Chemical Admixtures for Concrete
ASTM C 618	(2003) Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral

Admixture in Concrete

- ASTM C 685 (2000) Concrete Made by Volumetric Batching and Continuous Mixing
- ASTM C 920 (2002) Elastomeric Joint Sealants
- ASTM C 94/C 94M (2003a) Ready-Mixed Concrete
- ASTM D 1752 (1984; R 1996e1) Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
- ASTM D 75 (2003) Sampling Aggregates

U.S. ARMY CORPS OF ENGINEERS (USACE)

- COE CRD-C 400 (1963) Requirements for Water for Use in Mixing or Curing Concrete
- COE CRD-C 572 (1974) Specifications for Polyvinylchloride Waterstops

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

- Air-Entraining Admixture; G
- ;
- Water-Reducing or Retarding Admixture; G, RO
- Curing Materials; G, RO
- Reinforcing Steel; G, RO
- Expansion Joint Filler Strips, Premolded; G, RO
- Joint Sealants - Field Molded Sealants; G, RO
- Waterstops; G, RO

Manufacturer's literature is available from suppliers which demonstrates compliance with applicable specifications for the above materials.

Batching and Mixing Equipment; G, RO

Batching and mixing equipment will be accepted on the basis of manufacturer's data which demonstrates compliance with the applicable specifications.

Conveying and Placing Concrete;

The methods and equipment for transporting, handling, depositing, and consolidating the concrete shall be submitted prior to the first concrete placement.

Formwork; G, RO

Formwork design shall be submitted prior to the first concrete placement.

SD-06 Test Reports

Aggregates; G, RO

Aggregates will be accepted on the basis of certificates of compliance and test reports that show the material(s) meets the quality and grading requirements of the specifications under which it is furnished.

Concrete Mixture Proportions; G, RO

Ten days prior to placement of concrete, the contractor shall submit the mixture proportions that will produce concrete of the quality required. Applicable test reports shall be submitted to verify that the concrete mixture proportions selected will produce concrete of the quality specified.

SD-07 Certificates

Cementitious Materials; G, RO

Certificates of compliance attesting that the concrete materials meet the requirements of the specifications shall be submitted in accordance with the Special Clause "CERTIFICATES OF COMPLIANCE". Cementitious material will be accepted on the basis of a manufacturer's certificate of compliance, accompanied by mill test reports that the material(s) meet the requirements of the specification under which it is furnished.

Aggregates; G, RO

Aggregates will be accepted on the basis of certificates of compliance and tests reports that show the material(s) meet the quality and grading requirements of the specifications under which it is furnished.

1.3 DESIGN AND PERFORMANCE REQUIREMENTS

The Government will maintain the option to sample and test joint sealer, joint filler material, waterstop, aggregates and concrete to determine compliance with the specifications. The Contractor shall provide facilities and labor as may be necessary to assist the Government in procurement of representative test samples. Samples of aggregates will be obtained at the point of batching in accordance with ASTM D 75. Concrete will be sampled in accordance with ASTM C 172. Slump and air content will be determined in accordance with ASTM C 143/C 143M and ASTM C 231, respectively, when cylinders are molded. Compression test specimens will be made, cured, and transported in accordance with ASTM C 31/C 31M. Compression test specimens will be tested in accordance with ASTM C 39/C 39M. Samples for strength tests will be taken not less than once each shift in which concrete is produced from each class of concrete required. A minimum of three specimens will be made from each sample; two will be tested at 28 days (90 days if pozzolan is used) for acceptance, and one will be tested at 7 days for information.

1.3.1 Strength

Acceptance test results will be the average strengths of two specimens tested at 28 days (90 days if pozzolan is used). The strength of the concrete will be considered satisfactory so long as the average of three consecutive acceptance test results equal or exceed the specified compressive strength, f'c, and no individual acceptance test result falls below f'c by more than 500 psi.

1.3.2 Construction Tolerances

A Class "C" finish shall apply to all surfaces except those specified to receive a Class "D" finish. A Class "D" finish shall apply to all surfaces which will be permanently concealed after construction. The surface requirements for the classes of finish required shall be as specified in ACI 347R.

1.3.3 Concrete Mixture Proportions

Concrete mixture proportions shall be the responsibility of the Contractor.

Mixture proportions shall include the dry weights of cementitious material(s); the nominal maximum size of the coarse aggregate; the specific gravities, absorptions, and saturated surface-dry weights of fine and coarse aggregates; the quantities, types, and names of admixtures; and quantity of water per cubic yard of concrete. All materials included in the mixture proportions shall be of the same type and from the same source as will be used on the project. Specified compressive strength f'c shall be 4,000 psi at 28 days (90 days if pozzolan is used). The maximum nominal size coarse aggregate shall be 1-1/2 inches, in accordance with ACI 318/318R.

The air content shall be between 4.5 and 7.5 percent. The slump shall be between 2 and 5 inches. The maximum water cement ratio shall be 0.50 .

1.4 REGULATORY REQUIREMENTS

The state statutory and regulatory requirements listed below form a part of this specification to the extent referenced. Kansas Standard Specifications for Road and Bridge, Construction, Class A Concrete (AE).

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Cementitious Materials

Cementitious materials shall conform to the appropriate specifications listed:

2.1.1.1 Portland Cement

ASTM C 150, Type I or II, .

2.1.1.2 Pozzolan

Pozzolan shall conform to ASTM C 618, Class C or F, including requirements of Tables 1A and 2A.

2.1.2 Aggregates

Aggregates shall meet the quality and grading requirements of state highway

department specification in accordance with paragraph REGULATORY REQUIREMENTS.

2.1.3 Admixtures

Admixtures to be used, when required or approved, shall comply with the appropriate specification listed. Chemical admixtures that have been in storage at the project site for longer than 6 months or that have been subjected to freezing shall be retested at the expense of the contractor at the request of the Contracting Officer and shall be rejected if test results are not satisfactory.

2.1.3.1 Air-Entraining Admixture

Air-entraining admixture shall meet the requirements of ASTM C 260.

2.1.3.2 Water-Reducing or Retarding Admixture

Water-reducing or retarding admixture shall meet the requirements of ASTM C 494/C 494M, Type A, B, or D. High-range water reducing admixture Type F or G may be used only when approved, approval being contingent upon particular placement requirements as described in the Contractor's Quality Control Plan.

2.1.4 Water

Water for mixing and curing shall be fresh, clean, potable, and free from injurious amounts of oil, acid, salt, or alkali, except that unpotable water may be used if it meets the requirements of COE CRD-C 400.

2.1.5 Reinforcing Steel

Reinforcing steel bar shall conform to the requirements of ASTM A 615/A 615M, Grade 60. Welded steel wire fabric shall conform to the requirements of ASTM A 185. Details of reinforcement not shown shall be in accordance with ACI 318/318R, Chapters 7 and 12.

2.1.6 Expansion Joint Filler Strips, Premolded

Expansion joint filler strips, premolded shall be sponge rubber conforming to ASTM D 1752, Type I.

2.1.7 Joint Sealants - Field Molded Sealants

Joint sealants - field molded sealants shall conform to ASTM C 920, Type M, Grade NS, Class 25, use NT for vertical joints and Type M, Grade P, Class 25, use T for horizontal joints. Bond-breaker material shall be polyethylene tape, coated paper, metal foil, or similar type materials. The backup material shall be compressible, nonshrink, nonreactive with the sealant, and a nonabsorptive material such as extruded butyl or polychloroprene foam rubber. Immediately prior to installation of field-molded sealants, the joint shall be cleaned of all debris and further cleaned using water, chemical solvents, or other means as recommended by the sealant manufacturer or directed.

2.1.8 Waterstops

Waterstops shall conform to COE CRD-C 572.

2.1.9 Formwork

The design and engineering of the formwork as well as its construction, shall be the responsibility of the Contractor.

2.1.10 Form Coatings

Forms for exposed surfaces shall be coated with a nonstaining form oil, which shall be applied shortly before concrete is placed.

2.1.11 Curing Materials

Curing materials shall conform to the following requirements.

2.1.11.1 Impervious Sheet Materials

Impervious sheet materials, ASTM C 171, type optional, except polyethylene film, if used, shall be white opaque.

2.1.11.2 Membrane-Forming Curing Compound

ASTM C 309, Type 1-D or 2, Class A .

2.1.12 Color

Concrete for encasing airfield electrical ducts shall be dyed red.

PART 3 EXECUTION

3.1 PREPARATION

3.1.1 General

Construction joints shall be prepared to expose coarse aggregate, and the surface shall be clean, damp, and free of laitance. Ramps and walkways, as necessary, shall be constructed to allow safe and expeditious access for concrete and workmen. Snow, ice, standing or flowing water, loose particles, debris, and foreign matter shall have been removed. Earth foundations shall be satisfactorily compacted. Spare vibrators shall be available. The entire preparation shall be accepted by the Government prior to placing.

3.1.2 Embedded Items

Reinforcement shall be secured in place; joints, anchors, and other embedded items shall have been positioned. Internal ties shall be arranged so that when the forms are removed the metal part of the tie will be not less than 2 inches from concrete surfaces permanently exposed to view or exposed to water on the finished structures. Embedded items shall be free of oil and other foreign matters such as loose coatings or rust, paint, and scale. The embedding of wood in concrete will be permitted only when specifically authorized or directed. All equipment needed to place, consolidate, protect, and cure the concrete shall be at the placement site and in good operating condition.

3.1.3 Formwork Installation

Forms shall be properly aligned, adequately supported, and mortar-tight. The form surfaces shall be smooth and free from irregularities, dents,

sags, or holes when used for permanently exposed faces. All exposed joints and edges shall be chamfered, unless otherwise indicated.

3.1.4 Production of Concrete

3.1.4.1 Ready-Mixed Concrete

Ready-mixed concrete shall conform to ASTM C 94/C 94M except as otherwise specified.

3.1.4.2 Concrete Made by Volumetric Batching and Continuous Mixing

Concrete made by volumetric batching and continuous mixing shall conform to ASTM C 685.

3.1.4.3 Batching and Mixing Equipment

The contractor shall have the option of using an on-site batching and mixing facility. The facility shall provide sufficient batching and mixing equipment capacity to prevent cold joints. The method of measuring materials, batching operation, and mixer shall be submitted for review. On-site plant shall conform to the requirements of either Section 02753.

3.1.5 Waterstops

Waterstops shall be installed and spliced as directed by the manufacturer.

3.2 CONVEYING AND PLACING CONCRETE

Conveying and placing concrete shall conform to the following requirements.

3.2.1 General

Concrete placement shall not be permitted when weather conditions prevent proper placement and consolidation without approval. When concrete is mixed and/or transported by a truck mixer, the concrete shall be delivered to the site of the work and discharge shall be completed within 1-1/2 hours or 45 minutes when the placing temperature is 85 degrees F or greater unless a retarding admixture is used. Concrete shall be conveyed from the mixer to the forms as rapidly as practicable by methods which prevent segregation or loss of ingredients. Concrete shall be in place and consolidated within 15 minutes after discharge from the mixer. Concrete shall be deposited as close as possible to its final position in the forms and be so regulated that it may be effectively consolidated in horizontal layers 18 inches or less in thickness with a minimum of lateral movement. The placement shall be carried on at such a rate that the formation of cold joints will be prevented.

