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SECTION 02050

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SECTION 02050

DEMOLITION

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.

ENGINEERING MANUALS (EM)

EM 385-1-1 (1996) U.S. Army Corps of Engineers Safety and Health Requirements Manual

1.2 GENERAL REQUIREMENTS

The work includes demolition or removal of all construction indicated, specified or which interferes with the construction. All materials resulting from demolition work, except as indicated or specified otherwise, shall become the property of the Contractor and shall be removed from the limits of Government property except as specified below. 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.

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01300 SUBMITTAL PROCEDURES:

SD-08 Statements

Work Plan; GA.

The procedures proposed for the accomplishment of the work. The procedures shall provide for safe conduct of the work, including procedures and methods to provide necessary supports, lateral bracing and shoring when required, careful removal and disposition of materials specified to be salvaged, protection of property which is to remain undisturbed, coordination with other work in progress, and timely disconnection of utility services. The procedures shall include a detailed description of the methods and equipment to be used for each operation, and the sequence of operations in accordance with EM 385-1-1.

1.4 PROTECTION

1.4.1 Protection of Existing Property

Before beginning any demolition work, the Contractor shall carefully survey the existing work 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; and any damage to such work shall be repaired or replaced as approved by the Contracting Officer at no additional cost to the Government. The Contractor shall carefully 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.

1.4.2 Protection of Trees

Trees within the project site which might be damaged during demolition and which are indicated to be left in place shall be protected by a 6 foot high fence. The fence shall be securely erected a minimum of 5 feet from the trunk of individual trees or follow the outer perimeter of branches or clumps of trees. Any tree designated to remain that is damaged during the work under this contract shall be replaced in kind or as approved by the Contracting Officer.

1.4.3 Environmental Protection

All work and Contractor operations shall comply with the requirements of SECTION: ENVIRONMENTAL PROTECTION

1.5 BURNING

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

1.6 USE OF EXPLOSIVES

Use of explosives will not be permitted.

2 PRODUCTS (NOT APPLICABLE)

3 EXECUTION

3.1 EXISTING STRUCTURES

Existing structures indicated shall be removed. Materials including, but not limited to asphalt, stone, grouted stone, reinforced concrete, slabs, cutoff walls, poles, side drains, miscellaneous concrete structures, flap gates, fencing, and steel sheetpiles shall be removed, where indicated.

3.1.1 Utilities

Disconnections, relocation, removal and coordination of utility services shall conform to the requirements of SECTION: GENERAL REQUIREMENTS.

3.1.2 Plugging Abandoned Drains and Pipes

Abandoned drains and pipes shall be plugged with standard clay sewer disks caulked with oakum and mortared in place, or plugged with brickwork in accordance with applicable requirements of SECTION: CAST-IN-PLACE STRUCTURAL CONCRETE.

3.2 DISPOSITION OF MATERIAL

Title to material and equipment to be demolished, except Government salvage and historical items, is vested in the Contractor upon receipt of notice to proceed. The Government will not be responsible for the condition, loss or damage to such property after notice to proceed.

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SECTION 02060

BICYCLE TRAIL DETOUR

1 GENERAL

1.1 REFERENCES (NOT APPLICABLE)

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.

STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION (CALTRANS)

Standard Plans

July 1997

1.2 GENERAL

The Contractor shall provide a safe bicycle trail through and/or around the project area using the existing trail system and detour paths shown on the plans.

1.3 TRAIL CLOSURES

1.3.1 Closures

Signage with the date and time of closure shall be posted along the trail in both directions and at all trail connections (4) weeks prior to the actual closing of the trail. Signage shall contain the period of closure and detour route.

1.3.2 Bicycle Bridge

The Contractor shall provide barricades at the bicycle bridge entrances which prevent public access onto the bridge while construction activities are being performed in the vicinity.

1.4 TRAFFIC CONTROL FACILITIES

The Contractor shall furnish, install, and maintain all temporary barricades, lights, warning signs, flagmen, temporary striping, temporary and/or permanent fencing, temporary and/or permanent paving, signal actuators and other facilities as required by applicable State, city, and county traffic regulations and as indicated to control and protect the traffic within the project limits and the limits of the detour area. All temporary/permanent signs, striping and barricading shall conform to State of California, Department of Transportation, *Standard Plans*, July 1997. Existing signs and mile posts shall be removed and reused to the extent possible.

1.5 MAINTENANCE

The maintenance of temporary pavement, temporary fencing and culverts shall be performed by the Contractor at no additional cost to the Government. The

Contractor shall maintain all traffic control facilities and replace broken signs and barricades as necessary without additional compensation. Emergency closure barricades and signs shall be posted during flooding of the detour. In conformance with the County of Orange's Public Property Encroachment Permit, the Contractor shall sweep and keep free of sand the bicycle trail detours.

1.6 DETOUR

1.6.1 General

Detours shall be constructed and ready to receive bicycle traffic prior to the closure of any portion of the existing trail system. The Contractor shall apply for, obtain and fully pay all fees for all necessary permits from all cities, County and other regulatory agencies for the required detours. The bicycle trail detour is within the City of Anaheim. The bicycle trail detour plans, including the detour around the staging area, have been approved by the City of Anaheim. The Contractor, however, still needs to apply for and obtain a final permit from the aforementioned cities. Construction of the detours shall conform to the details and notes on the drawings and to the following requirements:

1.6.1.1 The bicycle trail detour shall consist of a 12-foot wide min. asphalt paved surface with temporary protective fencing. The asphalt pavement shall be true to line and grade without abrupt changes of over 1/2-inch in ten (10) feet.

1.6.1.2 Earthwork, paving, and concrete pads shall conform to the applicable requirements of SECTION: EXCAVATION, FILLS AND SUBGRADE PREPARATION and SECTION: BITUMINOUS PAVING FOR ROADS, STREETS AND OPEN STORAGE AREAS.

1.6.1.3 Striping shall conform to SECTION: PAVEMENT MARKINGS.

1.7 REMOVALS

Except as otherwise specified, after completion of construction, the Contractor shall completely remove detour and traffic control facilities, including those existing features mentioned above, and restore the areas. Restored areas shall be graded to drain properly in conformance with the new construction. Contractor-furnished temporary traffic control facilities shall remain the property of the Contractor and shall be removed from the site.

2 PRODUCTS (NOT APPLICABLE)

3 EXECUTION (NOT APPLICABLE)

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SECTION 02070

EQUESTRIAN TRAIL REQUIREMENTS

1 GENERAL

1.1 REFERENCES (NOT APPLICABLE)

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.

STATE OF CALIFORNIA, DEPARTMENT OF TRANSPORTATION (CALTRANS)

Standard Plans

July 1997

1.2 GENERAL

The Contractor shall provide a safe equestrian trail through and around the project area using the existing equestrian trail system. Closures and detours of more than 5 days shall require the approval of the Contracting Officer. In areas where construction activities restrict access to the existing trail, the Contractor shall provide openings in the existing wooden fence to allow equestrians a means around the impacted area. Upon completion, the Contractor shall restore the fence to its original condition.

1.3 FENCING

The equestrian trail shall be temporarily fenced off from construction traffic, except in areas where a natural and/or existing barrier is present, to separate trail users from construction traffic and activities.

1.4 BICYCLE TRAIL DETOUR

The equestrian trail detours shall not conflict with the bicycle trail detours that are also required for the project.

1.5 PERMITS

The Contractor shall apply for, obtain, and fully pay all fees for all necessary permits from all cities, county, and other regulatory agencies for the equestrian trail detour.

1.6 TRAFFIC CONTROL FACILITIES

The Contractor shall furnish, install, and maintain all temporary barricades, lights, warning signs, flagmen, temporary striping, and other facilities as required by applicable State, city, and county traffic regulations and as indicated to control and protect the traffic within the limits of the detour area. All temporary signs, striping and barricading shall conform to State of California, Department of Transportation, **Standard Plans**, July 1997. Existing signs and mile posts shall be removed and reused to the extent possible.

1.7 EMERGENCY CLOSURES

In the event of flooding, the Contractor shall control and protect the detoured traffic from any crossings located in the channel invert. Emergency closure barricades and signs shall be posted during flooding. The Contractor shall restore facilities within 5 days after recession of flows.

1.8 MAINTENANCE

The maintenance of the equestrian trail, temporary fencing and culverts (including cleaning, debris removal, weed removal, repairs, etc.) shall be performed by the Contractor at no additional cost to the Government.

1.9 DETOUR

Construction of the detours shall conform to the details and notes on the plans and to the following requirements:

1.9.1 Trail Width

The equestrian trail detour shall consist of a 10-foot wide minimum earthen (non-paved) surface with temporary protective fencing.

1.9.1.1 Earthwork

Earthwork shall conform to the applicable requirements of **SECTION: EXCAVATION, FILLS AND SUBGRADE PREPARATION.**

1.10 REMOVALS

Except as otherwise specified, after completion of construction, the Contractor shall completely remove the equestrian trail detour and traffic control facilities and restore the areas. Restored areas shall be graded to drain properly in conformance with the new construction. Contractor-furnished temporary traffic control facilities shall remain the property of the Contractor and shall be removed from the site.

2 PRODUCTS (NOT APPLICABLE)

3 EXECUTION (NOT APPLICABLE)

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SECTION 02100

DIVERSION AND CONTROL OF WATER

1 GENERAL

1.1 GENERAL

All permanent construction except demolition, excavation and toe backfill shall be carried on in areas free from water. Water in varying quantities may be flowing in the channel during the entire period of construction. Runoff from the watersheds is rapid and, during periods of rain, intermittent freshets may be expected. The responsibility for damage to any part of the permanent work shall be as set forth in the CONTRACT CLAUSE: PERMITS AND RESPONSIBILITIES. Damage to all work (including temporary construction), utilities, materials, equipment, and plant shall be repaired to the satisfaction of the Contracting Officer at the Contractor's expense, regardless of the cause of such damage.

1.2 DIVERSION REQUIREMENTS

The Contractor is responsible for the diversion and control of all runoff entering the construction area. The runoff will include water originating from upstream, urban runoff, adjacent drainages; and in addition any and all seepage and groundwater originating within the work. The work site may be inundated because of runoff. The Contractor shall be responsible for protection of work site during times of runoff by his own means. The Contractor shall coordinate diversion plans with the downstream Contractor, the bridge contractors, and the Orange County Water District. The Contractor's dewatering operations shall not impact operations of the concurrent construction contracts.

1.3 DEWATERING

At all locations where construction work is at a lower elevation than the elevation of the stream or groundwater at the time of doing the work, drainage pipes, well points, pumps, sheet pile, ditches, cofferdams or dikes, if necessary, shall be constructed. The construction area shall be dewatered prior to commencement of the work, and all subgrades, whether for earthfill, or concrete, shall be kept drained and free of water throughout the working period. Special precautions shall be taken to avoid impairing the permanent subgrade, and any excavation below invert subgrade shall be refilled with compacted fill in accordance with SECTION: FILLS AND SUBGRADE PREPARATION at no additional cost to the Government.

1.4 RESTRICTIONS

1.4.1 Existing Channel Capacity

The existing channel and new channel improvements on the Santa Ana River shall remain functional and the pre-construction channel discharge capacity shall not be reduced during the period 1 November to 15 April. Channel construction shall be in accordance with paragraph: Special Considerations of SECTION: GENERAL REQUIREMENTS.

2 PRODUCTS (NOT APPLICABLE)

3 EXECUTION (NOT APPLICABLE)

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SECTION 02110

CLEARING AND GRUBBING

1 GENERAL

1.1 DEFINITIONS

1.1.1 Clearing

Clearing shall consist of satisfactory disposal of the vegetation designated for removal, including down timber, snags, brush, and rubbish occurring in the areas to be cleared.

1.1.2 Grubbing

Grubbing shall consist of the removal and disposal of stumps, roots larger than 3 inches in diameter, and matted roots from the designated grubbing areas.

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01300 SUBMITTAL PROCEDURES:

SD-18 Records

Disposal Permit; GA.

Permission to dispose of such products on private property shall be in writing, and a copy of this permit shall be filed with the Contracting Officer.

2 PRODUCTS (NOT APPLICABLE)

3 EXECUTION

3.1 CLEARING

Trees smaller than 1-1/2 inches in diameter, stumps, roots, brush, and other vegetation in areas to be cleared shall be cut off 6 inches below the indicated channel subgrade or at the original ground surface, whichever is lower, except as specified. Other vegetation shall be cut of flush or slightly below the original ground surface. Clearing operations shall be conducted so as to prevent damage to trees, structures, installations under construction or to remain in place.

3.2 GRUBBING

Material to be grubbed, together with logs and other organic or metallic debris not suitable for foundation purposes, shall be removed to a depth of not less than 18 inches below the original surface level of the ground in

areas indicated to be grubbed and in areas indicated as construction areas under this contract, such as areas for structures, fills and areas to be paved. Depressions made by grubbing shall be filled with suitable material and compacted to make the surface conform with the original adjacent surface of the ground.

3.3 DISPOSAL OF MATERIALS

Roots, brush, rotten wood, and other refuse from the clearing and grubbing operations, shall become the property of the Contractor and shall be removed from the site. Clearing and grubbing materials shall not be disposed of by burning.