3.2.2 Consolidation

Each layer of concrete shall be consolidated by internal vibrating equipment. External vibrating equipment may be used when authorized. Internal vibration shall be systematically accomplished by inserting the vibrator through the fresh concrete in the layer below at a uniform spacing over the entire area of placement. The distance between insertions shall be approximately 1.5 times the radius of action of the vibrator and overlay the adjacent, just-vibrated area by a few inches. The vibrator shall penetrate rapidly to the bottom of the layer and at least 6 inches into the layer below, if such a layer exists. It shall be held stationary until the

concrete is consolidated and then withdrawn slowly at the rate of about 3 inches per second.

3.2.3 Cold-Weather Requirements

No concrete placement shall be made when the ambient temperature is below 35 degrees F or if the ambient temperature is below 40 degrees F and falling. Suitable covering and other means as approved shall be provided for maintaining the concrete at a temperature of at least 50 degrees F for not less than 72 hours after placing and at a temperature above freezing for the remainder of the curing period. Salt, chemicals, or other foreign materials shall not be mixed with the concrete to prevent freezing. Any concrete damaged by freezing shall be removed and replaced at the expense of the contractor.

3.2.4 Hot-Weather Requirements

When the rate of evaporation of surface moisture, as determined by use of Figure 1 of ACI 308, is expected to exceed 0.2 pound per square foot per hour, provisions for windbreaks, shading, fog spraying, or covering with a light-colored material shall be made in advance of placement, and such protective measures shall be taken as quickly as finishing operations will allow.

3.3 FORM REMOVAL

Forms shall not be removed before the expiration of 24 hours after concrete placement except where otherwise specifically authorized. Supporting forms and shoring shall not be removed until the concrete has cured for at least 5 days. When conditions on the work are such as to justify the requirement, forms will be required to remain in place for longer periods.

3.4 FINISHING

3.4.1 General

No finishing or repair will be done when either the concrete or the ambient temperature is below 50 degrees F.

3.4.2 Finishing Formed Surfaces

All fins and loose materials shall be removed, and surface defects including tie holes shall be filled. All honeycomb areas and other defects shall be repaired. All unsound concrete shall be removed from areas to be repaired. Surface defects greater than 1/2 inch in diameter and holes left by removal of tie rods in all surfaces not to receive additional concrete shall be reamed or chipped and filled with dry-pack mortar. The prepared area shall be brush-coated with an approved epoxy resin or latex bonding compound or with a neat cement grout after dampening and filled with mortar or concrete. The cement used in mortar or concrete for repairs to all surfaces permanently exposed to view shall be a blend of portland cement and white cement so that the final color when cured will be the same as adjacent concrete.

3.4.3 Finishing Unformed Surfaces

All unformed surfaces that are not to be covered by additional concrete or backfill shall be float finished to elevations shown, unless otherwise specified. Surfaces to receive additional concrete or backfill shall be

brought to the elevations shown and left as a true and regular surface. Exterior surfaces shall be sloped for drainage unless otherwise shown. Joints shall be carefully made with a jointing tool. Unformed surfaces shall be finished to a tolerance of 3/8 inch for a float finish and 5/16 inch for a trowel finish as determined by a 10 foot straightedge placed on surfaces shown on the plans to be level or having a constant slope. Finishing shall not be performed while there is excess moisture or bleeding water on the surface. No water or cement shall be added to the surface during finishing.

3.4.3.1 Float Finish

Surfaces to be float finished shall be screeded and darbied or bullfloated to eliminate the ridges and to fill in the voids left by the screed. In addition, the darby or bullfloat shall fill all surface voids and only slightly embed the coarse aggregate below the surface of the fresh concrete. When the water sheen disappears and the concrete will support a person's weight without deep imprint, floating should be completed. Floating should embed large aggregates just beneath the surface, remove slight imperfections, humps, and voids to produce a plane surface, compact the concrete, and consolidate mortar at the surface.

3.4.3.2 Trowel Finish

A trowel finish shall be applied to areas indicated. Trowelling shall be done immediately following floating to provide a smooth, even, dense finish free from blemishes including trowel marks. Finished surfaces shall be protected from damage during the construction period.

3.4.3.3 Broom Finish

A broom finish shall be applied to areas indicated. The concrete shall be screeded and floated to required finish plane with no coarse aggregate visible. After surface moisture disappears, the surface shall be broomed or brushed with a broom or fiber bristle brush in a direction transverse to that of the main traffic or as directed.

3.4.3.4 Expansion and Contraction Joints

Expansion and contraction joints shall be made in accordance with the details shown or as otherwise specified.

3.5 CURING AND PROTECTION

Beginning immediately after placement and continuing for at least 7 days, all concrete shall be cured and protected from premature drying, extremes in temperature, rapid temperature change, freezing, mechanical damage, and exposure to rain or flowing water. All materials and equipment needed for adequate curing and protection shall be available and at the site of the placement prior to the start of concrete placement. Preservation of moisture for concrete surfaces not in contact with forms shall be accomplished by one of the following methods:

- a. Continuous sprinkling or ponding.
- b. Application of absorptive mats or fabrics kept continuously wet.
- c. Application of sand kept continuously wet.

- d. Application of impervious sheet material conforming to ASTM C 171.
- e. Application of membrane-forming curing compound conforming to ASTM C 309, Type 1-D, on surfaces permanently exposed to view and Type 2 on other surfaces shall be accomplished in accordance with manufacturer's instructions.

The preservation of moisture for concrete surfaces placed against wooden forms shall be accomplished by keeping the forms continuously wet for 7 days . If forms are removed prior to end of the required curing period, other curing methods shall be used for the balance of the curing period. During the period of protection removal, the temperature of the air in contact with the concrete shall not be allowed to drop more than 25 degrees F within a 24 hour period.

3.6 TESTS AND INSPECTIONS

3.6.1 General

The individuals who sample and test concrete as required in this specification shall have demonstrated a knowledge and ability to perform the necessary test procedures equivalent to the ACI minimum guidelines for certification of Concrete Field Testing Technicians, Grade I.

3.6.2 Inspection Details and Frequency of Testing

3.6.2.1 Preparations for Placing

Foundation or construction joints, forms, and embedded items shall be inspected in sufficient time prior to each concrete placement by the Contractor to certify that it is ready to receive concrete.

3.6.2.2 Air Content

Air content shall be checked at least twice during each shift that concrete is placed for each class of concrete required. Samples shall be obtained in accordance with ASTM C 172 and tested in accordance with ASTM C 231.

3.6.2.3 Slump

Slump shall be checked twice during each shift that concrete is produced for each class of concrete required. Samples shall be obtained in accordance with ASTM C 172 and tested in accordance with ASTM C 143/C 143M.

3.6.2.4 Consolidation and Protection

The Contractor shall ensure that the concrete is properly consolidated, finished, protected, and cured.

3.6.3 Action Required

3.6.3.1 Placing

The placing foreman shall not permit placing to begin until he has verified that an adequate number of acceptable vibrators, which are in working order and have competent operators, are available. Placing shall not be continued if any pile is inadequately consolidated.

3.6.3.2 Air Content

Whenever a test result is outside the specification limits, the concrete shall not be delivered to the forms and an adjustment shall be made to the dosage of the air-entrainment admixture.

3.6.3.3 Slump

Whenever a test result is outside the specification limits, the concrete shall not be delivered to the forms and an adjustment should be made in the batch weights of water and fine aggregate. The adjustments are to be made so that the water-cement ratio does not exceed that specified in the submitted concrete mixture proportion.

3.6.4 Reports

The results of all tests and inspections conducted at the project site shall be reported informally at the end of each shift and in writing weekly and shall be delivered within 3 days after the end of each weekly reporting period. See Section 01451A CONTRACTOR QUALITY CONTROL.

-- End of Section --

DIVISION 4 - MASONRY
THRU
DIVISION 15 - MECHANICAL
NOT APPLICABLE

DIVISION 16 - ELECTRICAL

16526A Airport and Heliport Lighting and Visual Navigation Aids

SECTION 16526A

AIRFIELD AND HELIPORT LIGHTING AND VISUAL NAVIGATION AIDS

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C119.1 (2002) Sealed Insulated Underground Connector Systems Rated 600 Volts

ASTM INTERNATIONAL (ASTM)

ASTM A 123/A 123M (2002) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

ASTM A 153/A 153M (2003) Zinc Coating (Hot-Dip) on Iron and Steel Hardware

ASTM A 536 Standard Specification for Ductile Iron Castings

ASTM A 780 (2001) Repair of Damaged and Uncoated Areas of Hot-Dipped Galvanized Coatings

ASTM B 117 (2002) Operating Salt Spray (Fog) Apparatus

ASTM C-31 (2003) Practice for Making and Curing Concrete Test Specimens in the Field

ASTM C-39 (2001) Test Method for Compressive Strength of Cylindrical Concrete Specimens

ASTM C-150 (2002 ae1) Portland Cement

ASTM C-618 (2003) Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete

ASTM D 1248 (2002) Polyethylene Plastics Extrusion Materials for Wire and Cable

ASTM D 1654 (1992; R 2000) Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments

ASTM D 709 (2001) Laminated Thermosetting Materials

FM GLOBAL (FM)

FM P7825a (2003) Approval Guide Fire Protection
FM P7825b (2003) Approval Guide Electrical Equipment

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2 (2002) National Electrical Safety Code
IEEE C62.11 (1999) Metal-Oxide Surge Arresters for
Alternating Current Power Circuits (>1KV)
IEEE C62.41 (1991) Recommended Practice for Surge
Voltages in Low-Voltage AC Power Circuits

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA LA 1 (1992; R 1999) Surge Arresters
NEMA RN 1 (1998) Polyvinyl Chloride (PVC) Externally
Coated Galvanized Rigid Steel Conduit and
Intermediate Metal Conduit
NEMA TC 2 (2003) Electrical Polyvinyl Chloride (PVC)
Tubing (EPT) and Conduit
NEMA TC 3 (1999) PVC Fittings for Use with Rigid PVC
Conduit and Tubing
NEMA TC 6 (1990) PVC and ABS Plastic Utilities Duct
for Underground Installation **

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2002) National Electrical Code

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC Paint 20 (2002) Zinc-Rich Primers, (Type I -
"Inorganic" and Type II - "Organic")

U.S. FEDERAL AVIATION ADMINISTRATION (FAA)