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SECTION 02200

EXCAVATION

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 SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 2487

(1992) Classification of Soils for Engineering Purposes (Unified Soil Classification System)

1.2 GENERAL

Excavation shall consist of the removal of every type of material encountered (except materials covered by the provisions of the **SECTIONS: CLEARING AND GRUBBING and DEMOLITION**) in the designated areas or from areas directed. The material to be removed may include but is not limited to earth, hardpan, silt, clay, gravel, cemented sand and gravel, cobble and boulders, adobe, detached pieces of stone and concrete, riprap rock fills, existing fills of miscellaneous debris and rubbish, and other unsuitable materials. Slope lines indicated on the drawings for temporary cuts do not necessarily represent the actual slope to which the excavation must be made to safely perform the work. Excavation for permanent cuts shall be made to the slope lines indicated. Excavation shall be performed in a manner which will not impair the subgrade. Except as otherwise specified, the finish surface of subgrades shall be smooth and shall not vary more than 1/2 inch from indicated grade.

1.3 BLASTING

Blasting will not be permitted.

1.4 PRESERVATION OF PROPERTY

All excavation operations shall be conducted in such a manner that street pavements, bridges, utilities, or other facilities and improvements which are to remain in place permanently will not be subjected to settlement or horizontal movement. The Contractor shall furnish and install sheet piling, cribbing, bulkheads, shores, or whatever means may be necessary to adequately support material carrying such improvements or to support the improvements themselves and shall maintain such means in position until they are no longer needed. Temporary sheet piling, cribbing, bulkheads, shores or other protective means shall remain the property of the Contractor and when no longer needed shall be removed from the site. The Contractor shall submit for approval shop drawings showing proposed method of bracing which he intends to use. All shoring and bracing shall be designed so that it is effective to the bottom of the excavation, and shall be based upon calculation of pressures exerted by, and the condition and nature of the

materials to be retained, including surcharge imparted to the side of the trench by equipment and stored materials. Removal of shoring shall be performed in such manner as not to disturb or damage the finished concrete or other facility.

2 PRODUCTS (NOT APPLICABLE)

3 EXECUTION

3.1 EXCAVATION FOR STRUCTURES

Excavation within the vicinity of existing structures, utilities, and drainage pipes to remain in place shall be performed in a manner to prevent damage to the structure. Earth banks and facilities to remain in place shall be supported as necessary during excavation. In general, unless otherwise shown or specified, the actual side slopes will be at the Contractor's option.

3.2 EXCAVATION FOR SIDE DRAINS

All excavations shall be made by open cut unless otherwise specified. The banks of trenches shall be kept as nearly vertical as practicable. Unless otherwise indicated, trenches shall be not less than 12 inches wider nor more than 16 inches wider than the outside diameter of the pipe to be laid therein, and shall be excavated true to line, so that a clear space not less than 6 inches nor more than 8 inches in width is provided on each side of the pipe. The maximum width of trench specified applies to the width at or below the level of the top of the pipe. The width of the trench above the level may be made as wide as necessary for sheathing and bracing; and the proper installation of the work. The bottom of trenches shall be accurately graded to provide uniform bearing and support for each section of the pipe at every point along its entire length, except for portions of the pipe sections where it is necessary to excavate for the proper sealing of pipe joints. Except as otherwise indicated, the bottom of all trenches excavated shall be shaped and rounded to conform to the lowest one-fourth of the outside portion of circular pipe or to the lower curved portion of pipe arch for the entire length of the pipe or arch. If soft, spongy, unsuitable material, or material which by reason of its nature cannot be properly shaped or finished to a true pipe subgrade is encountered, it shall be removed and replaced with compacted fill.

3.3 REMOVAL OF UNSATISFACTORY SOILS

The removal of soils which are unsatisfactory for foundations of the channel, structures, levees, and drains, may be required in certain areas. Unsatisfactory materials include but are not limited to those materials containing roots and other organic matter, trash, debris and materials classified in [ASTM D 2487](#), as MH, CH, Pt, OH, and OL. The Contractor will be required to excavate any such areas to the depth directed and backfill the areas with compacted fill conforming to the requirements of the [SECTION: FILLS AND SUBGRADE PREPARATION](#).

3.4 DISPOSAL OF EXCAVATED MATERIALS

Excavated materials suitable for required fills shall be placed in temporary stock piles or used directly in the work. Excess excavated material not utilized as part of the construction can be transported to the designated

disposal area and fill in accordance with the requirements of the SECTION: **FILLS AND SUBGRADE PREPARATION**. Contractor shall coordinate disposal operations with disposal site owner and shall conform to the owner's requirements. Unsatisfactory material shall become the property of the Contractor and shall be removed from the site. Contractor shall furnish notice of his intentions in connection with the use of indicated disposal area in accordance with the requirements of the paragraph: **PUBLIC UTILITIES, NOTICES, and RESTRICTIONS** of the **GENERAL REQUIREMENTS**. Additional requirements for disposal of excess material can be found in the **SPECIAL CLAUSES** and **SECTIONS: GENERAL REQUIREMENTS, ENVIRONMENTAL PROTECTION, and CLEARING AND GRUBBING**.

3.4.1 Hauled Excavation Material

The Contractor will be responsible for obtaining all permits and licenses necessary to haul material, off-site. The Contractor will provide to the Contracting Officer three copies of the proposed street haul route plan for transport of all excess excavated material. The Contractor will coordinate the street haul route plan with all affected cities.

3.4.2 Upstream River Access

The Contractor will be restricted from utilizing the Lower Santa Ana River Channel upstream of the project limits to transport excess excavated material as off-site street haul route.

3.4.3 Downstream River Access

Access within the portions of the Lower Santa Ana River Channel downstream of the contract limits, currently under construction shall be coordinated jointly with the Contracting Officer, the Orange County Water District and Paul Hubbs Construction Co., Inc.

3.5 OVERCUT

Except as otherwise specified or as may be ordered in writing, any overcut or excavation made outside the lines indicated on the drawings or directed shall be backfilled with compacted fill conforming to the SECTION: **FILLS AND SUBGRADE PREPARATION**, or concrete conforming to the SECTION: **CAST-IN-PLACE STRUCTURAL CONCRETE**. All excavating, backfilling, compacting of backfill, and concreting occasioned thereby shall be by the Contractor at no additional cost to the Government. Any overcut under bridge footings shall be backfilled with concrete.

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SECTION 02215

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SECTION 02215

GEOTEXTILES USED AS FILTERS

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 SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 123	(1993a) Standard Terminology Relating to Textiles
ASTM D 1683	(1990a) Failure in Sewn Seams of Woven Fabrics
ASTM D 3884	(1992) Abrasion Resistance of Textile Fabrics (Rotary Platform, Double-Head Method)
ASTM D 4632	(1991) Grab Breaking Load and Elongation of Geotextiles
ASTM D 4751	(1987) Determining Apparent Opening Size of a Geotextile
ASTM D 4833	(1988) Index Punctured Resistance of Geotextiles, Geomembrane, and Related Products

1.2 SUBMITTALS

Government approval is required for all submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01300 SUBMITTAL PROCEDURES:

SD-13 Certificates

Geotextile; FIO.

All brands of geotextile and all seams to be used shall be accepted on the basis of mill certificates or affidavits. The Contractor shall furnish the Contracting Officer, in duplicate, a mill certificate or affidavit signed by a legally authorized official from the company manufacturing the geotextile. The mill certificate or affidavit shall attest that the geotextile meets the chemical, physical and manufacturing requirements stated in this specification.

2 PRODUCTS

2.1 MATERIALS

2.1.1 Geotextile

2.1.1.1 General

The geotextile shall be a non-woven needle punch pervious sheet of plastic yarn as defined by ASTM D 123. The geotextile shall equal or exceed the physical requirements listed in TABLE 1, MINIMUM PHYSICAL REQUIREMENTS FOR DRAINAGE GEOTEXTILE. The geotextile fiber shall consist of a long-chain synthetic polymer composed of at least 85 percent by weight of propylene, ethylene, ester, amide, or vinylidene-chloride, and shall contain stabilizers and/or inhibitors added to the base plastic if necessary to make the filaments resistant to deterioration due to ultra-violet and heat exposure. The edges of the geotextile shall be finished to prevent the outer fiber from pulling away from the geotextile.

Table 1. MINIMUM PHYSICAL REQUIREMENTS FOR DRAINAGE GEOTEXTILE

Physical Property Values++	Test Procedure	Acceptable
Tensile Strength (unaged geotextile)	ASTM D 4632 Grab Test Method using 1 inch square jaws and a 12 inches per minute constant rate of traverse.	200 pound min.in any principal direction.
Puncture Strength (unaged geotextile)	ASTM D 4833 Test Method for Index Puncture Resistance.	50 pound minimum
Abrasion Resistance Residual	ASTM D 3884 Rubber-base abrasive wheels equal to CS-17 "Calibrase" by Taber Instrument Co; 1 kilogram load per wheel; 1000 revolutions, determine residual breaking load.	55 pound minimum Breaking Load in any principal direction.
Equivalent Opening Size (EOS)	ASTM D 4751 Determining Apparent Opening Size of a Geotextile	No finer than the U.S. Std. Sieve No. 120 and no coarser than the U.S. Std. Sieve No.50

+ Unaged geotextile is defined as geotextile in the condition received from the manufacturer or distributor.

++ All numerical values represent minimum average roll values (i.e., any roll in a lot should meet or exceed the minimum in the table).

2.1.2 Seams

The seams of the geotextile shall be sewn with thread of a material meeting the chemical requirements given above for geotextile yarn or shall be bonded by cementing or by heat. The sheets of geotextile shall be attached at the factory or another approved location, if necessary, to form sections not less than 12 feet wide. Seams shall be tested in accordance with method

ASTM D 1683, using 1-inch square jaws and 12 inches per minute constant rate of traverse. The strength of the seam shall be not less than 90 percent of the required grab tensile strength (Table 1) of the unaged geotextile in any principal direction.

2.1.3 Acceptance Requirements

All brands of geotextile and all seams to be used shall be accepted on the following basis. The Contractor shall furnish the Contracting Officer, in duplicate, a mill certificate or affidavit signed by a legally authorized official from the company manufacturing the geotextile. The mill certificate or affidavit shall attest that the geotextile meets the chemical, physical and manufacturing requirements stated in this specification. If requested by the Contracting Officer, the Contractor shall provide to the Government geotextile samples for testing to determine compliance with any or all of the requirements in this specification. When samples are to be provided, they shall be submitted a minimum of 60 days prior to the beginning of installation of the same geotextile. All samples provided shall be from the same production lot as will be supplied for the contract, and shall be the full manufactured width of the geotextile by at least 10 feet long, except that samples for seam strength may be a full width sample folded over and the edges stitched for a length of at least 5 feet. Samples submitted for testing shall be identified by manufacturers lot designation.

2.2 SHIPMENT AND STORAGE

During all periods of shipment and storage, the geotextile shall be protected from direct sunlight, ultra-violet rays, temperatures greater than 140 degrees fahrenheit, mud, dirt, dust and debris. To the extent possible, the fabric shall be maintained wrapped in a heavy duty protective covering.

3 EXECUTION

3.1 INSTALLATION OF THE GEOTEXTILE

The geotextile shall be placed in the manner and at the locations indicated. At the time of installation, the geotextile shall be rejected if it has defects, rips, holes, flaws, deterioration or damage incurred during manufacture, transportation or storage. The surface to receive the geotextile shall be prepared to a relatively smooth condition free of obstructions, depressions, debris and soft or low density pockets of material. Erosion features such as rills, gullies, etc., must be graded out of the surface before geotextile placement. The geotextile shall be placed with the long dimension perpendicular to the centerline of the channel and laid smooth and free of tension, stress, folds, wrinkles, or creases. The strips shall be placed to provide a minimum width of 18 inches of overlap for each joint. Temporary pinning of the textile to help hold it in place shall be allowed. The temporary pins shall be removed during placement of material on the geotextile to relieve high tensile stress. The placement procedure requires that the length of the geotextile be approximately 15 percent greater than the slope length. The Contractor shall adjust the actual length of the geotextile used based on initial installation experience. The geotextile shall be protected at all times during construction from contamination by surface runoff and any geotextile so contaminated shall be removed and replaced with uncontaminated geotextile. Any damage to the geotextile during its installation or during placement of

riprap shall be replaced by the Contractor at no cost to the Government. The work shall be scheduled so that the covering of the geotextile with a layer of the specified material is accomplished within 7 calendar days after placement of the geotextile. Failure to comply shall require replacement of geotextile. The geotextile shall be protected from damage prior to and during the placement of riprap or other materials by limiting the height of drop to less than 1 foot. The Contractor will be allowed to place a cushioning layer of sand or gravel on top of the geotextile before placing the specified material. Before placement of riprap or other materials, the Contractor shall demonstrate that the placement technique will prevent damage to the geotextile. In no case shall any type of equipment be allowed on the unprotected geotextile.

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SECTION 02250

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SECTION 02250

FILLS AND SUBGRADE PREPARATION

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 SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 422	(1963; R 1990) Particle-Size Analysis of Soils
ASTM D 1556	(1990) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 1557	(1991) Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/cu.ft. (2,700 kN-m/cu.m.))
ASTM D 2216	(1992) Laboratory Determination of Water (Moisture) Content of Soil, and Rock
ASTM D 2487	(1992) Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 2922	(1991) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)

1.2 COMPACTION EQUIPMENTS

Compaction shall be accomplished by tamping roller, sheeps foot roller vibratory compactor or mechanical tampers. All equipment, tools, and machines shall be maintained in satisfactory working condition at all times. Compaction equipment shall be suitable for consistently producing uniform soil densities.

1.3 GENERAL REQUIREMENTS FOR COMPACTED FILLS AND COMPACTED BACKFILLS

1.3.1 Control

Moisture-density relations shall be established by the Contractor. The soil used for each maximum density test shall be classified in accordance with ASTM D 2487 and shall include a particle size analysis in accordance with ASTM D 422. At least one five point maximum density test shall be made for every 10 field density tests. Field density tests shall be performed by the Contractor at the frequency established in paragraph: Field Control, and in such locations to insure that the specified density is being obtained. Moisture-density relations and field densities shall be reported on approved forms. One copy of density data less dry weight determinations shall be

provided on the day each test is taken. The completed test reports shall be provided with the Contractor Quality Control Report on the work day following the test.

1.3.1.1 Laboratory Control

Moisture-density relations shall be established by the Contractor. One moisture-density relation shall be made for each classification, blend or change in classification of soil materials encountered. Approval of moisture-density relations shall be obtained prior to the compacting of any material in the work. The moisture-density relations shall be determined in a laboratory in accordance with [ASTM D 1557](#), modified as specified hereafter.

b) A separate batch of materials will be used for each compaction test specimen. No materials will be re-used.

c) The desired amount of mixing water will be added for each compaction test specimen, mixed well, and the mixture will be placed in a container with an airtight cover and allowed to cure for 24 hours. A shorter curing time may be allowed where tests show that shortening the curing time will not affect the results.

1.3.1.2 Field Control

Field in-place density shall be determined in accordance with [ASTM D 1556](#). The field moisture content shall be determined in accordance with [ASTM D 2216](#). Determination of in-place densities using the nuclear method ([ASTM D 2922](#)) may be used to supplement the sand cone density tests ([ASTM D 1556](#)). 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](#). At least one adjacent sand cone test shall be performed for every five nuclear density tests performed. If field density tests determined by the nuclear method vary by more than 3 pounds per cubic foot from comparison sand-cone tests, and are consistently high or low, adjustment of the calibration curve is necessary.

1.3.1.2.1 In-Place Densities

The frequency of in-place field density tests shall be as follows:

One test per 1,000 cubic yards, for the first 10,000 cubic yards of material and one test for each 4,000 yards thereafter, or fraction thereof, of each lift of fill or backfill areas compacted by other than hand-operated machines. At least one test shall be made in each 2-foot layer of compacted fill or backfill processed as a unit and not less than one test shall be made in each area.

One test per 500 cubic yards, or fraction thereof, of each lift of fill or backfill areas compacted by hand-operated machines.

1.3.1.3 Moisture-Density Curves for Cohesionless and Cohesive Material

Cohesionless materials include gravels, gravel-sand mixtures, sands, and gravelly sands. Cohesive materials include clayey and silty gravels, gravel-silt mixtures, clayey and silty sands, sand-clay mixtures, clays, silts, and very fine sands. When results of compaction tests for moisture-

density relations are recorded on graphs, cohesionless soils will show straight lines or reverse-shaped moisture-density curves, and cohesive soils will show normal moisture-density curves.

1.3.1.4 One Point Maximum Density Test

A one-point maximum density test shall be performed at every field density test. This point will be used by the Contractor to determine: the type of soil, the maximum density of the soil, and if the specified density in the soil is being obtained. The one-point maximum density test shall follow the procedure detailed in following paragraph:

One-Point Compaction Method. The material from the field density tests is allowed to dry to a water content on the dry side of estimated optimum, and then compacted using the same equipment and procedure used in the five-point compaction test. Thorough mixing is required to obtain uniform drying; otherwise, results obtained may be erroneous. The water content and dry density of the compacted sample are determined and then used to estimate its optimum water content and maximum dry density as illustrated in Figure 1 at the end of this section. In Figure 1, the line of optimums is well defined and the compaction curves are approximately parallel to each other consequently, the one point compaction method could be used with a relatively high degree of confidence. However, in Figure 2 at the end of this section, the optimums do not define a line, but a broad band. Also, the compaction curves are not parallel to each other and in several instances will cross if extended on the dry side. Consequently, the correct curve cannot be determined from the one-point method, therefore, the two-point compaction method should be used as defined below. The one-point method should be used only when the data define a relatively good line of optimums.

Two-Point Compaction Method. In the two-point test, one sample of material from the location of the field density test is compacted at the fill water content if thought to be at or on the dry side of optimum water content (otherwise, reduced by drying to this condition) using the same equipment and procedures used in the five-point compaction test. A second sample of material is allowed to dry back about 2 to 3 percentage points dry of the water content of the first sample and then compacted in the same manner. At least one point shall fall within 3 percent of the line of optimums. After compaction, the water contents and dry densities of the two samples are determined. The results are used to identify the appropriate compaction curve for the material being tested as shown in Figure 2 at the end of this section. The data shown in Figure 2 warrant the use of the two-point compaction test because the five-point test method, would result in appreciable error as the shape of the curve would not be defined. The estimated compaction curve can be more accurately defined by two compaction points.

1.3.2 Settling of Fills or Backfills with Water

Settling of fills or backfills with water will not be permitted, except as specified hereinafter.

1.3.3 Fill Material

Fill material shall be obtained from the required excavations. Materials considered unsatisfactory for use as compacted fill include but are not limited to those materials containing roots and other organic matter, trash, debris, and stones larger than 3/4 of the compacted layer thickness, and materials classified in ASTM D 2487 as MH, CH, PT, OH, and OL.

1.3.4 Placement

Fill material shall not be placed against concrete which has not been in place at least 14 days or until the concrete has attained a strength of 2,500 p.s.i. when tested in accordance with the SECTION: CAST-IN-PLACE STRUCTURAL CONCRETE. Heavy equipment shall not be operated over pipes and buried structures until at least 2 feet of fill material has been placed and compacted over them in conformance with the requirements of the SECTION: SIDE DRAINS AND STREET DRAINS. Compacted fill and backfill shall be placed with suitable equipment in horizontal layers which after compaction, shall not exceed 12 inches in depth for rubber-tired or vibratory rollers, 6 inches in depth for tamping rollers, and 4 inches in depth when mechanical tampers are used. The Contractor may vary the layer thickness within these limits for most efficient operations. Material containing stones shall be placed in a manner to prevent the stones from striking the concrete structures and to prevent the formation of voids.

1.3.5 Moisture Content

Material shall have a uniform moisture content while being placed and compacted. Water shall be added at the source, if required, or by sprinkling each layer of material during placement. Uniform distribution of moisture shall be obtained by disking, harrowing, or otherwise manipulating the soil during and after time water is added. Material containing an excess of moisture shall be manipulated with suitable implements to facilitate maximum aeration and shall be permitted to dry to the proper consistency before being compacted. Fill shall have a maximum moisture content of not more than 3 percent above optimum and a minimum moisture content of not less than 3 percent below optimum.

1.3.6 Compaction

No layer of fill shall be compacted before the practicable uniform moisture content has been obtained. Scarified areas shall be compacted as specified for the fill placed thereon. Rollers will not be permitted to operate within one foot of channel or structure walls or over buried structures until the compacted fill over the top of the structures has reached a depth of 2 feet. Compaction equipment shall be so operated that structures are not damaged nor overstressed during compaction operations. Mechanical tampers shall be used for compaction of fill material adjacent to structures where rolling equipment is impracticable for use in compaction.

2 PRODUCTS (NOT APPLICABLE)

3 EXECUTION

3.1 COMPACTED FILL

3.1.1 Levee

3.1.1.1 Preparation for Placing

Before placing material for compacted fill, the foundation surface shall be cleared of all existing obstructions, including existing slope protection, vegetation, and debris. Unsuitable material not meeting the requirements for fill material shall be removed where directed. The existing surfaces shall be proofrolled by 4 passes of the compaction equipment, and scarified to a depth of 6 inches before placing the fill. Sloped ground surfaces steeper than one vertical to four horizontal, on which fill or compacted backfill is to be placed, shall be stepped in such a manner that the compaction equipment will bear on the full depth of the fill layer.

3.1.1.2 Compaction

Each layer of the materials shall be compacted to not less than 90 percent of maximum density, per [ASTM D 1557](#).

3.1.2 Behind Concrete Walls

3.1.2.1 Limitations on Equipment

The gross weight of any piece of equipment, or the combined weight of any combinations of equipment coupled together, used to place, moisten and/or compact fill behind and within 4 feet of concrete walls shall not exceed 35,000 pounds, including dynamic forces produced by vibratory equipment. Equipment used to compact the fill behind the concrete walls shall be of such size as to be capable of operating in the area between the cut slope and the concrete wall.

3.1.2.2 Compaction

Each layer of fill behind concrete walls shall be compacted to not less than 90 percent of maximum density, per [ASTM D 1557](#).

3.1.2.3 Trimming

The top of fill adjacent to concrete walls shall be trimmed to the lines indicated on the drawings with a tolerance of plus or minus one inch. Any material loosened by trimming shall be recompact and the berm area moistened and compacted with one pass of a smooth-wheeled roller. Tolerances shall apply after rolling.

3.2 BACKFILL

3.2.1 Backfill, Toe

Material. Backfill shall consist of material from the required excavation, place in the area indicated and shall be placed with suitable equipment in layers which shall not exceed 24 inches in depth before consolidation. No

depressions in which water might pond shall be left in miscellaneous fill areas. The finished areas shall be sloped to drain. Compaction other than that obtained by the controlled movement of the construction equipment will not be required.

3.2.2 Backfill, Channel

Material. Backfill shall consist of material from the required excavation, place in the area indicated and shall be placed with suitable equipment in layers which shall not exceed 24 inches in depth before consolidation. No depressions in which water might pond shall be left in miscellaneous fill areas. The finished areas shall be sloped to drain. Compaction other than that obtained by the controlled movement of the construction equipment will not be required.

3.3 COMPACTED FILL, SIDE DRAINS

Bedding and backfill for side drains shall conform to the requirements of the SECTION: SIDE DRAINS AND STREET DRAINS.

3.4 BACKFILLS

3.4.1 Backfill About Structures

3.4.1.1 Location. Backfill shall consist of all fill against and/or around structures, except backfill for side drains and compacted fill, channels.

3.4.1.2 Material. Backfill material shall be obtained from the required excavation as approved by the Contracting Officer. In general, the best material available will be designated as backfill and fill about structures. Backfill may consist of sand, gravelly sand, silty sands, sandy silts, clayey sands, and sandy clays. Organic material, silt, clay, broken concrete or pavement, boulders and other objectionable material shall not be used.

3.4.1.3 Placing. Backfill material shall not be placed against concrete which has not been in place at least 14 days or until the concrete has attained a strength of 2,500 p.s.i. when tested in accordance with SECTION: CAST-IN PLACE STRUCTURAL CONCRETE. Backfill shall be placed in 4-inch layers.

3.4.1.4 Compaction. Compaction shall be not less than 90 percent of maximum density, per ASTM D 1557.

3.4.2 Backfill, Side Drain Trenches

Backfill for side drains shall conform to the requirements of the SECTION: SIDE DRAINS AND STREET DRAINS.

3.5 MISCELLANEOUS FILL

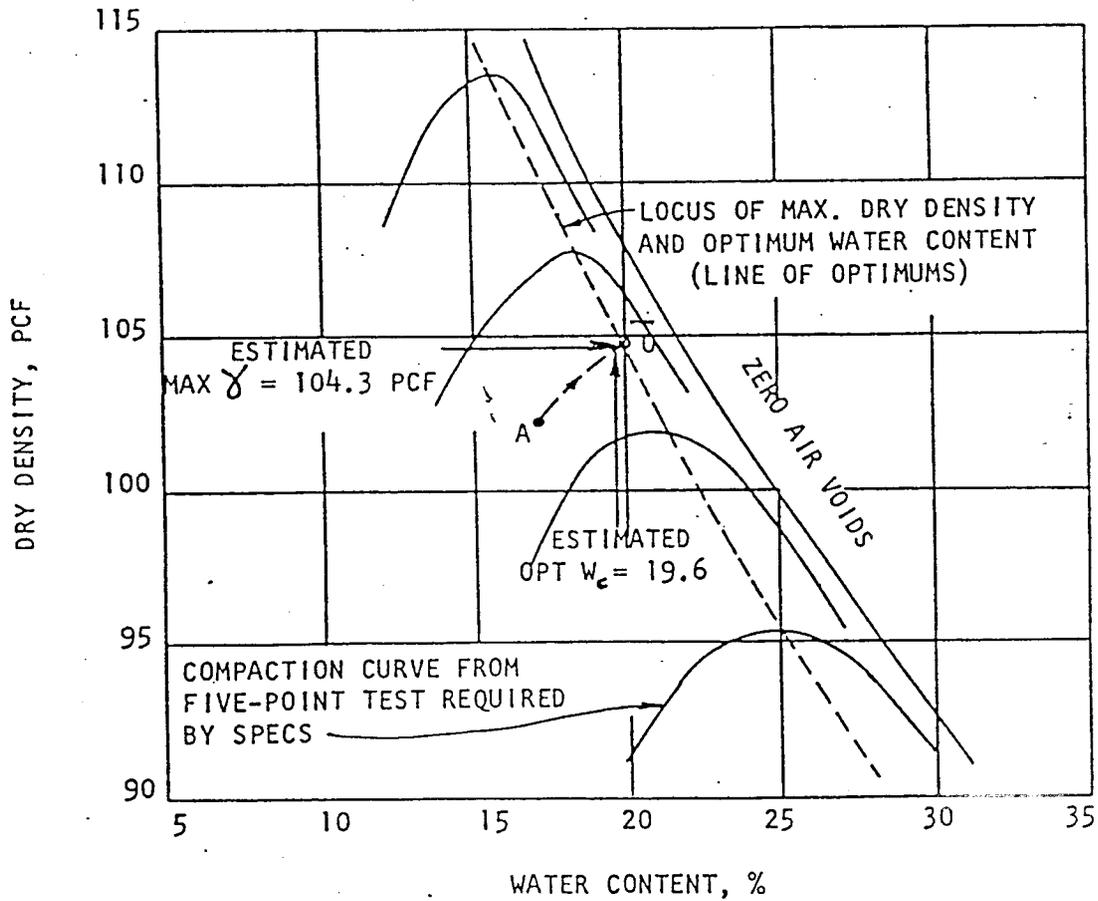
Miscellaneous fill shall consist of material from the required excavation, placed in the area indicated and shall be placed with suitable equipment in layers which shall not exceed 24 inches in depth before consolidation. No depressions in which water might pond shall be left in miscellaneous fill areas. The finished areas shall be sloped to drain. Compaction other than that obtained by the controlled movement of the construction equipment will not be required.