FAA AC 150/5345-10 (Rev E) Constant Current Regulators
Regulator Monitors
FAA AC 150/5345-26 (Rev C) L-823 Plug and Receptacle, Cable
Connectors
FAA AC 150/5345-42 (Rev C; change 1) Airport Light Bases,
Transformer Houses, Junction Boxes and
Accessories
FAA AC 150/5345-44 (Rev F; Change 1) Taxiway and Runway Signs
FAA AC 150/5345-46 (Rev B) Runway and Taxiway Light Fixtures

- FAA AC 150/5345-47 (Rev A) Isolation Transformers for Airport Lighting Systems
- FAA AC 150/5345-7 (Rev E) L-824 Underground Electrical Cable for Airport Lighting Circuits
- FAA AC 150/5370-10 (Rev A; Changes 1-13) Specifying Construction of Airports
- FAA DWG C-6046 (1978) Frangible Coupling Type 1 and Type 1A, Details

UNDERWRITERS LABORATORIES (UL)

- UL 1 (2000) Flexible Metal Conduit
- UL 1242 (2000; Rev thru May 2003) Electrical Intermediate Metal Conduit -- Steel
- UL 360 (1996; Rev thru May 2003) Liquid-Tight Flexible Steel Conduits
- UL 486A (1997; Rev thru May 2001) Wire Connectors and Soldering Lugs for Use with Copper Conductors
- UL 486B (1997; Rev thru May 2001) Wire Connectors for Use with Aluminum Conductors
- UL 510 (1994; Rev thru Apr 1998) Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape
- UL 514A (1996; Rev thru Nov 2001) Metallic Outlet Boxes
- UL 6 (2000; Rev thru May 2003) Rigid Metal Conduit
- UL 797 (2000; Rev thru May 2003) Electrical Metallic Tubing -- Steel
- UL 83 (1998; Rev thru Nov 2001) Thermoplastic-Insulated Wires and Cables
- UL 854 (1999; Rev thru Nov 2002) Service-Entrance Cables
- UL Elec Const Dir (2003) Electrical Construction Equipment Directory

1.2 GENERAL REQUIREMENTS

Items of the same classification shall be identical including equipment, assemblies, parts, and components.

1.2.1 Code Compliance

The installation shall comply with the requirements and recommendations of

NFPA 70 and IEEE C2 and local codes where required.

1.2.2 Standard Product

Material and equipment shall be a standard product of a manufacturer regularly engaged in the manufacture of the product and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening.

1.2.3 Prevention of Corrosion

1.2.3.1 Metallic Materials

Metallic materials shall be protected against corrosion as specified. Aluminum shall not be used in contact with earth or concrete. Where aluminum conductors are connected to dissimilar metal, fittings conforming to UL 486B shall be used.

1.2.3.2 Ferrous Metal Hardware

Ferrous metal hardware shall be hot-dip galvanized in accordance with ASTM A 123/A 123M and ASTM A 153/A 153M.

1.2.3.3 Luminaires Fabricated from Ferrous Metals

Luminaires fabricated from ferrous metals, unless hot-dip galvanized or of porcelain enamel finish shall be factory finished with a weather-resistant finish in accordance with paragraphs FACTORY COATING and FINISHING, except exposure shall be 200 hours. Finish color shall be the manufacturer's standard, unless otherwise indicated.

1.2.4 Unusual Service Conditions

Items furnished under this section shall be specifically suitable for the following unusual service conditions:

1.2.4.1 Altitude

Any equipment shall be suitable for operation up to an altitude of 6,600 ft..

1.2.4.2 Other

Material or equipment to be installed underground; in handholes, manholes, or underground vaults; or in light bases, shall be suitable for submerged operation.

1.2.5 Verification of Dimensions

The Contractor shall become familiar with details of the work, verify dimensions in the field, and advise the Contracting Officer of any discrepancy before performing any work.

1.2.6 Electrical Outages

The Contractor shall keep airfield lights functional at all times, except lights within a closed portion of the airfield shall be off while the pavement is closed. Any outage of lights on the airfield shall be coordinated with the base operations and Base Civil Engineer by the Contracting Officer 30 days prior to outage. If the Contractor's operation

results in an outage in an area not closed to traffic, the Contractor shall stay onsite until all damaged or inoperable airfield lights have been repaired and are functional.

1.2.7 Excavation Permit

The Contractor shall obtain an excavation permit from 22 Civil Engineer in accordance with Section 01100.

1.3 SYSTEM DESCRIPTION

The airfield lighting and visual navigation aids shall consist of airfield lighting airfield marking approach lights runway lights taxiway lights taxiway signs and the lighting power supply and control.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Lighting and Navigation Aids;

Structures;

Coordination drawings consisting of composite drawings showing coordination of work of one trade with that of other trades and with the structural and architectural elements of the work. Drawings shall be in sufficient detail to show overall dimensions of related items, clearances, and relative locations of work in allotted spaces. Drawings shall indicate where conflicts or clearance problems exist between the various trades.

As-Built Drawings;

Drawings that provide current factual information including deviations from, and amendments to the drawings and changes in the work, concealed and visible, shall be provided as instructed. The as-built drawings shall show installations with respect to fixed installations not associated with the systems specified herein. Cable and wire shall be accurately identified as to direct-burial or in conduit and shall locate the connection and routing to and away from bases, housings, and boxes.

SD-03 Product Data

Materials and Equipment;

A complete itemized listing of equipment and materials proposed for incorporation into the work. Each itemization shall include an item number, the quantity of items proposed, and the name of the manufacturer. Data composed of catalog cuts, brochures, circulars, specifications and product data, and printed information in sufficient detail and scope to verify compliance with requirements of the contract documents.

Protection Plan;

Detailed procedures to prevent damage to existing facilities or infrastructures. If damage does occur, the procedures shall address repair and replacement of damaged property at the Contractor's expense.

Training;

Information describing training to be provided, training aids to be used, samples of training materials to be provided, and schedules of training, two weeks before training is scheduled to begin.

Special Tools;

List of special tools and test equipment required for maintenance and testing of the products supplied by the Contractor.

Parts;

A list of parts and components for the system by manufacturer's name, part number, nomenclature, and stock level required for maintenance and repair necessary to ensure continued operation with minimal delays.

Repair Requirements;

Instructions necessary to check out, troubleshoot, repair, and replace components of the systems, including integrated electrical and mechanical schematics and diagrams and diagnostic techniques necessary to enable operation and troubleshooting after acceptance of the system shall be provided.

Posted Instructions; G,

A typed copy of the proposed posted instructions showing wiring, control diagrams, complete layout and operating instructions explaining preventive maintenance procedures, methods of checking the system for normal safe operation, and procedures for safely starting and stopping the system. Proposed diagrams, instructions, and other sheets shall be submitted prior to posting.

Conduit in Casing Installation

A complete itemized listing of equipment, materials and techniques for installation of conduit installation in casing, including grout mixture and grouting injection techniques.

Material; G, RO

Quick setting patching material, including performance history; primer for patch material.

SD-06 Test Reports

Field Quality Control;

Upon completion and testing of the installed system, performance test reports are required in booklet form showing all field tests performed to adjust each component and all field tests performed to provide compliance with the specified performance criteria. Each test shall indicate the final position of controls.

Field test reports shall be written, signed and provided as each circuit or installation item is completed. Field tests shall include resistance-to-ground and resistance between conductors, and continuity measurements for each circuit. For each series circuit the input voltage and output current of the constant current regulator at each intensity shall be measured. For multiple circuits the input and output voltage of the transformer for each intensity setting shall be measured. A visual inspection of the lights operation, or of the markings appearance, or of the installation of fixtures or units installed shall be reported.

Inspection;

Inspection reports shall be prepared and provided as each stage of installation is completed. These reports shall identify the activity by contract number, location, quantity of material placed, and compliance with requirements.

Controlled Low Strength Material Mix Design; Consistency
Compressive Strength

SD-07 Certificates

Cables, General Requirements

Certifications, when specified or required, including Certification of the Qualifications of Medium-Voltage Cable Installers, Certified Factory and Field Test Reports, and Certificates of Compliance submitted in lieu of other proofs of compliance with these contract provisions. A certification that contains the names and the qualifications of persons recommended to perform the splicing and termination of medium-voltage cables approved for installation under this contract shall be included. The certification shall indicate that any person recommended to perform actual splicing and termination has been adequately trained in the proper techniques and has had at least 3 recent years of experience in splicing and terminating the same or similar types of cables approved for installation. Any person recommended by the Contractor may be required to perform a dummy or practice splice and termination, in the presence of the Contracting Officer, before being approved as a qualified installer of medium-voltage cables. If that additional requirement is imposed, the Contractor shall provide short sections of the approved types of cables with the approved type of splice and termination kits, and detailed manufacturer's instruction for the proper splicing and termination of the approved cable types. The certification shall be prepared in conformance with paragraph CERTIFICATES OF COMPLIANCE in the SPECIAL CONTRACT REQUIREMENTS, and shall be accompanied by satisfactory proof of the training and experience of persons recommended by the Contractor as cable installers. The SF sub 6 gas pressurized cable and conduit system installer must be trained and certified in installation of this type of system and must be

approved by the manufacturer of the system.

Materials and Equipment;

When equipment or materials are specified to conform to the standards or publications and requirements of AASHTO, ANSI, ASTM, AEIC, FM, IEEE, IES, NEMA, NFPA, or UL, or to an FAA, FS, or MS, proof that the items furnished under this section of the specifications conform to the specified requirements shall be included. The label or listing in UL Elec Const Dir or in FM P7825a, FM P7825b or the manufacturer's certification or published catalog specification data statement that the items comply with applicable specifications, standards, or publications and with the manufacturer's standards will be acceptable evidence of such compliance. Certificates shall be prepared by the manufacturer when the manufacturer's published data or drawings do not indicate conformance with other requirements of these specifications.

Frames and Covers; G, RO

Certification on the ability of frame and covers to carry the imposed live loads.

SD-10 Operation and Maintenance Data

Equipment;

10 copies of operation and 10 copies of maintenance manuals for the equipment furnished. One complete set shall be furnished prior to performance testing and the remainder shall be furnished upon acceptance. Operating manuals shall detail the step-by-step procedures required for system startup, operation, and shutdown. Operating manuals shall include the manufacturer's name, model number, parts list, and brief description of all equipment and their basic operating features. Maintenance manuals shall list routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guides. Maintenance manuals shall include conduit and equipment layout and simplified wiring and control diagrams of the system as installed.

1.5 MEASUREMENT AND PAYMENT

1.5.1 Measurement

1.5.1.1 Duct Bank Repair

The quantity of duct bank repair to be paid for will be the total linear feet of duct bank liner installed in the duct bank, at each installation location.

1.5.1.2 Replace Duct Bank

The quantity of replace duct bank to be paid for will be the total linear feet of duct bank installed at each location, size of duct as indicated.

1.5.2 Payment

1.5.2.1 Duct Bank Repair

The quantity of duct bank repair measured as specified above will be paid for the contract unit price for cleaned and lined duct bank. Payment will constitute full compensation for cleaning the duct bank with rodding equipment, for lining the cleaned duct and for furnishing all materials, equipment, tools and for all labor and incidentals necessary to complete the duct bank repair.