3.6 SUBGRADE PREPARATION

3.6.1 Subgrade Preparation for Roads

The subgrade shall be alternately watered and scarified until the material is uniformly moistened throughout for a depth of not less than 6 inches. All stones larger than 4 inches in diameter, and hard ribs of earth shall be removed. The amount of water to be applied shall be that which is required to provide optimum results in compaction under rolling. Following the above operations, the roadbed shall be shaped to a true cross section sufficiently higher than the specified grade to allow for subsequent compaction and then be thoroughly compacted to not less than 95 percent of maximum density as determined by [ASTM D 1557](#). After the subgrade has been prepared and complete, the surface shall be firm, hard, unyielding, with a true, even, and uniform surface conforming to the grade and cross section indicated on the drawings. All points of the finished subgrade shall be not more than 1/4 inch below or above true subgrade.

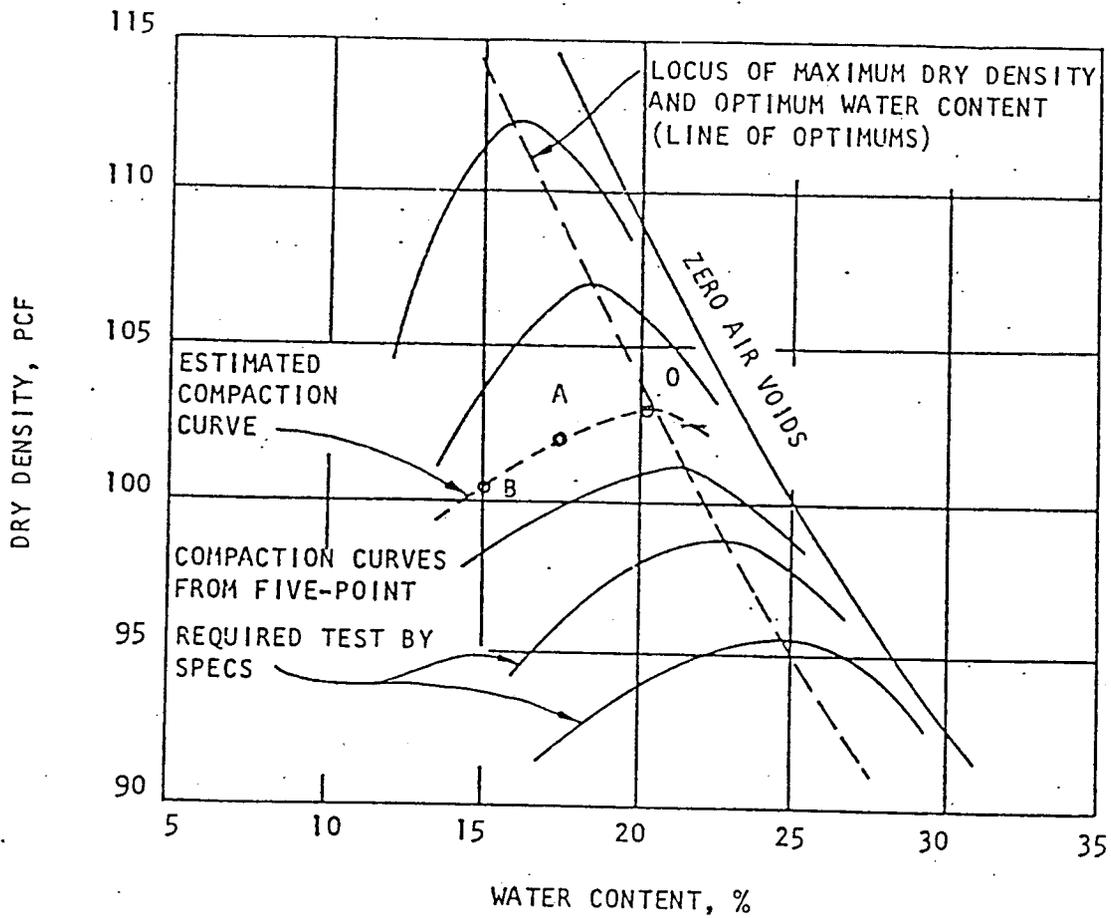
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PROCEDURE:

1. Point A is the result of a one-point test on material from field density test. This point must be on the dry side of optimum water content.
2. Point O gives the estimated OPT w_c and Max γ of the fill material based on a projection of point A approximately parallel to the adjacent compaction curves.
3. Point A must plot within 3 percent of the line of optimums.

FIGURE 1. Illustration of one-point compaction method.



PROCEDURE:

1. Points A and B are results of a two-point compaction test on material from field density test. Points A and B must be on the dry side of optimum water content.
2. The estimated compaction curve based on Points A and B establishes Point O on the locus, which is the estimated maximum dry density and optimum water content of the fill material.
3. One point must plot within 3 percent of the line of optimums.

FIGURE 2. Illustration of two-point compaction method.

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SECTION 02551

BITUMINOUS PAVING FOR ROADS, STREETS AND OPEN STORAGE AREAS

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 SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 88	(1990) Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C 127	(1988; R 1993) Specific Gravity and Absorption of Coarse Aggregate
ASTM C 128	(1993) Specific Gravity and Absorption of Fine Aggregate
ASTM C 131	(1989) Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM D 5	(1986) Penetration of Bituminous Materials
ASTM D 242	(1985; R 1990) Mineral Filler for Bituminous Paving Mixtures
ASTM D 422	(1963; R 1990) Particle-Size Analysis of Soils
ASTM D 1559	(1989) Resistance to Plastic Flow of Bituminous Mixture Using Marshall Apparatus
ASTM D 1856	(1979; R 1984) Recovery of Asphalt from Solution by Abson Method
ASTM D 2041	(1991) Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures
ASTM D 2172	(1992) Quantitative Extraction of Bitumen from Bituminous Paving Mixtures
ASTM D 2216	(1992) Laboratory Determination of Water (Moisture) Content of Soil, and Rock
ASTM D 3381	(1992) Viscosity-Graded Asphalt Cement for Use in Pavement Construction

ASTM D 3515

(1989) Hot-Mixed, Hot-Laid Bituminous Paving Mixtures

STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION (CALTRANS)

Standard Specifications

July 1992

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01300 SUBMITTAL PROCEDURES:

SD-01 Data

Aggregate Sources; GA.

SD-14 Samples

Asphalt Cement; GA.

One quart of asphalt cement shall be furnished by the Contractor for approval by the Contracting Officer prior to the start of production.

SD-18 Records

Waybills and Delivery Tickets; FIO.

Waybills and delivery tickets, during progress of the work.

1.3 PLANT, EQUIPMENT, MACHINES, AND TOOLS

1.3.1 General

The bituminous plant shall be of such capacity to produce the quantities of bituminous mixtures required. Hauling equipment, paving machines, rollers, miscellaneous equipment, and tools shall be provided in sufficient numbers and capacity and in proper working condition to place the bituminous paving mixtures at a rate equal to the plant output.

1.3.2 Mixing Plants

The mixing plant shall be an automatic or semiautomatic controlled commercially manufactured unit designed and operated to consistently produce a mixture within the job-mix formula (JMF). The plant shall have a minimum capacity of 100 tons per hour. Drum mixers shall be prequalified at the production rate to be used during actual mix production. The prequalification tests will include extraction and recovery of the asphalt cement in accordance with ASTM D 2172 and ASTM D 1856. The penetration of the recovered asphalt binder shall not be less than 60 percent of the original penetration, as measured in accordance with ASTM D 5.

1.3.3 Straightedge

The Contractor shall furnish and maintain at the site, in good condition, one 12-foot straightedge for each bituminous paver. 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.

1.4 WEATHER LIMITATIONS

Unless otherwise directed, bituminous courses shall not be constructed when temperature of the surface of the existing pavement or base course is below 40 degrees F.

1.5 PROTECTION OF PAVEMENT

After final rolling, no vehicular traffic of any kind shall be permitted on the pavement until the pavement has cooled to 140 degrees F.

1.6 GRADE AND SURFACE-SMOOTHNESS REQUIREMENTS

Finished surface of bituminous courses shall conform to gradeline and elevations shown and to surface-smoothness requirements specified.

1.6.1 Plan Grade

The grade of the completed surface shall not deviate more than 0.05 foot from the plan grade.

1.6.2 Surface Smoothness

When a 12-foot straightedge is laid on the surface parallel with the centerline of the paved area, the surface shall vary not more than 1/4 inch from the straightedge.

1.7 GRADE CONTROL

Lines and grades shall be established and maintained by means of line and grade stakes placed at site of work. Elevations of bench marks used by the Contractor for controlling pavement operations at the site of work will be determined, established, and maintained by the Government. Finished pavement elevations shall be established and controlled at the site of work by the Contractor in accordance with bench mark elevations furnished by the Contracting Officer.

1.8 SAMPLING AND TESTING

1.8.1 Aggregates

1.8.1.1 Sources

Sources of aggregates shall be selected well in advance of the time the materials are required in the work. If a previously developed source is selected, evidence shall be submitted 15 days before starting production, indicating that the central-plant hot-mix bituminous pavements constructed with the aggregates have had a satisfactory service record of at least five years under similar climatic and traffic conditions. The Contracting Officer will make such tests and other investigations as necessary to determine whether aggregates meeting requirements specified herein can be

produced from proposed sources. If a sample of material from a new source fails to meet specification requirements, the material represented by the sample shall be replaced, and the cost of testing the replaced sample will be at the expense of the Contractor. Approval of the source of aggregate does not relieve the Contractor of responsibility for delivery at the jobsite of aggregates that meet the requirements specified herein.

1.8.2 Bituminous Materials

Sources where bituminous materials are obtained shall be selected in advance of the time when materials will be required in the work. Samples shall be taken before and during construction when shipments of bituminous materials are received or when necessary to assure some condition of handling or storage has not been detrimental to the bituminous material. The samples will be taken by the Contractor and tested by the Contracting Officer.

1.8.3 Bituminous Mixtures

Sampling and testing of bituminous mixtures will be accomplished by the Contracting Officer.

1.9 DELIVERY, STORAGE, AND HANDLING OF MATERIALS

1.9.1 Mineral Aggregates

Mineral aggregates shall be delivered to the site of the bituminous mixing plant and stockpiled in such manner as to preclude fracturing of aggregate particles, segregation, contamination, or intermingling of different materials in the stockpiles or cold-feed hoppers. Mineral filler shall be delivered, stored, and introduced into the mixing plant in a manner to preclude exposure to moisture or other detrimental conditions.

1.9.2 Bituminous Materials

Bituminous materials shall be maintained at appropriate temperature during storage but shall not be heated by application of direct flame to walls of storage tanks or transfer lines. Storage tanks, transfer lines, and weigh buckets shall be thoroughly cleaned before a different type or grade of bitumen is introduced into the system. The asphalt cement shall be heated sufficiently to allow satisfactory pumping of the material; however, the storage temperature shall be maintained below 300 degrees F.

1.10 ACCESS TO PLANT AND EQUIPMENT

The Contracting Officer shall have access at all times to all parts of the paving plant for checking adequacy of the equipment in use; inspecting operation of the plant; verifying weights, proportions, and character of materials; and checking temperatures maintained in preparation of the mixtures.

1.11 WAYBILLS AND DELIVERY TICKETS

Before the final statement is allowed, the Contractor shall file with the Contracting Officer certified waybills and certified delivery tickets for all aggregates and bituminous materials actually used in construction.

1.12 SCALES

Scales shall comply with the requirements specified in SECTION: STONE PROTECTION.

2 PRODUCTS

2.1 BITUMINOUS HOT MIX

Shall consist of coarse aggregate, fine aggregate, mineral filler, bituminous material, and approved additives, if required, of the qualities and in the proportions specified and shall conform to the requirements contained in paragraphs PROPORTIONING OF MIXTURE.