Payment will be made under:

Duct Bank Repair less than 25 feet	per linear foot
Duct Bank Repair, 26 to 75 feet	per linear foot
Duct Bank Repair, 76 to 150 feet	per linear foot
Duct Bank Repair, 151 to 500 feet	per linear foot
Duct Bank Repair, 501 to 1000 feet	per linear foot

1.5.2.2 Duct Bank Replacement

The quantity of duct bank replacement measured as specified above will be paid for the contract unit price for new one-way duct banks, size of duct as indicated. Payment will constitute full compensation for excavation, forms, supplying and placing PCC concrete, reinforcement, and PVC ducts, supplying and placing counterpoise above duct, for all connections and splices, backfilling, seeding and mulching and for furnishing all materials, equipment, tools and for all labor and incidentals necessary to complete the duct bank replacement.

Payment will be made under:

2 inch Duct Bank Replacement, less than 200 feet	per linear foot
2 inch Duct Bank Replacement, 201 to 400 feet	per linear foot
2 inch Duct Bank Replacement, 401 to 600 feet	per linear foot
2 inch Duct Bank Replacement, 601 to 1,000 feet	per linear foot
4 inch Duct Bank Replacement, less than 200 feet	per linear foot
4 inch Duct Bank Replacement, 201 to 400 feet	per linear foot
4 inch Duct Bank Replacement, 401 to 600 feet	per linear foot
4 inch Duct Bank Replacement, 601 to 1,000 feet	per linear foot

PART 2 PRODUCTS

2.1 MATERIALS

Equipment and materials shall be new unless indicated or specified otherwise. Materials and equipment shall be labeled when approved by Underwriters Laboratories (UL) or Factory Mutual (FM) System. Askarel and insulating liquids containing polychlorinated biphenyls (PCB's) will not be allowed in any equipment. Equipment installed below grade in vaults, manholes, and handholes shall be the submersible type.

2.1.1 Electrical Tape

Electrical tape shall be UL 510 plastic insulating tape.

2.1.2 Nameplates

Each major component of equipment shall have as a minimum the

manufacturer's name, address, and catalog or style number on a nameplate securely attached to the item of equipment. Laminated plastic nameplates shall be provided for equipment, controls, and devices to identify function, and where applicable, position. Nameplates shall be 1/8 inch thick laminated cellulose paper base phenolic resin plastic conforming to ASTM D 709 sheet type, grade ES-3, white with black center core. Surface shall be a matte finish with square corners. Lettering shall be engraved into the black core. Size of nameplates shall be 1 by 2-1/2 inches minimum with minimum 1/4 inch high normal block lettering. Nameplates provided as indicated. Nameplates shall be fastened to the device with a minimum of two sheet metal screws or two rivets.

2.1.3 Conduit, Conduit Fittings, and Boxes

2.1.3.1 Rigid Steel or Intermediate Metal Conduit (IMC) and Fittings

The metal conduit and fittings shall be UL 6 and UL 1242, respectively, coated with a polyvinylchloride (PVC) sheath bonded to the galvanized exterior surface, nominal 40 mils thick, conforming to NEMA RN 1.

2.1.3.2 Flexible Metal Conduit

Flexible metal conduit shall be UL 1, zinc-coated steel. UL 360 liquid-tight flexible metal conduit shall be used in wet locations.

2.1.3.3 Outlet Boxes for Use with Steel Conduit, Rigid or Flexible

These outlet boxes shall be UL 514A, cast metal with gasket closures.

2.1.3.4 Plastic Duct for Concrete Encased Burial

These ducts shall be PVC conforming to NEMA TC 6, Type EB or UL 651 Schedule 40.

2.1.3.5 Plastic Conduit for Direct Burial

Plastic conduit shall be PVC conforming to NEMA TC 2 (conduit) and NEMA TC 3 (fittings) Type EPC-80 PVC or UL 651.

2.1.3.6 Frangible Couplings and Adapters

These frangible couplings shall be in accordance with FAA DWG C-6046. Upper section of frangible coupling shall be provided with one of the following:

- a. Unthreaded for slip-fitter connections.
- b. 2-13/32 inch 16N-1A modified thread for nut and compression ring to secure 2 inch EMT.
- c. 2 inch 11-1/2-N.P.T. (tapered) with 7/32 inch nominal wall thickness to accept rigid conduit coupling.
- d. Frangible Couplings for specialized applications as approved.
- e. Electrical Metallic Tubing UL 797, where indicated for use with frangible couplings and adapters.

2.1.4 Wire and Cable

Conductors shall be copper except as otherwise indicated.

2.1.4.1 Conductor Sizes

Conductor size shall conform to American Wire Gage (AWG). Conductor sizes larger than No. 8 AWG shall be stranded. No. 8 AWG and smaller may be solid or stranded unless otherwise indicated.

2.1.4.2 Low Voltage Wire and Cable

UL 854, Type USE, 600 volts shall be used for underground low voltage power cables. UL 83, Type THWN shall be used for secondary series lighting circuits to be installed in pavement.

2.1.4.3 Wire and Cable for Airfield and Heliport Lighting Systems

- a. Airfield lighting cable shall be FAA AC 150/5345-7, Type L-824 for crosslinked polyethylene Type C 5000-volt cable. Series airfield and heliport lighting cable shall be unshielded.
- b. Cable for pavement slot installation shall be UL 83 Type THWN , except as indicated otherwise.
- c. Counterpoise Wire. No. 4 AWG bare stranded copper, annealed or soft drawn.

2.1.4.4 Cable Tags

Cable tags for each cable or wire shall be installed at duct entrances entering or leaving manholes, handholes, and at each terminal within the lighting vault. Cable tags shall be stainless steel, bronze, lead strap, or copper strip, approximately 1/16 inch thick or hard plastic 1/8 inch thick suitable for immersion in salt water and impervious to petroleum products and shall be of sufficient length for imprinting the legend on one line using raised letters. Cable tags shall be permanently marked or stamped with letters not less than 1/4 inch in height as indicated. Two-color laminated plastic is acceptable. Plastic tags shall be dark colored with markings of light color to provide contrast so that identification can be easily read. Fastening material shall be of a type that will not deteriorate when exposed to water with a high saline content and to petroleum products.

2.1.5 Ground Rods

Ground rods shall be copper-clad steel with diameter adequate to permit driving to full length of the rod, but not less than 3/4 inch in diameter and not more than 10 feet long, unless indicated otherwise.

2.1.6 Lightning Arresters

These lightning arresters shall be in accordance with IEEE C62.11 and IEEE C62.41 as applicable with ratings as indicated.

2.1.7 Surge Protection

Surge protection shall be metal oxide varistors (MOV) in accordance with NEMA LA 1 for power and signal circuits with ratings as recommended by the

system manufacturer.

2.1.8 Cable Connectors and Splices

Cable connectors in accordance with FAA AC 150/5345-26, Item L-823 shall be used for connections and splices appropriate for the type of cable. Other types of cable connectors and splices shall be of copper alloys for copper conductors, For FAA Type L-824 lighting cable, connectors shall be FAA AC 150/5345-26, Type L-823.

2.1.9 Transformers

2.1.9.1 Encapsulated Isolation Transformers

These transformers shall be FAA AC 150/5345-47, Type L-830. Each transformer shall be provided with rating as shown on the contract drawings.

2.1.10 Light Bases

Light bases shall be FAA AC 150/5345-42 Type L-868 . Steel bases, Class 1, Size A, B or C shall be provided as indicated or as required to accommodate the fixture or device installed thereon if diameter is not shown.

2.1.10.1 Accessories

Base plates, cover plates, and adapter plates shall be provided to accommodate various sizes of fixtures. Bolts shall be stainless steel.

2.1.11 Sealant for Fixtures and Wires in Drilled Holes or Saw Kerfs

The sealant shall be in accordance with FAA AC 150/5370-10, Type P-606. Use FAA AC 150/5370-10, Type P-606 sealant for use in asphaltic concrete (AC) or Portland cement concrete (PCC) pavement compatible with AC pavement and having a minimum elongation of 50 percent. Formulations of Type P-606 which are compatible with PCC pavement only are prohibited.

2.1.12 Constant Current Regulator

The regulator shall be FAA AC 150/5345-10, Type L-828, without monitoring system and with ratings as indicated. Regulators shall be ferroresonant. Due to excessive electromagnetic interference, regulators with solid state output will not be permitted.

2.1.12.1 Regulator Options

Regulators shall operate on 60 Hz, have internal primary switch excluded, have input voltage of 240 and be controlled by 120-volt external control voltage. Three brightness steps shall be provided.

2.1.13 Lamps and Filters

Lamps shall be of size and type indicated, or as required by fixture manufacturer for each lighting fixture required under this contract. Filters shall be of colors as indicated and conforming to the specification for the light concerned or to the standard referenced.

2.1.14 Lighting Fixtures

The lighting fixtures for the airfield lighting shall be as shown in the contract drawings or as required in other contract documents.

2.2 HIGH-INTENSITY APPROACH LIGHTING SYSTEMS

2.3 RUNWAY LIGHTING SYSTEM

Runway lights include runway edge lights, runway threshold lights, mounting structures, controls, and the associated equipment and interconnecting wiring to provide complete systems as indicated and specified herein. In-pavement light fixtures shall be able to withstand a minimum static single wheel load of 75,000 pounds.

2.3.1 Runway Edge Lights

The runway edge light fixtures shall meet the requirements of FAA AC 150/5345-46, Type L-862, elevated high-intensity or Type L-850C, semiflush, high-intensity white lights. All existing runway edge lights shall be removed and stored for reinstallation at new locations. If additional runway edge lights are required, the Contractor shall supply new runway edge lights. All semiflush fixtures shall be constructed of ductile iron or have ductile iron snow plow rings. Stainless steel bolts with anti-seize compound shall be used for fixture installation.

2.3.2 Runway Threshold and End Lights

The threshold lights shall use aviation green filter and the end lights shall use aviation red filters. These lights shall be combined in a single bidirectional fixture with the appropriate color filters if so indicated on the contract drawings. The runway threshold/end light fixtures shall meet Air Force candela requirements of 10,000 cd on the green approach side and 2,500 cd on the red runway end side for Type L-850D, semiflush, high-intensity, bidirectional airfield lights as indicated on the contract drawings.

2.4 TAXIWAY LIGHTING SYSTEMS

Taxiway lighting systems shall include edge lights, , guidance signs, and hold position signs. These systems shall also include the associated equipment, power supplies and controls, mounting devices, and interconnecting wiring to provide complete systems as specified.

2.4.1 Taxiway Edge Lights

All taxiway edge lights, except those shown on the plans as LED taxiway edge lights, shall emit aviation blue light provided by filters or globes for both airfields and heliports. Taxiway edge lights, except those indicated as LED type, shall have a quartz or incandescent lamp. LED lights shall not be considered as a substitute for a quartz or incandescent lamp. The edge lights shall meet the requirements of FAA AC 150/5345-46, Type L-861, elevated, Type L-852E, semiflush, lights. All semiflush light fixtures shall be constructed of ductile iron or be installed with ductile iron snow plow rings. Stainless steel bolts with anti-seize compound shall be used for fixture installation. All Taxiway A lights south of taxiway shall be reused. All other taxiway edge lights shall be removed and delivered to a location on McConnell AFB. The Contractor shall supply new taxiway edge lights.

2.4.1.1 LED Taxiway Edge Lights

Taxiway edge lights shown on the plans as LED taxiway edge lights shall emit aviation blue light provided by globes. LED taxiway edge lights shall have low wattage LED lamp. Aortic kits or heaters are not required. The LED edge lights shall meet the requirements of FAA AC 150/5345-46, Type L-861T and FAA LED Requirements Document - 2001. LED lights shall only be installed where shown in the plans, and will not be considered as a substitute for taxiway edge lights with quartz or incandescent lamp.

2.4.2 Taxiway Guidance Signs

The taxiway guidance signs shall meet the requirements of FAA AC 150/5345-44, Type L-858Y for information, Type L-858L for location, and Type L-858R for mandatory signs. The size and information on the signs shall be as shown on contract drawings. The power supply to connect to series circuits shall be as indicated by the manufacturer. Airfield signs shall be either FAA Size 3, Style 2, Class 1 (61.6A, 3-Step) or Style 3, Class 1 (6.6 or 20A 5-Step) as shown on the plans. Use Mode 2 signs for holding position signs and runway exit signs and Mode 1 for signs located more than 110 feet from the edge of runway full strength pavement. All airfield signs shall be low VA type with maximum load of 380VA for a 4 module sign.

2.4.3 Hold Position Lights and Signs

The hold positions shall be marked by painted lines and signs as specified or indicated on the contract drawings. Hold position signs shall meet the requirements of FAA AC 150/5345-44, Type L-858R, with the size and information as indicated on the contract drawings. Hold position signs shall be either FAA Size 3, Style 2, Class 1 (6.6A, 3-Step) or Style 3.6.6A or 20A 5-Step) as shown on plans. Use Mode 2 signs for hold position signs. All airfield signs shall be low VA type with maximum load of 380VA for a 4 module sign.

2.5 FACTORY COATINGS

Equipment and component items, including but not limited to transformer stations and ferrous metal luminaires not hot-dip galvanized or porcelain enamel finish shall be provided with corrosion-resistant finishes which shall withstand 200 hours of exposure to the salt spray test specified in ASTM B 117 without loss of paint or release of adhesion of the paint primer coat to the metal surface in excess of 1/16 inch from the test mark. The scribed test mark and test evaluation shall be in accordance with ASTM D 1654 with a rating of not less than 7 in accordance with TABLE 1, (Procedure A). Cut edges or otherwise damaged surfaces of hot-dip galvanized sheet steel or mill galvanized sheet steel shall be coated with zinc rich paint conforming to SSPC Paint 20 in accordance with ASTM A 780.

2.6 INITIAL CASING FOR CONCRETE ENCASED DUCT

- a. The initial casing for concrete encased duct installation shall be Schedule 80 plastic duct meeting the requirements of Paragraph 2.1.3.5.
- b. In addition, the following items shall be supplied to assist in the installation of conduit in steel casing:
 - Manufactured bore spacers from non-metallic material
 - Wire Ropes
 - Float Stops

2.7 GROUT FOR CONCRETE ENCASED DUCT

The Contractor shall submit a grout mix design for filling the cavity between the 2-inch duct and initial casing. The grout mixture shall be high in cement and fly ash content and have a slump of approximately 7-inches to 8-inches. An additive shall be used that reduces the grout density to about 75 lbs/cu ft and increases the fluidity to that of an 11-inch slump.

2.8 QUICK SETTING PATCH MATERIAL

2.8.1 Material

The quick setting patch material shall be a flexible concrete repair material with high tensile strength and strong bonding with existing PCC. Patch material shall remain flexible throughout anticipated temperature extremes to avoid cracking, delaminating and premature material loss due to thermal climatic changes and traffic loadings. Patch material shall be capable of supporting aircraft loads (250 psi tires), within 1 hour of placement. Patch material shall be gray in color. Patch material shall not be adversely affected by jet fuel or de-icing fluids.

Patch material shall have a documented history of successful performance at an airfield for a minimum of 3 years.

Acceptable products include:

- a. Delpatch Elastomeric Concrete, manufactured by The D.S. Brown Company.
- b. PERCOL Elastic Cement, manufactured by GeoCHEM Incorporated.
- c. TechCrete, manufactured by Crafcro, Incorporated.

2.8.2 Primer

Primer material shall be as recommended by the manufacturer of the quick setting patch material.

2.9 MANHOLES AND HANDHOLES

Strength of manholes, handholes, and pullboxes and their frames and cover shall conform to the requirements of IEEE C2. Precast-concrete manholes shall have the required strength established by ASTM C478. Frames and covers shall be made of ductile iron and a machine-finished seat shall be provided to ensure a matching joint between frame and cover. Cast iron shall comply with ASTM A 536. Airfield type manholes, handholes, vaults and their associated frames and covers shall be able to support a 100,000 pound maximum single wheel load at 250 psi tire pressure. The minimum factor of safety shall be 2.5.

2.10 Concrete and Reinforcement

Concrete and reinforcement shall meet the requirements of 03307A CONCRETE FOR MINOR STRUCTURES.

2.11 Controlled Low Strength Material (CLSM)

2.11.1 Materials

2.11.1.1 Portland Cement

Portland cement shall conform to the requirements of ASTM ASTM C-150 Type I or II.

2.11.1.2 Fly Ash

Fly Ash shall conform to ASTM ASTM C-618, Class C or F.

2.11.1.3 Fine Aggregate (Sand)

Fine aggregate quality and gradation shall meet the requirements for Kansas Department of Transportation FA-A, FA-B or FA-M, and shall produce the performance characteristics of the CLSM specified herein.

2.11.1.4 Water

Water used in mixing shall be free of oil, salt, acid alkali, sugar vegetable matter, or other substances injurious to the finished product.

2.11.2 Mix Design

2.11.2.1 Proportions

Contractor shall submit, to the Contracting Officer, a mix design including the proportions and source of materials, admixtures and dry cubic yard batch weights. The mix shall contain a minimum of 50 pounds of cement and 250 pounds fly ash per cubic yard with the remainder of the volume composed of sand, water and any approved admixtures.

2.11.2.2 Compressive Strength

CLSM shall be designed to achieve a 28-day compressive strength of 100 to 200 psi when tested in accordance with ASTM ASTM C-39. There should be no significant strength gain after 28 days. Test specimens shall be made in accordance with ASTM ASTM C-31 except that the samples will not be rodded or vibrated and shall be air cured in the molds for the duration of the cure period.

2.11.2.3 Consistency

Consistency of the fresh mixture shall be such that the mixture may be placed without segregation. A desired consistency may be approximated by filling an open-ended three inch diameter cylinder, six inches high to the top, with the mixture and cylinder immediately pulled straight up. The correct consistency of the mixture will produce an approximate eight-inch diameter circular-typed spread without segregation. Adjustments of the proportions of materials should be made to achieve proper solid suspension and flowable characteristics, however the theoretical yield shall be maintained at one cubic yard for the given batch weights.

2.11.3 Color

2.11.3.1 Overtop Electrical Ducts

Overtop electrical ducts the CLSM shall be dyed red.

2.11.3.2 All Other Locations

At all locations, except overtop electrical ducts, the CLSM shall not be dyed, but shall be its natural color.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

Except as covered herein, excavation, trenching, and backfilling shall conform to the requirements of Section 02300 EARTHWORK. Equipment and devices shall be installed and energized in accordance with the manufacturer's published instructions. Concrete work shall have minimum 4000 psi compressive strength and conform to the requirements of Section 03307A. Concrete used to encase duct lines shall be dyed red.

3.1.1 Conformance to Codes

The installation shall comply with the requirements and recommendations of NFPA 70 and IEEE C2 as applicable.

3.1.2 Verification of Dimensions

The Contractor shall become familiar with details of the work, shall verify dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing any work.

3.1.3 Disposal of Liquid Dielectrics

PCB-contaminated dielectrics must be marked as PCB and transported to and incinerated by an approved EPA waste disposal facility. The Contractor shall furnish certification of proper disposal. Contaminated dielectrics shall not be diluted to lower the contamination level.

3.2 CABLES, GENERAL REQUIREMENTS

The type of installation, size and number of cables shall be as indicated. Conductors larger than No. 8 AWG shall be stranded. Loads shall be divided as evenly as practicable on the various phases of the system. Manufacturer's written recommendations shall be furnished for each type of splice and medium-voltage cable joint and termination, and for fireproofing application methods, and shall be approved before any work is done. Medium-voltage cable joints and terminations shall be the standard product of a manufacturer and shall be either of the factory preformed type or of the kit type containing tapes and other required parts. Medium-voltage cable joints shall be made by qualified cable splicers. Compounds and tapes shall be electrical grade suitable for the cable insulation provided and shall use design materials and techniques recommended by the manufacturer. Maximum length of cable pull and cable pulling tensions shall not exceed the cable manufacturer's recommendations.

3.2.1 Duct Line Installation

Cables shall be installed in duct lines where indicated. Cable splices shall be made in manholes and handholes only, except as otherwise noted. Parallel circuit neutral and ground conductors shall be installed in the same duct with their associated phase conductors. Counterpoise cable shall be installed in a separate duct or direct-burial not less than 6 inches above the uppermost duct containing electrical cable. Electrical metallic tubing shall not be installed underground or enclosed in concrete.

3.3 LOW-VOLTAGE CABLES

Cable shall be rated 600 volts, except that secondaries of isolation transformer to in-pavement lights installed in pavement saw kerf and 48 volt DC control cables may be 300 volts. Other parts of cable systems such as splices and terminations shall be rated at not less than 600 volts. Splices in wires No. 10 AWG and smaller shall be made with an insulated, solderless, pressure type connector, conforming to the applicable requirements of UL 486A. Splices in wires No. 8 AWG single conductor cable shall be made with solderless, pressure type connector, conforming to the applicable requirements of UL 486A and UL 486B. They shall then be covered with an insulation and jacket material equivalent to the conductor insulation and jacket. Splices below grade or in wet locations shall be sealed type conforming to ANSI C119.1 or shall be waterproofed by a sealant-filled, thick wall, heat shrinkable, thermosetting tubing or by pouring a thermosetting resin into a mold that surrounds the joined conductors.

3.4 DUCT LINES

Duct lines shall be concrete-encased, Schedule 40 PVC type. Low-voltage lines run elsewhere may be non-encased direct-burial, thick-wall type.