2.1.1 Aggregates

Aggregates shall consist of crushed stone, crushed and uncrushed gravel, screening, sand, and mineral filler, as required. The portion of materials retained on the No. 4 sieve shall be known as coarse aggregate, the portion passing the No. 4 sieve and retained on the No. 200 sieve as fine aggregate, and the portion passing the No. 200 sieve as mineral filler. Aggregate gradation shall conform to gradation(s) specified in TABLE I. TABLE I is based on aggregates of uniform specific gravity; the percentage passing various sieves may be changed by the Contracting Officer when aggregates of varying specific gravities are used. Adjustments of percentage passing various sieves may be changed by the Contracting Officer when aggregates vary by more than 0.2 in specific gravity. The gradation below shall conform to the State of California Department of Transportation Standard Specifications Section 39-2.02, 1/2 inch and 3/4 inch Maximum, Medium.

TABLE I. AGGREGATE GRADATION

Sieve Size	Limits of Proposed Gradation	Operation Range	Contract Compliance
1/2 inch Maximum, Medium Wearing Course			
3/4 inch		100	100
1/2 inch		95-100	89-100
3/8 inch		80-95	75-100
No. 4	59-66	X+5	X+8
No. 8	43-49	X+5	X+8
No. 30	22-27	X+5	X+8
No. 200		3-8	0-11
3/4 inch Maximum, Medium Intermediate Course			
1 inch		100	100
3/4 inch		95-100	90-100
3/8 inch		65-80	60-85
No. 4	49-54	X+5	X+8
No. 8	36-40	X+5	X+8
No. 30	18-21	X+5	X+8
No. 200		3-8	0-11

In TABLE I above, the symbol "X" is the gradation which the Contractor proposes to furnish for the specific sieve. The proposed gradation shall meet the gradation shown in the table under "Limits of Proposed Gradation". Changes from one mix design to another shall not be made during the progress work unless permitted by the Engineer. However, changes in proportions to conform to the approved mix design shall not be considered changes in the mix design.

2.1.1.1 Coarse Aggregate

Coarse aggregate shall consist of clean, sound, durable particles meeting the following requirements.

- a. Percentage of loss shall not exceed 40 after 500 revolutions, as determined in accordance with ASTM C 131.
- b. Percentage of loss shall not exceed 18 after five cycles performed in accordance with ASTM C 88, using magnesium sulfate.

2.1.1.2 Fine Aggregate

Fine aggregate shall consist of clean, sound, durable particles including natural sand or crushed stone, or gravel that meets requirements for wear and soundness specified for coarse aggregate. Quantity of natural sand to be added to the wearing- and intermediate-course mixtures shall not exceed 25 percent by weight of coarse and fine aggregate and material passing the No. 200 sieve. Natural sand shall be clean and free from clay and organic matter. Percentage of loss shall not exceed 18 after five cycles of the soundness test performed in accordance with ASTM C 88, using magnesium sulfate.

2.1.1.3 Mineral Filler

Mineral filler shall conform to ASTM D 242.

Grain size in mm	Percent Finer
0.05	70-100
0.02	35-65
0.005	10-22

Grain size shall be determined in accordance with ASTM D 422.

2.1.2 Bituminous Material

Asphalt cement shall conform to ASTM D 3381, Grade AR-4,000 or AR-8,000.

2.1.3 Additives

The use of additives such as antistripping and antifoaming agents is subject to approval.

2.2 PROPORTIONING OF MIXTURE

2.2.1 Job Mix Formula

The JMF for the bituminous mixture shall be submitted by the Contractor and no bituminous mixture shall be manufactured until it has been approved. The formula will indicate the percentage of each sieve fraction of aggregate, the percentage of asphalt, and temperature of the mixture as discharged from the mixer. The percentage of asphalt in the job-mix formula will be between 5 and 6. Results of stability, flow and voids in the bituminous mixtures shall conform to the requirements specified herein.

2.2.2 Test Properties of Bituminous Mixtures

Finished mixture shall meet requirements described below when tested in accordance with ASTM D 1559. All samples will be compacted with 50 blows of specified hammer on each side of sample. When bituminous mixture fails to meet the requirements specified below, the paving operation shall be stopped until the cause of noncompliance is determined and corrected.

2.2.2.1 Stability, Flow, and Voids

Requirements for stability, flow, and voids are shown in TABLES II and III for nonabsorptive and absorptive aggregates, respectively.

TABLE II. NONABSORPTIVE-AGGREGATE MIXTURE

	Wearing Course	Intermediate Course
Stability minimum, pounds	1,000	1,000
Flow maximum, 1/100-inch units	20	20
Voids total mix, percent (1)	3-5	4-6
Voids filled with bitumen, percent (2)	75-85	65-75

(1) The Contracting Officer may permit deviations from limits specified when gyratory method of design is used to develop the JMF.

(2) The Contracting Officer may permit deviation from limits specified for voids filled with bitumen in the intermediate course in order to stay within limits for percent voids total mix.

TABLE III. ABSORPTIVE-AGGREGATE MIXTURE

	Wearing Course	Intermediate Course
Stability minimum, pounds	1,000	1,000
Flow maximum, 1/100-inch units	20	20
Voids total mix, percent (1)	2-4	3-5
Voids filled with bitumen, percent (2)	80-90	70-80

(1) The Contracting Officer may permit deviations from limits specified when gyratory method of design is used to develop the JMF.

(2) The Contracting Officer may permit deviation from limits specified for voids filled with bitumen in the intermediate course in order to stay within limits for percent voids total mix.

- a. When the water-absorption value of the entire blend of aggregate does not exceed 2.5 percent as determined in accordance with [ASTM C 127](#) and [ASTM C 128](#), the aggregate is designated as nonabsorptive. The theoretical specific gravity computed from the apparent specific gravity or [ASTM D 2041](#) will be used in computing voids total mix and voids filled with bitumen, and the mixture shall meet requirements in TABLE II.
- b. When the water-absorption value of the entire blend of aggregate exceeds 2.5 percent as determined in accordance with [ASTM C 127](#) and [ASTM C 128](#), the aggregate is designated as absorptive. The theoretical specific gravity computed from the bulk-impregnated specific gravity method contained in [ASTM D 2041](#) shall be used in computing percentages of voids total mix and voids filled with bitumen; the mixture shall meet requirements in TABLE III.

2.2.2.2 Stability

The index of retained stability must be greater than 75 percent as determined by [ASTM D 1559](#). When the index of retained stability is less than 75, the aggregate stripping tendencies may be countered by the use of hydrated lime or by treating the bitumen with an approved antistripping agent. The hydrated lime is considered as mineral filler and should be considered in the gradation requirements. The amount of hydrated lime or antistripping agent added to bitumen shall be sufficient, as approved, to produce an index of retained stability of not less than 75 percent. No additional payment will be made to the Contractor for addition of antistripping agent required.

3 EXECUTION

3.1 BASE COURSE CONDITIONING OR SUBGRADE PREPARATION

The surface of the base course or subgrade will be inspected for adequate compaction and surface tolerances.

3.2 PREPARATION OF BITUMINOUS MIXTURES

Rates of feed of aggregates shall be regulated so that the moisture content and temperature of aggregates will be within specified tolerances. Aggregates, mineral filler, and bitumen shall be conveyed into the mixer in proportionate quantities required to meet the JMF. Mixing time shall be as required to obtain a uniform coating of the aggregate with the bituminous material. Temperature of bitumen at time of mixing shall not exceed 300 degrees F. Temperature of aggregate and mineral filler in the mixer shall not exceed 325 degrees F when bitumen is added. Overheated and carbonized mixtures or mixtures that foam shall not be used.

3.3 WATER CONTENT OF AGGREGATES

Drying operations shall reduce the water content of mixture to less than 0.75 percent. The water content test will be conducted in accordance with [ASTM D 2216](#); the weight of the sample shall be at least 500 grams. If the

water content is determined on hot bin samples, the water content will be a weighted average based on composition of blend.

3.4 STORAGE OF BITUMINOUS PAVING MIXTURE

Storage shall conform to the applicable requirements of [ASTM D 3515](#); however, in no case shall the mixture be stored for more than 4 hours.

3.5 TRANSPORTATION OF BITUMINOUS MIXTURE

Transportation from paving plant to site shall be in trucks having tight, clean, smooth beds lightly coated with an approved releasing agent to prevent adhesion of the mixture to the truck bodies. Excessive releasing agent shall be drained prior to loading. Each load shall be covered with canvas or other approved material of ample size to protect mixture from weather and to prevent loss of heat. Loads that have crusts of cold, unworkable material or that have become wet will be rejected. Hauling over freshly placed material will not be permitted.

3.6 SURFACE PREPARATION OF UNDERLYING COURSE

Prior to placing of the intermediate or wearing course, the underlying course shall be cleaned of all foreign or objectionable matter with power brooms and hand brooms.

3.7 TACK COATING

Contact surfaces of previously constructed pavement, curbs, manholes, and other structures shall be sprayed with a thin coat of bituminous material conforming to Section [02558](#) BITUMINOUS TACK COAT.

3.8 PLACING

Bituminous courses shall be constructed only when the base course or existing pavement has no free water on the surface. Bituminous mixtures shall not be placed without ample time to complete spreading and rolling during daylight hours, unless approved satisfactory artificial lighting is provided. The final thickness of both wearing and intermediate courses shall conform to the thicknesses indicated in the plans.

3.8.1 Bicycle Trail Detour

The existing asphalt pavement shall be sprayed with a thin coat of bituminous tack coat prior to overlay with a new asphalt. All pavements thicker than 2.5 inches shall be placed in two courses. The compacted intermediate course shall be sprayed with a thin coat of tack coat prior to placing the wearing course. Maximum compacted thickness of intermediate course shall not be more than 2.5 inches.

3.8.2 Offsetting Joints

The wearing course shall be placed so that transverse joints in the wearing course shall be offset by at least 2 feet from transverse joints in the intermediate course.

3.8.3 General Requirements for Use of Mechanical Spreader

Range of temperatures of mixtures, when dumped into the mechanical spreader, shall be as determined by the Contracting Officer. Mixtures having temperatures less than 225 degrees F when dumped into the mechanical spreader shall not be used. The mechanical spreader shall be adjusted and the speed regulated so that the surface of the course being laid will be smooth and continuous without tears and pulls, and of such depth that, when compacted, the surface will conform to the cross section indicated. Placing with respect to center line areas with crowned sections or high side of areas with one-way slope shall be as directed. Placing of the mixture shall be as nearly continuous as possible, and speed of placing shall be adjusted, as directed, to permit proper rolling. When segregation occurs in the mixture during placing, the spreading operation shall be suspended until the cause is determined and corrected.

3.8.4 Placing Strips Succeeding Initial Strips

In placing each succeeding strip after initial strip has been spread and compacted as specified below, the screed of the mechanical spreader shall overlap the previously placed strip 2 to 3 inches and be sufficiently high so that compaction produces a smooth dense joint. Mixture placed on the edge of a previously placed strip by the mechanical spreader shall be pushed back to the edge of the strip by use of a lute. Excess mixture shall be removed and wasted.

3.8.5 Handspreading in Lieu of Machine Spreading

In areas where the use of machine spreading is impractical, the mixture shall be spread by hand. Spreading shall be in a manner to prevent segregation. The mixture shall be spread uniformly with hot rakes in a loose layer of thickness that, when compacted, will conform to required grade, density, and thickness.

3.9 COMPACTION OF MIXTURE

Rolling shall begin as soon after placing as the mixture will bear a roller without undue displacement. Delays in rolling freshly spread mixture will not be permitted. After initial rolling, preliminary tests of grade, and smoothness shall be made by the Contractor. Deficiencies shall be corrected so that the finished course will conform to requirements for grade and smoothness specified herein. Grade and smoothness will be checked in each section of completed pavement by the Contracting Officer for compliance. After the Contractor is assured of meeting grade and smoothness requirements, rolling shall be continued until a mat density of 97.0 to 100.0 percent and a joint density of 95.0 to 100.0 percent of density of laboratory-compacted specimens of the same mixture is obtained. Places inaccessible to rollers shall be thoroughly compacted with hot hand tampers.

3.9.1 Correcting Deficient Areas

Mixtures that become contaminated or are defective shall be removed to the full thickness of the course. Edges of the area to be removed shall be cut so that sides are perpendicular and parallel to the direction of traffic and so that the edges are vertical. Edges shall be sprayed with bituminous materials conforming to Section 02558 BITUMINOUS TACK COAT. Fresh paving mixture shall be placed in the excavated areas in sufficient quantity so

that the finished surface will conform to grade and smoothness requirements. Paving mixture shall be compacted to the density specified herein. Skin patching of an area that has been rolled shall not be permitted.

3.10 JOINTS

3.10.1 General

Joints between old and new pavements, between successive work days, or joints that have become cold (less than 175 degrees F) shall be made to insure continuous bond between the old and new sections of the course. All joints shall have the same texture and smoothness as other sections of the course. Contact surfaces of previously constructed pavements coated by dust, sand, or other objectionable material shall be cleaned by brushing or shall be cut back as directed. When directed by the Contracting Officer, the surface against which new material is placed shall be sprayed with a thin, uniform coat of bituminous material conforming to Section 02558 BITUMINOUS TACK COAT. Material shall be applied far enough in advance of placement of a fresh mixture to insure adequate curing. Care shall be taken to prevent damage or contamination of the sprayed surface.

3.10.2 Transverse Joints

The roller shall pass over the unprotected end of a strip of freshly placed material only when placing is discontinued or delivery of the mixture is interrupted to the extent that the material in place may become cold. In all cases, prior to continuing placement, the edge of previously placed pavement shall be cut back to expose an even vertical surface for full thickness of the course. In continuing placement of a strip, the mechanical spreader shall be positioned on the transverse joint so that sufficient hot mixture will be spread to obtain a joint after rolling that conforms to the required density and smoothness specified herein.