3.4.1 Requirements

Numbers and sizes of ducts shall be as indicated. Duct lines shall be laid with a minimum slope of 4 inches per 100 feet. Depending on the contour of the finished grade, the high point may be at a terminal, a manhole, a handhold, or between manholes or handholes. Manufactured 90 degree duct bends may be used only for pole or equipment risers, unless specifically indicated as acceptable. The minimum manufactured bend radius shall be 18 inches for ducts of less than 3 inches diameter, and 36 inches for ducts 3 inches or greater in diameter. Otherwise, long sweep bends having a minimum radius of 25 feet shall be used for a change of direction of more than 5 degrees, either horizontally or vertically. Both curved and straight sections may be used to form long sweep bends as required, but the maximum curve shall be 30 degrees and manufactured bends shall be used. Ducts shall be provided with end bells when duct lines terminate in manholes or handholes. Duct line markers shall be provided as indicated at the ends of long duct line stubouts or for other ducts whose locations are indeterminate because of duct curvature or terminations at completely below-grade structures. In lieu of markers, a 5 mil brightly colored plastic tape not less than 3 inches in width and suitably inscribed at not more than 10 feet on centers with a continuous metallic backing and a corrosion-resistant 1 mil metallic foil core to permit easy location of the duct line, shall be placed approximately 12 inches below finished grade levels of such lines.

3.4.2 Treatment

Ducts shall be kept clean of concrete, dirt, or foreign substances during construction. Field cuts requiring tapers shall be made with proper tools and match factory tapers. After a duct line is completed, a standard flexible mandrel shall be used for cleaning followed by a brush with stiff bristles. Mandrels shall be at least 12 inches long and shall have diameters 1/4 inch less than the inside diameter of the duct being cleaned. Pneumatic rodding may be used to draw in lead wires. A coupling recommended by the duct manufacturer shall be used when an existing duct is connected to a duct of different material or shape. Ducts shall be stored to avoid warping and deterioration with ends sufficiently plugged to prevent entry of water or solid substances. Ducts shall be thoroughly cleaned before being laid. Plastic ducts shall be stored on a flat surface and protected from the direct rays of the sun.

3.4.3 Concrete Encasement

Each single duct shall be completely encased in concrete with a minimum of 3 inches of concrete around each duct, except that 4 inches of concrete shall be provided between adjacent electric power and communication ducts. Duct line encasements shall be monolithic construction. Where a connection is made to a previously poured encasement, the new encasement shall be well bonded or doweled to the existing encasement. At any point, except railroad crossings, tops of concrete encasements shall be not less than 18 inches below finished grade or paving. At railroad crossings, duct lines shall be encased with concrete, reinforced as indicated. Tops of concrete encasements shall be not less than 5 feet below tops of rails, unless otherwise indicated. Separators or spacing blocks shall be made of steel, concrete, plastic, or a combination of these materials placed not further apart than 4 feet on centers. Ducts shall be securely anchored to prevent movement during the placement of concrete and joints shall be staggered at least 6 inches vertically. Trace tape shall be laid above the encased duct in accordance with 02300.

3.4.4 Installation of Couplings

Joints in each type of duct shall be made up in accordance with the manufacturer's recommendations for the particular type of duct and coupling selected and as approved. In the absence of specific recommendations, various types of duct joint couplings shall be made watertight as specified.

3.4.4.1 Plastic Duct

Duct joints shall be made by brushing a plastic solvent cement on insides of plastic coupling fittings and on outsides of duct ends. Each duct and fitting shall then be slipped together with a quick one-quarter-turn twist to set the joint tightly.

3.4.4.2 Backfill Under All Pavement

Backfill overtop the duct bank with controlled low strength material (CLSM) to the top of the excavation or to the bottom of the aggregate base course, whichever is lower.

3.4.5 Duct Installation by Horizontal Directional Drilling

Where shown on the plans, new duct lines shall be installed by directionally drilling methods. The ducts shall be of the size, material

and type indicated in the plans and specifications.

3.4.5.1 Construction - PVC Ducts

- a. The Contractor shall construction entrance and exit pits for the directional boring, and shall remove PCC pavement for an entrance pit and new light locations, prior to the start of boring.
- b. Under PCC pavement, the duct lines shall be a minimum of 4 inches below the bottom of the PCC pavement. Under bituminous pavements and turfed areas, the duct line shall be a minimum of 18 inches below finished grade. Extend the duct 5 feet beyond the edge of the shoulder pavement and connect the duct to concrete encased duct lines. Encase the duct lines beyond the shoulder pavement in concrete.
- c. At each light location, curve the duct to allow connection to the light can. Curvature of the duct must be minimized at entrance and exit pits to keep axial strain within the limits of the conduit including joints. Minimum bending radii of 64 feet for Schedule 40 PVC conduit shall not be exceeded.
- d. A breakaway link, rated within the tensile load limit of the conduit, shall be installed between the swivel and the conduit when pulling in. Pulling heads should be designed so that pull back force is uniformly transmitted to the conduit and surface stress concentrations are minimized. Seal conduit ends before pulling back to prevent slurry from entering conduit. Allow approximately 4 percent extra length to insure the pull-nose remains extended beyond the borehole exit after axial strains recover.
- e. For PVC conduit with cemented joints, follow manufacturer's installation instructions for cure time and temperature for maximum strength. Use of screws, rivets or other fasteners that destroy the integrity of the conduit wall or protrude in the inside of the conduit will not be allowed. Use of PVC conduit with seals and mechanical locking rings, designed for installation by horizontal directional drilling is allowed if it meets the requirements for short-term tensile loads and long-term ring stress loads.
- f. The Contractor shall inspect the conduit at the borehole exit for damage, such as roughness, deep scratches or necking. The Contractor shall notify the Contracting Officer when the inspection will be possible so the Contracting Officer can observe the condition of the conduit and make a judgment decision as to whether the installation is acceptable.

3.4.5.2 Construction - Concrete Encased Conduit

- a. The Contractor shall construction entrance and exit pits for the directional boring. Prior to the start of boring, the Contractor shall remove PCC pavement for an entrance pit and at each new light location. In addition, at each light location the Contractor shall excavate a pit below the removed pavement sufficient in depth to accept the initial conduit.
- b. The Contractor shall directional bore from the entrance pit to the new light location. The initial casing shall be installed in the bored hole. The initial casing shall be Schedule 80 PVC, sufficient in size to accept a 2-inch conduit and grout. The top of the initial casing

shall be a minimum of 4 inches below the bottom of the PCC pavement. Under bituminous pavements and turfed areas, the top of the initial casing shall be a minimum of 18 inches below finished grade. Extend the initial casing 5 feet beyond the edge of the shoulder.

c. Insert 2-inch PVC conduit into the initial casing. As the 2-inch conduit is inserted into the initial casing, place bore spacers between the 2-inch conduit and initial casing. The bore spaces shall be spaced a maximum of 5 feet apart for the full length of the initial casing. Steel bands shall be secured around the 2-inch duct near each spacer, locking them into position. Float stops shall be used to prevent the conduit from being deformed by the upward load created by the duck bank floating when the grout is injected.

d. Inject grout into the area between the 2-inch conduit and initial casing. The grout shall fill the void completely. The pumping pressure shall be kept low so as to not collapse or deform the 2-inch conduit.

e. Allow the grout to cure for a minimum of 3 days. Connect the 2-inch conduit and initial casing to the concrete encased duct.

f. The Contractor shall inspect the conduit at the borehold exit for damage, such as roughness, deep scratches or necking. The Contractor shall notify the Contracting Officer when the inspection will be possible so the Contracting Officer can observe the condition of the conduit and make a judgment decision as to whether the installation is acceptable.

3.4.5.3 Restoration

In all areas disturbed by the trenching, directional boring and pit and other work shall be restored to its original condition.

3.4.5.4 Safety

The Contractor shall prepare, post and be sure his employees are aware of site safety procedures to be following during the horizontal directional drilling operation. Emergency procedures, to be followed in the event an existing utility is struck, shall be thoroughly understood by employees and implemented if necessary to reduce the likelihood of injury. Emergency procedures for inadvertently boring into existing buried utilities shall comply with applicable regulations.

3.4.6 Duck Bank Repair

If, during the installation of cables in existing duct banks, the Contractor finds the conduit plugged and unable to accept the cable, the duct bank will be cleaned using rodding equipment and lined with PVC liner.

3.4.6.1 Construction - Duck Bank Repair

a. The Contractor shall construct an entrance to the existing duct bank to be cleaned. If the rodding equipment can not be placed through the manhole/handhole entrance, the Contractor shall excavate alongside the manhole/handhole and cut a hole in the manhole/handhole through which the rodding equipment can reach the duct bank to be cleaned.

b. If existing cables are in the duct to be cleaned, they shall be

removed prior to rodding. The plugged 4-inch duct shall be cleaned with the largest rod possible but in no case less than 2-1/2 inches.

c. The cleaned 4-inch duct shall be lined with new 3-inch PVC conduit. If, due to debris remaining in the pipe, a 3-inch PVC pipe will not fit, the Contracting Officer may approve the lining of the duct with a 2-inch PVC pipe. As an alternative to installing a PVC pipe, other lining methods and sizes will be considered by the Contracting Officer. Approval of the alternative lining will be based on suitability for underground electrical installation and a minimum 2-inch opening is obtained.

d. The Contractor shall inspect the conduit at the borehole exit for damage, such as roughness, deep scratches or necking. The Contractor shall notify the Contracting Officer when the inspection will be possible so the Contracting Officer can observe the condition of the conduit and make a judgment decision as to whether the installation is acceptable.

e. The Contractor shall restore all areas disturbed by the rodding equipment and plug the opening in the manhole/handhole with water tight PC concrete plug.

3.4.7 Removal of Duct Bank Underneath Shoulder Pavement

3.4.7.1 Duct Bank to be Removed and Replaced with New Duct Bank at New Location

Where the plans show the existing duct bank underneath shoulder pavement to be removed, and new duct bank to be constructed at a new location, the existing duct bank shall be removed after the edge lights and shoulder pavement have been removed. Removal of the shoulder pavement shall be in accordance with Section 02575 PAVEMENT REMOVAL. The aggregate base course and duct bank shall be removed and disposed of off Government property. The excavation shall be filled with Controlled Low Strength Material (CLSM), meeting the requirements of paragraph 2.25, to the elevation of the bottom of the aggregate base course. After the CLSM has cured for 48 hours, place and compact graded crushed aggregate base course in accordance with Section 02722A. Place the graded crushed aggregate base course to the elevation of the top of existing aggregate base course. Place and compact bituminous surface course in accordance with Section 02749.

3.4.7.2 Duct Bank to be Removed and Replaced with New Duct Bank at Same Location

Where the plans show the existing duct bank underneath shoulder pavement to be removed, and new duct bank to be constructed at the same location, the existing duct bank shall be removed after the edge lights and shoulder pavement has been removed. Removal of the shoulder pavement shall be in accordance with Section 02575 PAVEMENT REMOVAL. The aggregate base course and duct bank shall be removed and disposed of off Government property. The new duct bank shall be constructed in the excavation, size of duct and number of ducts as shown. The area between the excavation and sides of duct bank and overtop duct bank shall be filled with Controlled Low Strength Material (CLSM), meeting the requirements of paragraph 2.25, to the elevation of the bottom of the aggregate base course. After the CLSM has cured for 48 hours, place and compact graded crushed aggregate base course in accordance with Section 02722A. Place the graded crushed aggregate base course to the elevation of the top of existing aggregate

base course. Place and compact bituminous surface course in accordance with Section 02749.

3.4.8 New Duct Bank Installation in Shoulder Pavement

Where the plans show the installation of new duct underneath existing bituminous concrete shoulder pavement to remain, first remove the edge light. Saw cut the edges of the pavement to be removed and the perimeter of the light base in accordance with Section 02575 PAVEMENT REMOVAL. The pavement removal width shall be sufficient for the contractor's operation, but no wider than 12 inches. Remove the bituminous pavement, aggregate base course and subgrade to a sufficient depth to install the new duct. Remove the existing light base and replace with a new base containing sufficient 2-inch hubs for the installation. Connect the new duct to the hub in the new base and place the new duct. The new duct bank shall be constructed in the excavation, size of duct and number of ducts as shown. The area between the excavation and sides of duct bank and overtop duct bank shall be filled with Controlled Low Strength Material (CLSM), meeting the requirements of paragraph 2.25, to the elevation of the bottom of the aggregate base course. After the CLSM has cured for 48 hours, place and compact graded crushed aggregate base course in accordance with Section 02749. Place the graded crushed aggregate base course to the elevation of the top of existing aggregate base course. Place and compact bituminous surface course in accordance with Section 02749. Aggregate base course removal and replacement will not be paid for separately. Bituminous surface course removal and replacement shall be paid for as Bituminous Pavement Repair, Section 02749.

3.4.9 Placement, Cure and Protection of CLSM

3.4.9.1 Placement

CLSM may be placed by any reasonable means from a mixing unit into the space to be filled. Agitation is required during transportation and waiting time. Placement shall be performed in such a manner that pipes are not displaced from their desired final position and intrusion of CLSM into undesirable areas is avoided. The material shall be brought up uniformly to the bottom of the existing aggregate base course. Each placement of CLSM shall be as continuous an operation as possible. If CLSM is placed in more than one layer, the base layer shall be free of surface water and loose or foreign material prior to placement of the next layer.

3.4.9.2 Limitations of Placement

CLSM shall not be placed on frozen ground. Mixing and placing may be when the air temperature is at least 35 degrees F and rising. At the time of placement, CLSM shall have a temperature of at least 40 degrees F. Mixing and placement shall stop when the air temperature is 40 degrees F and falling or when the anticipated air temperature will be 35 degrees F or less in the 24 hour period following proposed placement.

3.4.9.3 Curing

The air in contact with the CLSM should be maintained at temperatures above freezing for a minimum of 72 hours. If the CLSM is subjected to temperatures below 32 degrees F, the material may be rejected by the Contracting Officer if damage to the material is observed.

3.4.9.4 Protection

The CLSM shall not be subject to loads and shall remain undisturbed by construction activities for a period of 48 hours or until a compressive strength of 15 psi is obtained. The Contractor shall be responsible for providing evidence to the Engineer that the material has reached the desired strength. Acceptance evidence shall be based upon 2 compressive tests made for each 500 cubic yards of material used.

3.5 MANHOLES AND HANDHOLES

3.5.1 General

Manholes and handholes shall be constructed approximately where shown. The exact location of each manhole and handhole shall be determined after careful consideration has been given to the location of other utilities, grading, and paving. The location of each manhole and handhole shall be approved by the Contracting Officer before construction of the manhole and handhole is started. Manholes and handholes shall be the type noted on the drawings and shall be constructed in accordance with the applicable details as indicated. Top, walls, and bottom shall consist of reinforced concrete.

Walls and bottom shall be of monolithic concrete construction. The Contractor may at his option utilize monolithically constructed precast-concrete manholes and handholes having the required strength and inside dimensions as required by the drawings or specifications. In paved areas, frames and covers for manhole and handhole entrances in vehicular traffic areas shall be flush with the finished surface of the paving. In unpaved areas, the top of manhole and handhole covers shall be approximately 1/2 inch above the finished grade. Where existing grades that are higher than finished grades are encountered, concrete assemblies designed for the purpose shall be installed to elevate temporarily the manhole cover to existing grade level. All duct lines entering manholes/handholes must be installed on compact soil or otherwise supported when entering a manhole/handhole to prevent shear stress on the duct at the point of entrance to the manhole and handhole. Duct lines entering cast-in-place concrete manholes and handholes shall be cast in-place with the manhole/handhole. Duct lines entering precast concrete manholes/handholes through a precast knockout penetration shall be grouted tight with a portland cement mortar. PVC duct lines entering precast manholes through a PVC endbell shall be solvent welded to the endbell. Install endbells on conduit flush with inside walls. Grout around conduit penetrations with non-shrinking grout. A cast metal grille-type sump frame and cover shall be installed over the manhole sump. A cable-pulling iron shall be installed in the wall opposite each duct line entrance.

3.5.2 Cable Racks in Electric Manholes

Cables shall be securely supported from walls by hot-dip galvanized cable racks with a plastic coating over the galvanizing and equipped with adjustable hooks and insulators. The number of cable racks indicated shall be installed in each manhole and not less than 2 spare hooks shall be installed on each cable rack. Insulators shall be made of high-glazed porcelain. Insulators will not be required in spare hooks.

3.5.2.1 Routing Cables in Electric Manholes

Cables shall be routed around the interior walls and securely supported from walls on cables racks. Cable routing shall minimize cable crossover, provide access space for maintenance and installation of additional cables,

and maintain cable separation in accordance with IEEE C2.

3.5.3 Ground Rods

A ground rod shall be installed at the manholes and handholes. Ground rods shall be driven into the earth before the manhole/handhole floor is poured so that approximately 4 inches of the ground rod will extend above the manhole/handhole floor. When precast concrete manholes/handholes are used, the top of the ground rod may be below the manhole floor and a No. 1/0 AWG ground conductor brought into the manhole/handhole through a watertight sleeve in the manhole/handhole wall.

3.5.4 Manhole, Handhole, or Concrete Pullbox Grounding

Ground rods installed in manholes and handholes shall be connected to cable racks, cable-pulling irons, the cable shielding, metallic sheath, and armor at each cable joint or splice by means of a No. 4 AWG braided tinned copper wire. Connections to metallic cable sheaths shall be by means of tinned terminals soldered to ground wires and to cable sheaths. Care shall be taken in soldering not to damage metallic cable sheaths or shields. Ground rods shall be protected with a double wrapping of pressure-sensitive plastic tape for a distance of 2 inches above and 6 inches below concrete penetrations. Grounding electrode conductors shall be neatly and firmly attached to manhole/handhole walls and the amount of exposed bare wire shall be held to a minimum.

3.6 CABLE MARKERS

Cable markers or tags shall be provided for each cable at duct entrances entering or leaving manholes or handholes and at each termination within the lighting vault. Cables in each manhole or handhole shall have not less than two tags per cable, one near each duct entrance hole. Immediately after cable installation, tags shall be permanently attached to cables and wires so that they cannot be accidentally detached.

3.7 FRANGIBLE REQUIREMENTS

Frangible supports, couplings, and adapters shall be installed as indicated or specified.

3.8 ELEVATED AIRFIELD LIGHTS

Elevated lights shall be frangibly mounted, not to exceed 14 inches in height except where higher mounting is permitted in snow accumulation areas.

3.9 SEMIFLUSH AIRFIELD LIGHTS

Water, debris, and other foreign substances shall be removed prior to installing semiflush light base and light. Positioning jigs shall be used to hold the light bases and/or lights to ensure correct orientation and leveling until the concrete, adhesive, or sealant can provide permanent support.

3.10 WIRES, FIXTURES, AND ENCLOSURES IN SAW KERFS AND DRILLED HOLES

3.10.1 Holes for Light Fixtures

Holes shall be bored in existing pavement to the dimensions indicated with

a diamond-edged bit to provide a smooth, straight cut. Bottom of hole shall be flat or slightly concave, except that an area at least 1 inch wide around the perimeter shall be flat. Surfaces deeper than the prescribed depth shall be filled with sealant to the level of the flat area and allowed to cure before further placement.

3.10.2 Holes for Transformer Enclosures

Holes shall be drilled or excavated through concrete pavement and loose material removed. Hole shall be filled with concrete to depth indicated. A minimum of 3 inches of concrete shall be provided at bottom of hole.

3.10.3 Saw Kerfs and Splice Chambers

Saw kerfs and splice chambers shall be cut in pavements where indicated. Saw cuts shall be in straight lines with vertical sides. Width and depth of saw cuts shall be adequate for the required number of wires. Saw kerfs shall have the vertical edges chamfered at intersections. Where a saw kerf crosses a construction joint, the depth shall be increased sufficiently to allow for slack wire under the joint. The wire shall be enclosed in flexible tubing which extends not less than 2 feet each side of the joint.

3.10.4 Sandblasting

Saw kerfs, grooves, and holes shall be sandblasted to remove foreign or loose material. Sandblasting shall use approved equipment maintained in good working order. Sand for blasting shall be proper size and quality to perform the work. Nozzles for sandblasting shall be of the proper size in relation to the groove or holes to be cleaned. Nozzles enlarged by wear shall be replaced as necessary. Sandblast air pressure shall be not less than 90 psi.

3.10.5 Cleaning

Immediately prior to installation of wire or light fixtures, saw kerfs and holes shall be flushed with a high velocity water jet or steam, and then cleaned and dried with a high velocity air jet to remove dirt, water, and foreign material.

3.10.6 Lighting Fixture Installation

Sides and bottom of each light base shall be sandblasted immediately prior to installation. Inside faces of bored hole and bottom and sides of light base shall be covered with a coating of sealant that will completely fill the void between concrete and base. A jig or holding device shall be used when installing each light fixture to ensure positioning to the proper elevation, alignment, level control, and azimuth control. Light fixture shall be oriented with the light beams parallel to the runway or taxiway centerline and facing in the required direction. Outermost edge of fixture shall be level with the surrounding pavement. Surplus sealant or flexible embedding material shall be removed. The holding device shall remain in place until sealant has reached its initial set. Fixture lead wires shall be properly arranged with respect to their connecting position. The wireway entrance into the light recess shall be blocked to retain the sealant material during curing.