3.11 ACCEPTABILITY OF WORK

3.11.1 Grade

Grade-conformance tests will be conducted by the Government. The finished surface of the pavement will be tested for conformance with plan-grade requirements. Within 5 working days after completion of placement of a particular lot, the Contracting Officer will inform the Contractor in writing of results of grade-conformance tests. The finished grade of each pavement area shall 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. When more than 5 percent of all measurements made within an area are outside the tolerances specified in paragraph GRADE AND SURFACE-SMOOTHNESS REQUIREMENTS, the payment for that lot will not exceed 95 percent of the bid price. In areas where the grade exceeds the plan-grade tolerances given in paragraph GRADE AND SURFACE-SMOOTHNESS REQUIREMENTS by more than 50 percent, the Contractor shall remove the deficient area and replace with fresh paving mixture at no additional cost to the Government. Sufficient material shall be removed to allow at least 1 inch of asphalt concrete to be placed. Skin patching for correcting low areas or planing for correcting high areas shall not be permitted.

3.11.2 Surface Smoothness

After completion of final rolling of an area, the compacted surface will be tested by the Contracting Officer with a 12-foot straightedge. Measurements will be made perpendicular to and across all mats at distances along the mat not to exceed 25 feet. Location and deviation from straightedge of all measurements will be recorded. When more than 5 percent of all measurements along the mat within an area exceed the specified tolerance, the unit price for that area shall not exceed 95 percent of the bid price. Any joint or mat area surface deviation which exceeds the tolerance given in paragraph GRADE AND SURFACE-SMOOTHNESS REQUIREMENTS by more than 50 percent shall be corrected to meet the specification requirements. The Contractor shall remove the deficient area and replace with fresh paving mixture at no additional cost to the Government. Sufficient material shall be removed to allow at least 1 inch of asphalt concrete to be placed. Skin patching for correcting low areas or planing for correcting high areas shall not be permitted.

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SECTION 02558

BITUMINOUS TACK

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 SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 140	(1993) Sampling Bituminous Materials
ASTM D 977	(1991) Emulsified Asphalt
ASTM D 2995	(1993) Determining Application Rate of Bituminous Distributors

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01300 SUBMITTAL PROCEDURES:

SD-09 Reports

Tests; FIO.

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.

SD-18 Records

Waybills and Delivery Tickets; FIO.

Waybills and delivery tickets, during progress of 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.

2 PRODUCTS

2.1 BITUMINOUS MATERIAL

Emulsified asphalt shall conform to ASTM D 977, Grade SS-1h.

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 area to be tacked shall also be dry and clean.

3.2 APPLICATION RATE

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

3.3 APPLICATION TEMPERATURE

3.3.1 Viscosity Relationship

Asphalt application temperature shall provide an application viscosity between 20 and 100 seconds, Saybolt Furol. 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:

	Emulsions	
SS-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

Following preparation and subsequent inspection of the surface, the tack coat shall be applied at the specified rate with uniform distribution over the surface to be treated. The surface of the intermediate course shall be tack coated prior to placing the wearing course. All areas and spots missed by the distributor shall be properly treated with the hand spray. Following application of the tack material and prior to application of the succeeding layer of pavement, the tack shall be allowed to cure and to obtain evaporation of any volatiles or moisture. Until the succeeding layer of pavement is placed, the tacked area shall be maintained by protecting the surface against damage and by repairing and retacking 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 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.

3.5 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 2,500 gallons of bituminous material used.

3.6 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.

3.6.1 Sampling

The samples of bituminous material, unless otherwise specified, shall be in accordance with ASTM D 140. 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.

3.6.2 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 tack coat material to the

prepared surface. Calibration of the bituminous distributor shall be in accordance with ASTM D 2995.

3.6.3 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. 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.

3.6.4 Sampling and Testing During Construction

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

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SECTION 02580

PAVEMENT MARKINGS

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 247 (1981; Rev 1986) Glass Beads Used in Traffic Paint

AASHTO M 248 (1991I) Ready-Mixed White and Yellow Traffic Paints

FEDERAL SPECIFICATIONS (FS)

FS TT-B-1325 (Rev C) Beads (Glass Spheres) Retro-Reflective (Metric)

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01300 SUBMITTAL PROCEDURES:

SD-01 Data

Equipment Lists; GA.

Lists of proposed equipment to be used in performance of construction work, including descriptive data, and notifications of proposed Contractor actions as specified in this section.

SD-06 Instructions

Mixing, Thinning and Application; FIO.

Manufacturer's current printed product description and Material Safety Data Sheets (MSDS) for each type paint/color proposed for use.

SD-09 Reports

Material Tests; FIO.

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-13 Certificates

Volatile Organic Compound (VOC) Content; FIO.

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.

1.4.1 Paint Application Equipment

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 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 insure 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.

1.4.2 Reflective Media Dispenser

The dispenser for applying the reflective media shall be attached to the paint dispenser and 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.

1.5 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 shall 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.

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. Paint for roads and streets shall conform to [AASHTO M 248](#), color as indicated. 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 roads and streets shall conform to [FS TT-B-1325](#), Type I, Gradation A, or [AASHTO M 247](#), Type I.

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.

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. 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.

3.2 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 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 herein. 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

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 pavement at a rate of 6 plus or minus 0.5 pounds of glass spheres per gallon of paint.

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 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.

-- End of Section --

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SECTION 02600

STONE PROTECTION

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 SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 88	(1990) Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C 131	(1989) Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C 136	(1995a) Sieve Analysis of Fine and Coarse Aggregates
ASTM C 295	(1990) Petrographic Examination of Aggregates for Concrete
ASTM C 535	(1989) Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM D 1141	(1980) Substitute Ocean Water
ASTM D 5519	Ref Title
ASTM E 548	(1991) General Criteria Used for Evaluating Laboratory Competence

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01300 SUBMITTAL DESCRIPTIONS:

SD-01 Data

Source of Stone; GA.

Contractor shall comply with the requirements specified before any stone is produced.

SD-09 Reports

Sampling and Testing; FIO.

Sampling and testing shall be performed as specified. Certified copies of the laboratory's test reports indicating compliance with applicable specified requirements, not less than 30 days before the material is required in the work.

SD-14 Samples

Quality Compliance Testing; FIO.

Contractor shall submit test samples prior to the time stone is required in the work according to the requirements specified hereinbelow.

2 PRODUCTS

2.1 DEFINITIONS

2.1.1 Rounded Stone

Stone which is obtained from alluvial deposits and is nearly spherical and well rounded.

2.1.2 Angular Stone

Stone which is obtained from bedrock deposits and is angular in shape.

2.2 GENERAL

The Contractor shall make all arrangements, pay all royalties, and secure all permits for the procurement, furnishing and transporting of stone. The Contractor shall vary the quarrying, processing, loading and placing operations to produce the sizes and quality of stone specified. If the stone being furnished by the Contractor does not fully meet all the requirements of these specifications, the Contractor shall furnish, at no additional cost to the Government, other stone meeting the requirements of these specifications.

2.3 SOURCE AUTHORIZATION

Before any stone is produced from a source for completion of the work under this contract, the **source of stone** must be authorized by the Contracting Officer. Authorization of a stone source shall not be construed as a waiver of the right of the Government to require the Contractor to furnish stone which complies with these specifications. Materials produced from localized areas, zones or strata will be rejected when such materials do not comply with the specifications.

2.3.1 Source Development

Before a proposed source or sources of stone will be considered for sampling and testing, the Contractor must demonstrate that the source has sufficient stone to fulfill the contract requirements. If sufficient amounts of stone conforming to these specifications are not available from a source or sources used in the work, the Contractor shall submit stone from another source for authorization.

2.3.2 Source Documentation

Authorization of a proposed stone source will be based on test results and/or service records. In general, current Corps of Engineers test results shall be required as outlined in paragraph: Quality Compliance Testing, below. In special cases, however, the Contracting Officer may elect to use either past Corps of Engineers test results or a combination of service records along with test results from other agencies or private laboratories. A service record is considered to be acceptable if stone from the proposed source has remained sound and functional after at least 10 years of exposure on a project similar to the one to be constructed under these specifications.

2.3.3 Potential Stone Sources

The following are a few of the sources in the project area which have either undergone recent quality compliance testing for use on Corps of Engineers projects or have acceptable service records:

<u>Source Name</u>	<u>Nearest City</u>
3M	Corona
Atkinson	Riverside
Corona-Pacific	Corona
Slover Mtn.	Colton
Pyrite Street	Riverside
Fish Canyon	Azusa
Eagle Valley Quarry	Corona

Listing of a stone source is not to be construed as authorization of all materials from the source, nor as a waiver of inspection and testing of the source. Stone produced from any listed source must meet all the requirements set forth in these specifications. Listing of a stone source is also not to be construed as an indication that the source can produce the total quantity of stone required for the project.

2.3.4 Quality Compliance Testing

Samples for Corps of Engineers testing as specified in paragraph: Source Documentation shall be submitted a minimum of 45 days in advance of the time when the stone will be required in the work. Stone from a proposed source or sources will be tested by the Government for quality compliance. The first two tests shall be at Government expense, however, if the stone fails the tests, or if the Contractor desires to utilize more than two sources, additional testing will be performed by the Government at the Contractor's expense. The cost of additional testing will be deducted from payment due the Contractor in the amount of \$3,500 for each sample tested. All test samples (500 pounds minimum) shall be representative of the stone source and shall be obtained by the Contractor under the supervision of the Contracting Officer and delivered at the Contractor's expense to the South Pacific Division Laboratory, U.S. Army Corps of Engineers, 25 Liberty Ship Way, Sausalito, California 94965.

2.3.5 Stone Quality

Stone shall meet the following test requirements.

<u>Test</u>	<u>Test Method</u>	<u>Requirement</u>
Specific Gravity (Bulk SSD)	ASTM C 127	2.60 minimum
Absorption	ASTM C 127	2.0% maximum
Wetting and Drying	SPD Test Procedure(1)	No fracturing(3)
Sulfate Soundness	ASTM C 88(2)	10% max.loss(4)
Abrasion Loss	ASTM C 535	50% max. loss

In addition to the above tests, the stone shall be subjected to a petrographic(5) and X-ray diffraction analysis in accordance with [ASTM C 295](#). The stone must not contain any expansive clays.

NOTE: (1): Test procedure for wetting and drying test. The entire sample is carefully examined and representative test specimens are selected. The sample should be large enough to produce two cut slabs, 1 inch thick (+/-1/4 inch) with a minimum surface area of 30 square inches on one side. Two chunks approximately three by four inches are also chosen. The slabs and chunks are carefully examined under a low-power microscope and all visible surface features are noted and recorded. The specimens are then oven dried at 140 degrees F., for eight hours, cooled and weighed to the nearest tenth of a gram. The test specimens are photographed to show all surface features before the test. The chunks and slabs are then subjected to fifteen cycles of wetting and drying. One slab and one chunk are soaked in fresh tap water, the other slab and chunk are soaked in salt water prepared in accordance with [ASTM D 1141](#). Each cycle consists of soaking for sixteen hours at room temperature and then drying in an oven for eight hours at 140 degrees F. After each cycle the specimens are examined with the low-power microscope to check for opening or movement of fractures, flaking along edges, swelling of clays, softening of rock surfaces, heaving of micaceous minerals, breakdown of matrix material and any other evidence of weakness developing in the rock. The cycle in which any of these actions occurs is recorded. After fifteen cycles, the slabs and chunks are again carefully examined and all changes in the rocks are noted and recorded. The test specimens together with all particles broken off during the test are oven dried, weighed and photographed.

NOTE: (2): The test shall be made on 50 particles each weighing 100 grams, +/-25 grams, in lieu of the gradation given in [ASTM C 88](#).

NOTE: (3): Weakening and loss of individual surface particles is permissible unless bonding of the surface grains softens and causes general disintegration of the surface material.

NOTE: (4): Stone which has a loss greater than the specified limit will be accepted if the Contractor demonstrates that the stone has a satisfactory service record.

NOTE: (5): The test procedure for Petrographic and X-ray Diffraction is performed according to [ASTM C 295](#), except for the following:

- (a) A color, microscopic photograph shall be made of each stone type and the individual minerals within the stone shall be identified by labels and arrows upon the photograph.
- (b) A very detailed macroscopic and microscopic description shall be made of the stone, to include the entire mineral constituents, individual sizes, their approximate percentages and mineralogical

histories. A description of stone hardness, texture, weathering and durability factors shall also be discussed.

(c) A written summary of the suitability of stone for use as rip-rap based on the Petrographic and X-ray tests and the results of ASTM C 535 shall be presented in the final laboratory report on stone quality.

2.4 FILTER STONE

Filter stone obtained from an authorized source shall meet all the requirements specified herein but shall have a percentage of wear not to exceed 50 percent after 500 revolutions when tested in accordance with ASTM C 131.

2.5 STONE ACCEPTANCE

Prior to placement, all stone shall be subject to acceptance by the Contracting Officer. Acceptance of any stone shall not constitute acceptance of all stone from a source. All accepted stone shall be:

- a. of the same lithology as the original stone from which test results or service records were taken as a basis for authorization of the source;
- b. sound, durable and hard, and free from laminations, weak cleavages, undesirable weathering, or blasting or handling-induced fractures (or fracture zones which subtend more than 1/3 of the total circumference of the stone along the plane of fracturing);
- c. of such character that it will not disintegrate from the action of air, water, or the conditions of handling and placing;
- d. clean and free from earth, clay, refuse, or adherent coatings;
- e. material of a shape with the greatest dimension of each piece not greater than 3 times the least dimension.

2.6 REJECTED STONE

Stone of unsuitable quality and/or size distribution as required by these specifications shall be promptly removed from the project at no expense to the Government. Any portions of the work covered by these specifications containing rejected stone will be considered incomplete.

2.7 SALVAGED STONE

Existing stone protection may be salvaged from required clearing, excavation or demolition work. Various quarry sources producing variable quality rock have been used to build and re-build portions of the existing channels. If salvage stone is to be used as a source of stone, quality compliance tests may be required on each recognizable rock type proposed for use. Salvaged stone which is reused shall meet all the requirements of these specifications. Stone not meeting the requirements of these specifications shall not be used for stone protection.

2.8 SAMPLING AND TESTING FOR STONE PROTECTION

2.8.1 General

Testing shall be the responsibility of the Contractor and shall be performed at no additional cost to the Government. Testing shall be performed by an approved commercial testing laboratory or may be tested by the Contractor subject to approval by the Contracting Officer. If the Contractor elects to establish testing facilities, 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 by the Contracting Officer. Testing shall be supervised by a registered Civil Engineer experience in soil testing.

2.8.2 Testing

Testing shall be conducted on all specified stone and gravel drain materials at intervals during placement. Quality tests will be required if it is believed that quality requirements are not met. Gradation tests shall be made in accordance with the following schedule.

1. Tests shall be made after production has commenced and at least 3 days prior to placement of stone.
2. Tests shall be made not before 4 and not after 8 working days (of stone placement) after commencement of stone placement.
3. Test shall be made at intervals of not more than one month or when the placement of stone is 50 percent complete, whichever provides the greater number of tests.
4. One final test shall be made within 3 days prior to completion of stone placement.

2.8.3 Sampling

Sufficient stone shall be graded to be representative of size distribution as placed. The quantity to be tested will be dependent to some extent on the methods of delivery and method of placement. The following shall serve as a guide for selecting the size of the sample. When necessary to provide a representative sample, the quantity shall be increased.

- a) Where well-graded stone is dumped in truck-load lots, entire truck loads of materials shall be selected for grading. Trucks shall be selected at random and the entire load dumped in an area aside for the gradation testing. Where maximum size is less than 18 inches, a load may be quartered to produce a representative sample.
- b) Where samples are to be selected from the complete slope, stone shall be removed from a square area with a side dimension at least 5 times the thickness of the layer. All stone from the selected area must be removed to a work area set aside for the gradation test.

2.8.4 Report

The report shall contain the following:

- a) The date of test and sample location.
- b) The size of sample in pounds and where applicable, dimensions of the area sampled.
- c) The greatest dimension and least dimension of each stone larger than 3 inches.
- d) The weight of material not measured in c above.
- e) The weight of each stone larger than 3 inches.
- f) Gradation plot.
- g) The type of stone tested (i.e. derrick stone, riprap, grouted stone, etc.)
- h) Calculate the percent, by weight, of stone with a greatest dimension of 2-1/2 or more times the least dimension.

2.9 GRADATION

2.9.1 General

All points on individual grading curves shall be between the boundary limits as defined by smooth curves drawn through specified grading limits plotted on a mechanical analysis diagram. The individual grading curves shall not exhibit abrupt changes in slope denoting skip grading or scalping of certain sizes. Specified grading of all material shall be met both at the source and as delivered to the project. In addition, material not meeting the required grading due to segregation or degradation during placement shall be rejected. If test results show that stone does not meet the required grading, the hauling operation will be stopped immediately and will not resume until processing procedures are adjusted and a gradation test is completed showing gradation requirements are met. All gradation tests shall be at the expense of the Contractor.

2.9.2 Bedding Stone

Bedding stone shall be reasonably well graded between the limits specified below when tested in accordance with [ASTM C 136](#).

<u>Weight of Pieces, Pounds</u>	<u>Percent Smaller (by Weight)</u>
50	100
30	40-60
10	20-40
1	0-20

2.9.3 Gravel Drain

Gravel Drain shall consist of gravel or crushed stone, and shall have a loss in weight of not more than 50 percent when tested in accordance with ASTM C 131, and shall be reasonably well graded within the following limits:

Sieve Size	Percent by Weight Passing
1-1/2 inch	100
1 inch	90-100
3/4 inch	55-90
3/8 inch	8-20
No. 4	0-5

2.9.4 Derrick Stone

Derrick stone shall be quarried stone, uniformly graded, ranging in size from 500 to 3,000 pounds with approximately 50 percent of the individual stones weighing more than 1,000 pounds.

2.9.5 Riprap

Riprap shall be quarried stone reasonably graded within the limits specified below; when tested in accordance with ASTM D 5519, Test Method A.:

36-inch (Thickness) Riprap

Weight of Pieces, Pounds	Percent Smaller (by Weight)
2350	100
930	65-100
690	50-70
470	30-50
145	0-15

2.9.6 Stone for Grouted Stone

Stone for grouted stone shall be reasonably well graded between 6 and 12 inches with not less than 25 percent nor more than 60 percent 8 inches in size.

3 EXECUTION

3.1 FOUNDATION PREPARATION

3.1.1 General

Subgrade for stone protection shall conform with the provisions of SECTION: FILLS AND SUBGRADE PREPARATION. Areas on which bedding stone is to be placed shall be trimmed and dressed to conform to cross sections indicated or directed, within an allowable tolerance of plus or minus one inch from the theoretical slope lines and grades. Where such areas are below the allowable minus tolerance limit they shall be brought to grade by filling with earth similar to the adjacent material and well compacted, or by filling with approved material, and no additional payment will be made for any material thus required. Prior to placing the bedding stone, the

prepared base shall be inspected, in sufficient time prior to each stone placement by the Contractor, in order to certify to the Contracting Officer that it is ready to receive stone. The results of each inspection shall be reported in writing.

3.2 PLACEMENT

Method of placement shall be submitted to Contracting Officer for approval prior to commencement of placement operations.

3.2.1 Bedding Stone and Gravel Drain

Bedding stone and gravel drain shall be spread uniformly on the prepared base, in a satisfactory manner, to the neat lines indicated or directed. Placing of material by methods which will tend to segregate particle sizes will not be permitted. Material shall not be dropped from a height of more than 18 inches. Any damage to the prepared surface of the base during placing of the bedding stone and gravel drain shall be repaired before proceeding with the work. Compaction of the bedding stone and gravel drain will not be required but it shall be finished to present a reasonably even surface free from mounds or windrows. A tolerance of plus or minus one inch from the slope lines and grades when measured with a 10-foot straight edge will be allowed in each finished course, except that either extreme of such tolerance shall not be continuous over an area greater than 200 square feet.

3.2.2 Riprap

Riprap shall be placed in a manner to produce a reasonably well graded mass with the minimum practicable percentage of voids, and shall be constructed to the lines and grades indicated or directed. Stone shall be placed to its full course thickness in one operation and in a manner to avoid displacing the underlying material. Material shall not be dropped from a height of more than 18 inches. The Contractor shall maintain the stone protection until accepted and any material displaced by any cause shall be replaced at his expense to the lines and grades indicated. Self propelled equipment shall not be used on the levee slopes and/or toe slopes. Hand placing, barring, or placing by crane will be required only to the extent necessary to secure the results specified. Placing stone by dumping into chutes or by similar methods likely to cause segregation shall not be permitted. A tolerance of minus 1 to +5 inches from the indicated slope lines and grades will be allowed in the finished surface, except that either extreme of such tolerance shall not be continuous over an area greater than 200 square feet.

3.2.3 Derrick Stone

Derrick stone shall be placed in a uniform, well-graded mass to the lines indicated or directed. Barring of stone will be required only to the extent necessary to secure the results specified above. Hand placing will not be required. Stone shall not be dropped from a height more than 18 inches. A tolerance of plus or minus 6 inches from the indicated lines and grades will be allowed in the finished surface, except that either extreme of such tolerance shall not be continuous over an area greater than 200 square feet.

3.2.4 Stone for Grouted Stone

Stone for grouted stone shall be placed to produce a surface in which the tops of the individual stones do not vary more than 1-1/2 inches from final grade. Double decking thin flat stones to bring the surface up to the required grade will not be permitted.

3.3 DELIVERY

3.3.1 Truck Delivery

All stone delivered by truck shall be weighed and the scale tickets certified by authorized weighers. All trucks used for delivering stone shall be plainly numbered.

3.3.2 Scales

Scales shall be standard truck scales of the beam type. The scales shall be of sufficient size and capacity to accommodate all trucks used in hauling the material. Scales shall be tested, approved, and sealed by an inspector of the State Inspection Bureau charged with scales inspection within the State of California. Scales shall be calibrated and resealed as often as necessary to insure continuous accuracy. The necessary number of standard weights for testing the scales shall be on hand at all times and, if an official inspection bureau of the state is not available, the scales will be tested by the Contracting Officer. Where scales are found to be defective or questionable, stone deliveries shall immediately cease and shall not resume until approved scales are available. If salvaged stone is to be used, a scale for weighing salvaged stone will be required on site.

3.3.3 Scale Tickets

Copies of scale tickets and/or records of weights including displacement weight date, shall be submitted to the Contracting Officer during the progress of the work. The Contracting Officer will determine from the displacement weight date, the weight of stone shipped by barge and will certify displacement weight records. Each scale ticket and/or record shall include the gross, rate, dunnage, and net weight of stone. The weight of dunnage for each load, will be determined, recorded, and certified by the Contracting Officer. Deliveries and numbered scale tickets and/or records using an approved system will be used to maintain delivery control. Copies of scale tickets and/or records shall accompany each load of stone for all methods of transportation and a copy shall be delivered to the Contracting Officer on delivery of the stone. Before the final statement is allowed, the Contractor shall file with the Contracting Officer certified scale tickets and/or certified records for stone used in the construction covered by the contract.

3.4 DEMONSTRATION SECTION

3.4.1 General

Prior to placement of stonework, the Contractor shall construct a section of grouted stone slope protection, both prior to and after grouting, to demonstrate his proposed operations for production placement. The section shall demonstrate procedure and capability of grading, and placing stone,

within the tolerances specified. The demonstration section shall be 100 feet in length and shall conform with all applicable specifications.

3.4.1.1 Methods and Equipment

Methods and equipment employed for placement shall demonstrate the adequacy for use in placement of riprap and grouted stone and shall conform with the requirements specified herein. The quantities of all materials placed within the section shall be accurately tabulated and provided immediately to the Contracting Officer for comparison with the theoretical quantities.

3.4.1.2 Demonstration Section Evaluation

The Contractor shall not proceed with stone placement prior to the approval of the demonstration section. Within a period of 7 days after completion of the section, the Contracting Officer shall determine the adequacy and acceptability of the section. The Contractor shall be notified as to the acceptability of the section and will be required to modify methods of construction or materials, and to remove the section for noncompliance with specifications.

3.4.1.3 Removal of Demonstration Section

The unacceptable demonstration section shall be the property of the Contractor and unacceptable material shall be removed from the site with the requirement of SECTION: ENVIRONMENTAL PROTECTION.

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SECTION 02700

SIDE DRAIN AND STREET DRAINS

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 170 (1987I) Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe

AASHTO M 198 (1975; Rev 1986) Joints for Circular Concrete Sewer and Culvert Pipe Using Flexible Watertight Gaskets

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 76 (1990) Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe

ASTM C 443 (1985a; R 1990) Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets

ASTM C 476 (1983) Grout for Masonry

ASTM D 1556 (1990) Density and Unit Weight of Soil in Place by the Sand-Cone Method

ASTM D 1557 (1991) Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/cu.ft. (2,700 kN-m/cu.m.))

FEDERAL SPECIFICATIONS (FS)

FS HH-P-117 (_____) Packing; Jute, Twisted

FS SS-S-210 (Rev A; Reinstatement Notice) Sealing Compound, Preformed Plastic, for Expansion Joints and Pipe Joints

FEDERAL STANDARDS (FED-STD)

FED-STD 601 (Basic; Notice 7) Rubber: Sampling and Testing

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01300 SUBMITTAL DESCRIPTIONS:

SD-06 Instructions

Installation Procedures; FIO.

Manufacturer's recommendations for installation procedures shall be furnished to the Contracting Officer prior to installation of materials covered by these specifications.

SD-09 Reports

Pipe; FIO.

Certified copies of test reports demonstrating conformance to applicable pipe specifications shall be delivered to the Contracting Officer before pipe is installed.

Joints and Gaskets; FIO.

Certified copies of test reports for watertight joints shall be delivered to the Contracting Officer before gaskets or jointing materials are installed.

1.3 DELIVERY, STORAGE, AND HANDLING OF MATERIALS

1.3.1 Delivery and Storage

Materials delivered to site shall be inspected for damage, unloaded, and stored with the minimum of handling. Do not store materials directly on the ground. Inside of pipes and fittings shall be kept free of dirt and debris.

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 to the trench not dragged. Gasket materials and plastic materials that are not to be installed immediately shall not be stored in the direct sunlight.