3.10.7 Installation of Circuit Wires in Pavement

Wires shall be placed in saw kerfs and anchored at bottom by means of

rubber or plastic wedges or noncorrosive metal clips placed every 2 or 3 feet or as often as necessary to hold the wire down. Wires crossing existing joints shall be encased in a 24 inch length of flexible tubing of polyethylene material conforming to ASTM D 1248, Type II or Type III, to break the bond between the wires and the sealing material. Flexible tubing shall be centered on the joint and of sufficient size to accommodate the wires to allow for movement of the wires as the joint opens and closes. Ends of tubing shall be wrapped with tape to prevent entrance of sealing materials. The adjacent joint area shall be packed temporarily with roving material, such as hemp, jute, cotton or flax, to prevent sealing material from flowing into the open joint. Sealing materials shall be carefully mixed and applied in accordance with the manufacturer's instructions and at the recommended temperature. Surplus or spilled material shall be removed.

3.11 SPLICES FOR AIRFIELD LIGHTING CABLE

3.11.1 Connectors

Kit type connectors shall be used to splice 5 kV single-conductor series lighting cables. During installation, mating surfaces of connectors shall be covered until connected and clean when plugged together. At joint where connectors come together, heat shrinkable tubing shall be installed with waterproof sealant with two half-lapped layers of tape over the entire joint. Joint shall prevent entrapment of air which might subsequently loosen the joint.

3.11.2 Splicing Fixtures to the Wires in Pavement Saw Kerfs

Splices shall have preinsulated watertight connector sleeves crimped with a tool that requires a complete crimp before tool can be removed. Splice shall be taped with plastic insulating tape.

3.12 GROUNDING SYSTEMS

3.12.1 Counterpoise Installation

Counterpoise wire shall be laid for entire length of circuits supplying airfield lighting. Wire shall be in one piece, except where distance exceeds the length usually supplied. Counterpoise shall be installed on top of the envelope of concrete-encased duct and approximately 6 inches above duct lines. Where trenches or duct lines intersect, counterpoise wires shall be electrically interconnected by exothermic welding or brazing. Counterpoise to earth ground shall be connected at every 1,000 feet of cable run, at lighting vault, and at feeder connection to light circuit by means of ground rods as specified. Counterpoise shall be installed in a separate duct under roads, railroads, and paved areas above the highest duct containing electrical or communications circuits.

3.12.2 Fixture Grounding

Each fixture or group of adjacent fixtures shall be grounded by a grounding circuit separate from the counterpoise system unless required otherwise or by driven ground rods if permitted. Fixtures, steel light bases or grounding bushings on steel conduits shall be connected to an independent ground rod by a No. 6 AWG bare stranded copper wire. Semiflush fixtures for direct mounting in pavement need not be grounded. Copper wire shall be connected to ground rods by exothermic weld or brazing.

3.13 ISOLATION TRANSFORMERS

Transformer lead connections shall conform to FAA AC 150/5345-26. Transformer secondary connectors shall plug directly into a mating connector on the transformer secondary leads. During installation, mating surfaces of connectors shall be covered until connected and clean when plugged together. At joint where connectors come together, heat shrinkable tubing shall be installed with waterproof sealant or with two half-lapped layers of tape over the entire joint. Joint shall prevent entrapment of air which might subsequently loosen the joint.

3.14 RUNWAY AND TAXIWAY LIGHTING SYSTEMS

3.14.1 Runway and Taxiway Edge Lights

Edge lights shall be elevated type lights except in paved areas where semiflush lights are required. Threshold and runway end lights shall be semiflush type as indicated on the contract drawings. Elevated lights shall be frangibly mounted and each light supplied power through an isolation transformer. The taxiway lights shall be omnidirectional and only require leveling. The runway lights require leveling and alignment of the beams for the correct toe-in of the beams.

3.14.2 New Semi-Flush Edge Light in Existing PCC Pavement

At locations where new semi-flush light is to be installed in existing PCC pavement, first core drill holes through the existing pavement, width as shown. Remove the PCC core and any additional base course as required. Run new conduits into the cored hole using horizontal directional drilling techniques. Connect the conduits to the light can, and set the light can. Pour concrete around the light can, to the depth below the surface of the PCC pavement shown. The cored hole shall be thoroughly cleaned with high pressure water jets supplemented with oil-free compressed air to remove all loose material and thoroughly dry the cavity. Prior to installing patch materials, areas showing traces of oils or greases shall be cleaned by sandblasting. Immediately before filling the remaining cored hole cavity, the primer shall be applied to the dry cleaned surface of the sides of the cored hole. The primer shall be applied in accordance with the manufacturer's recommendation. Allow the primer to dry before applying the quick setting patch material. Prepare (mix, heat, etc.) and place the patch material in accordance with the manufacturer's directions. The surface of the PCC pavement in the cored hole shall be dried with a hot air lance prior to application of the patch material. The perimeter of the repair area shall be masked with tape to ensure no excess material will remain on the surface of the pavement. Apply texturing or surface finish to achieve a non-slip surface. Follow all safety precautions recommended by the patch material manufacturer. The patch shall be cured in accordance with the patch material manufacturer's directions. The finished surfaces of partial depth repair shall meet the grade of the adjoining pavements and shall not deviate more than 1/8 inch within the patched area. Any repair material on the surrounding surfaces of the existing concrete shall be removed before it hardens.

3.15 FIELD QUALITY CONTROL

The Contracting Officer shall be notified five working days prior to each test. Deficiencies found shall be corrected and tests repeated.

3.15.1 Operating Test

Each completed circuit installation shall be tested for operation. Equipment shall be demonstrated to operate in accordance with the requirements of this Section. Oneday and onenight test shall be conducted for the Contracting Officer.

3.15.2 Distribution Conductors, 600-Volt Class

Test shall verify that no short circuits or accidental grounds exist using an instrument which applies a voltage of approximately 500 volts providing a direct reading in resistance.

3.15.3 Counterpoise System Test and Inspection

Continuity of counterpoise system shall be visually inspected at accessible locations. Continuity of counterpoise system to the vault grounding system shall be tested in manhole closest to the vault.

3.15.4 Progress Testing for Series Lighting Circuits

A megger test shall be conducted on each section of circuit or progressive combinations of sections as they are installed. Each section or progressive combination of sections shall be tested with a megohmmeter providing a voltage of approximately 1000 volts, a direct reading in resistance. Results shall be documented. Faults indicated by these tests shall be eliminated before proceeding with the circuit installation.

3.15.5 Electrical Acceptance Tests

Acceptance tests shall be performed for series and multiple airfield and heliport lighting circuits only on complete lighting circuits. Each series and multiple lighting circuit shall receive a high voltage insulation test.

3.15.5.1 Low-Voltage Continuity Tests

Each series circuit shall be tested for electrical continuity. Faults indicated by this test shall be eliminated before proceeding with the high-voltage insulation resistance test.

3.15.5.2 High-Voltage Insulation Resistance Tests

Each series lighting circuit shall be subjected to a high-voltage insulation resistance test by measurement of the insulation leakage current with a suitable high-voltage test instrument which has a steady, filtered direct current output voltage and limited current. High-voltage tester shall include an accurate voltmeter and microammeter for reading voltage applied to the circuit and resultant insulation leakage current. Voltages shall not exceed test values specified below.

- a. Test Procedure: Both leads shall be disconnected from regulator output terminals and support so that air gaps of several inches exist between bare conductors and ground. Cable sheaths shall be cleaned and dried for a distance of 1 foot from ends of cables and exposed insulation at ends of cables. Ends of both conductors of the circuit shall be connected together and to high-voltage terminals of test equipment, and test voltage applied as specified in the following tabulation between conductors and ground for a period of 5 minutes.

Series Lighting Circuits	Test Voltage, dc	
	First Test on New Circuits	Test on Existing Circuits
High Intensity Series Lighting Circuits (5,000 volt leads, 500 and 200 watt transformers)	9000	5000
Medium Intensity Series Lighting Circuits (5,000 volt leads, 30/45 watt transformers)	6000	3000
600-Volt Circuits	1800	600

When additions are made to existing circuits, only new sections shall be tested in accordance with "First Test on New Circuits" in table above. To ensure reliable operation, complete circuit shall be tested at reduced voltages indicated above.

- b. Leakage Current: Insulation leakage current shall be measured and recorded for each circuit after a 1 minute application of the test voltage. If leakage current exceeds values specified below, the circuit shall be sectionalized and retested and the defective parts shall be repaired or replaced. Leakage current limits include allowances for the normal number of connectors and splices for each circuit as follows:

- (1) Three microamperes for each 1000 feet of cable.
- (2) Two microamperes for each 200 watt and each 500 watt 5,000-volt series transformer.
- (3) Two microamperes for each 30/45-Watt 5,000 volt series transformer.

If measured value of insulation leakage current exceeds calculated value, the circuit shall be sectionalized and tested as specified for each section. Defective components shall be repaired or replaced until repeated tests indicate an acceptable value of leakage current for the entire circuit.

3.15.6 Constant Current Regulators

Each constant current regulator shall be examined to ensure that porcelain bushings are not cracked, no shipping damage has occurred, internal and external connections are correct, switches and relays operate freely and are not tied or blocked, fuses, if required, are correct, and liquid level of liquid-filled regulators is correct. Relay panel covers shall be removed only for this examination; it is not necessary to open the main tank of liquid-filled regulators. The instructions on the plates attached to the regulators shall be followed. Covers shall be replaced tightly after completing examinations and tests.

3.15.7 Regulator Electrical Tests

Supply voltage and input tap shall correspond. With the loads disconnected, regulator shall be energized and the open circuit protector observed to ensure that it de-energizes the regulator within 3 seconds. After testing circuits for open circuit and ground fault and corrections, if any, and after determining that lamps are serviceable and in place, the loads shall be connected for each circuit or combination of circuits to be energized by the regulator and the voltage and current measured simultaneously for each brightness tap. Voltmeter and ammeter shall have an accuracy of plus or minus 1 percent of meter full scale. Readings shall be recorded during the day and night in order to obtain the average supply voltage. Output current on each brightness tap shall be within plus or minus 2 percent full scale of the nameplate values after making necessary correction in the supply voltage. Late model regulators have automatic supply voltage correction in lieu of input taps, and output current does not change as supply voltage varies. When output current on highest intensity setting deviates from nameplate value by more than 2 percent of meter full scale and the regulator is not overloaded, internal adjustment shall be checked as described on regulator instruction plate. Since adjustment may be rather delicate, a deviation of up to plus or minus 5 percent of meter full scale is allowed for lower intensity settings before attempting to readjust the regulator.

3.15.8 Final Operating Tests

After completion of installations and the above tests, circuits, control equipment, and lights covered by the contract shall be demonstrated to be in acceptable operating condition. Each switch in the control tower lighting panels shall be operated so that each switch position is engaged at least twice. During this process, lights and associated equipment shall be observed to determine that each switch properly controls the corresponding circuit. Telephone or radio communication shall be provided between the operator and the observer. Tests shall be repeated from the alternate control station, from the remote control points, and again from the local control switches on the regulators. Each lighting circuit shall be tested by operating the lamps at maximum brightness for not less than 30 minutes. At the beginning and at the end of this test the correct number of lights shall be observed to be burning at full brightness. One day and one night operating test shall be conducted for the Contracting Officer.

-- End of Section --