2 PRODUCTS

2.1 GENERAL

Concrete shall conform to the SECTION: CAST-IN-PLACE STRUCTURAL CONCRETE. Where pipe is embedded in concrete, the pipe shall be supported in such a manner to hold it rigidly in position while concrete is placed. Earthwork about the drains and structures shall conform to the applicable requirements of the SECTIONS: EXCAVATION and FILLS AND SUBGRADE PREPARATION. Welding shall conform to the requirements of the SECTION: MISCELLANEOUS METALS. Removal of existing side drains is specified in the SECTION: DEMOLITION. Specified and/or indicated pipe thickness, D-loading, weight, or gage are the minimum acceptable and heavier pipe may be furnished at the option of the Contractor. Before connecting side drains to the new

channel, the Contractor shall have completed all of the channel located downstream of the connection.

2.1.1 Extension of Drain Lines

Drain lines shall be extended with the same kind of pipe and shall have joints to match the existing joints unless shown otherwise on the drawings. All joints shall be watertight. Bends, elbows, and other fittings shall be standard fittings for the various types of pipe. Except as otherwise specified, all pipe and fittings shall be new. Salvaged pipe and fittings from drain removals may be used in temporary installations necessary to the work and in permanent installations, where specified.

2.1.2 Manufacturers Recommendations

Where installation procedures or any part thereof are required to be in accordance with the recommendations of the manufacturer of the material being installed, printed copies of these recommendations shall be furnished to the Contracting Officer prior to installation. Installation of the item will not be allowed until the recommendations are received. Failure to furnish these recommendations can be cause for rejection of the material.

2.2 TESTS FOR PIPE

Certified copies of test reports demonstrating conformance to applicable pipe specifications shall be delivered to the Contracting Officer before pipe is installed. Strength tests for concrete pipe, as required in applicable specifications, shall be the three-edge bearing tests.

2.3 PIPE

Pipe shall be as indicated and shall conform to the requirements for the following pertinent types.

2.3.1 Reinforced Concrete Pipe

ASTM C 76 or AASHTO M 170, Class III.

2.3.1.1 Salvaged Reinforced Concrete Pipe

Pipe suitable for reuse shall be removed and cleaned. All joint mortar and other foreign matter shall be removed.

2.4 DRAINAGE STRUCTURES

2.4.1 Inlets

Construction shall be of reinforced concrete complete with frames and gratings.

2.4.1.1 Frame and Gratings

Weight, shape, size, and waterway openings for grate inlets shall be as indicated on the plans. Frames and grates shall be galvanized after fabrication. The material for the frames and grates will conform to SECTION: MISCELLANEOUS METALS.

2.4.2 Walls and Headwalls

Construction shall be of reinforced concrete as indicated.

2.5 MORTAR

Mortar and grout for pipe joints and connections to drainage structures shall conform to [ASTM C 476](#), Mortar Type PL. The mortar shall be used within 30 minutes after the ingredients are mixed with water.

2.6 JOINTS

2.6.1 For Concrete Pipe

Upon completion of joining pipe sections, the inside of the joint shall be wiped clean and finished smooth. In pipe too small for a man to work inside, wiping may be done by dragging a suitable swab or long handled brush through the pipe as the work progresses. The mortar bead on the outside shall be protected from drying out until satisfactorily cured.

2.6.1.1 Cement-Mortar Bell-and-Spigot Joint

The first pipe shall be bedded to the established gradeline, with the bell end placed upstream. The interior surface of the bell shall be carefully cleaned with a wet brush and the lower portion of the bell filled with mortar to such depth as to bring inner surfaces of abutting pipes flush and even. The spigot end of each subsequent pipe shall be cleaned with a wet brush and uniformly matched into the bell so that sections are closely fitted. After each section is laid, remainder of the joint shall be filled with mortar, and a bead shall be formed around the outside of the joint with sufficient additional mortar. If mortar is not sufficiently stiff to prevent appreciable slump before setting, the outside of the joint shall be wrapped or bandaged with cheesecloth to hold mortar in place.

2.6.1.2 Cement-Mortar Oakum Joint for Bell-and-Spigot Pipe

A closely twisted gasket shall be made of joint packing, conforming to [FS HH-P-117](#), of the diameter required to support the spigot end of the pipe at the proper grade and to make the joint concentric. Joint packing shall be in one piece of sufficient length to pass around the pipe and lap at top. This gasket shall be thoroughly saturated with neat cement grout. The bell of the pipe shall be thoroughly cleaned with a wet brush, and the gasket shall be laid in the bell for the lower third of the circumference and covered with mortar. The spigot of the pipe shall be thoroughly cleaned with a wet brush, inserted in the bell, and carefully driven home. A small amount of mortar shall be inserted in the annular space for the upper two-thirds of the circumference. The gasket then shall be lapped at the top of the pipe and driven home in the annular space with a caulking tool. The remainder of the annular space then shall be filled completely with mortar and beveled at an angle of approximately 45 degrees with outside of the bell. If mortar is not sufficiently stiff to prevent appreciable slump before setting, the outside of the joint shall be wrapped with cheesecloth. Placing of this type joint shall be kept at least five joints behind laying operations.

2.6.1.3 Cement-Mortar Diaper Joint for Bell-and-Spigot Pipe

The pipe shall be centered so that the annular space is uniform. The annular space shall be caulked with joint packing conforming to **FS HH-P-117**. Before caulking, the inside of bell and outside of spigot shall be clean.

2.6.1.3.1 Diaper Bands

Diaper bands shall consist of heavy cloth fabric to hold grout in place at joints and shall be cut into such lengths that they will extend one-eighth of the circumference of pipe above the spring line on one side of the pipe and up to the spring line of the other side of the pipe. Longitudinal edges of fabric bands shall be rolled and stitched around two pieces of wire. Width of fabric bands shall be such that after fabric has been securely stitched around both edges on wires, the wires will be uniformly spaced not less than 8 inches apart. Wires shall be cut into lengths to pass around pipe with sufficient extra length for the ends to be twisted at top of pipe to hold band securely in place; bands shall be accurately centered around lower portion of joint.

2.6.1.3.2 Grout

Grout shall be poured between band and pipe from only the high side of band, until grout rises to the top of band at the spring line of pipe, or as nearly as possible, on the opposite side of pipe, to insure a thorough sealing of joint around the portion of pipe covered by band. Silt, slush, water, or polluted mortar grout forced up on the lower side shall be carefully forced out by the pouring and removed.

2.6.1.3.3 The remaining unfilled upper portion of the joint shall then be filled with mortar and a bead formed around outside of this upper portion of joint with sufficient amount of additional mortar. The diaper shall be left in place. Placing of this type joint shall be kept at least five joints behind actual laying of pipe. No backfilling around joints shall be done until joints have been fully inspected and approved.

2.6.1.4 Cement-Mortar Tongue-and-Groove Joint

The first pipe shall be bedded carefully to the established gradeline with the groove upstream. A shallow excavation shall be made underneath the pipe at the joint and filled with mortar to provide a bed for the pipe. The grooved end of the first pipe shall be carefully cleaned with a wet brush, and a layer of soft mortar applied to the lower half of the groove. The tongue of the second pipe shall be cleaned carefully with a wet brush, while in horizontal position, a layer of soft mortar shall be applied to the upper half of the tongue. The tongue end of the second pipe then shall be inserted in the grooved end of the first pipe until mortar is squeezed out on interior and exterior surfaces. Sufficient mortar shall be used to fill the joint completely and to form a bead on the outside.

2.6.1.5 Cement-Mortar Diaper Joint for Tongue-and-Groove Pipe

The joint shall be of the type described in paragraph: Cement-Mortar Tongue-and-Groove Joint, except that the shallow excavation directly beneath the joint shall not be filled with mortar until after a gauze or cheesecloth band dipped in cement mortar has been wrapped around the outside of the joint. The cement-mortar bead at the joint shall be at least 1/2-inch

thick, and the width of the diaper band shall be at least 8 inches. The diaper shall be left in place. Placing of this type of joint shall be kept at least five joints behind the actual laying of the pipe. No backfilling around the joints shall be done until joints have been fully inspected and approved.

2.6.1.6 Joints Under Levees

2.6.1.6.1 Materials and Test Requirements

Joints under levees shall be made with rubber-type gaskets. The design of joints and the physical requirements for rubber-type gaskets shall conform to **ASTM C 443** or **AASHTO M 198**. Gaskets shall have not more than one factory-fabricated splice, except that two factory-fabricated splices of the rubber gasket type are permitted if nominal diameter of pipe being gasketed exceeds 54 inches. Material conforming to **FS SS-S-210** is acceptable as an alternate to **ASTM C 443** provided the necessary installation instructions are furnished.

2.6.1.6.2 Joints for Pipe Under Levees

Joints shall be tested and shall meet test requirements of paragraph: HYDROSTATIC TEST ON WATERTIGHT JOINTS. (Gaskets or jointing materials shall not swell more than 100 percent by volume when immersed in accordance with Method 6211 of **FED-STD 601**, in immersion medium No. 3 for 70 hours at 212 degrees F.) Certified copies of test results shall be delivered to the Contracting Officer before gaskets or jointing materials are installed. Alternate types of watertight joint may be furnished if specifically approved.

3 EXECUTION

3.1 INSTALLATION

Gaskets and joining materials shall be as recommended by the particular manufacturer in regard to use of lubricants, cements, adhesives, and other special installation requirements. Surfaces to receive lubricants, cements, or adhesives shall be clean and dry. Gaskets and jointing materials shall be affixed to the pipe not more than 24 hours prior to the installation of the pipe, and shall be protected from the sun, blowing dust, and other deleterious agents at all times. Gaskets and jointing materials shall be inspected before installing the pipe; any loose or improperly affixed gaskets and jointing materials shall be removed and replaced. The pipe shall be aligned with the previously installed pipe, and the joint pulled together. If, while making the joint, the gasket or jointing material becomes loose and can be seen through the exterior joint recess when joint is pulled up to within one inch of closure, the pipe shall be removed and the joint remade.

3.2 EXCAVATION AND TRENCHING

Excavation of trenches and backfilling shall be in accordance with the applicable portions of SECTIONS: EXCAVATION and FILLS and SUBGRADE PREPARATION and the following requirements.

3.2.1 Trenching

The width of trenches at any point below the top of the pipe shall not be greater than the outside diameter of the pipe plus 16 inches to permit satisfactory jointing and thorough tamping of the bedding material under and around the pipe. Sheeting and bracing where required shall be placed within the trench width as specified. Care shall be taken not to over excavate. Where trench widths are exceeded, redesign with a resultant increase in cost of stronger pipe or special installation procedures shall be necessary. Cost of this redesign and increased cost of pipe or installation shall be borne by the Contractor without additional cost to the Government.

3.3 BEDDING

The bedding surface for the pipe shall provide a firm foundation of uniform density throughout the entire length of the pipe. The pipe shall be bedded carefully in a soil foundation accurately shaped and rounded to conform to the lowest one-fourth of the outside portion of circular pipe for the entire length of pipe. When necessary, the bedding shall be tamped. Bell holes and depressions for joints shall be only of such length, depth, and width as required for properly making the particular type joint.

3.4 PLACING PIPE

Each pipe shall be carefully examined before being laid, and defective or damaged pipe shall not be used. Pipelines shall be laid to the grades and alignment indicated. Proper facilities shall be provided for lowering sections of pipe into trenches. Lifting lugs in vertically elongated metal pipe shall be placed in the same vertical plane as the major axis of the pipe. Under no circumstances shall pipe be laid in water, and no pipe shall be laid when trench conditions or weather are unsuitable for such work. Diversion of drainage or dewatering of trenches during construction shall be provided as necessary. All pipe in place shall be inspected before backfilling, and those damaged during placement shall be removed and replaced at no additional cost to the Government.

3.4.1 Concrete Pipe

Laying shall proceed upgrade with spigot ends of bell-and-spigot pipe and tongue ends of tongue-and-groove pipe pointing in the direction of the flow. Circular concrete pipe with elliptical reinforcing shall be placed so that reference lines designating top of pipes will be not more than 5 degrees from the vertical plane through the longitudinal axis of the pipe. In all backfilling operations care shall be taken to prevent damage to or misalignment of the pipe.

3.5 BACKFILLING

3.5.1 Backfilling Pipe in Trenches

After the bedding has been prepared and the pipe installed, selected material from the required excavation at a moisture content that will facilitate compaction, shall be placed along both sides of pipe in layers not exceeding 4 inches in compacted depth. The backfill shall be brought up evenly on both sides of pipe for the full length of pipe. Care shall be taken to insure thorough compaction of the fill under the haunches of the pipe. Each layer shall be thoroughly compacted with mechanical tampers or

rammers. This method of filling and compacting shall continue until the fill has reached an elevation of at least 24 inches above the top of the pipe. The remainder of the trench shall be backfilled and compacted by spreading and rolling or compacted by mechanical rammers or tampers in layers not exceeding 6 inches and compacted to not less than 90 percent of maximum density [ASTM D 1557](#). In place densities shall be determined using [ASTM D 1556](#) where it is necessary in the opinion of the Contracting Officer, any sheeting and/or portions of bracing used shall be left in place, and the contract will be adjusted accordingly. Untreated sheeting shall not be left in place beneath structures or pavements.

3.5.2 Backfilling Pipe in Fill Sections

For pipe placed in fill sections, backfill material and the placement and compaction procedures shall be as specified above. The fill material shall be uniformly spread in layers longitudinally on both sides of pipe, not exceeding 4 inches in compacted depth, and shall be compacted by rolling parallel with pipe or by mechanical tamping or ramming. Prior to commencing normal filling operations, the crown width of the fill at a height of 24 inches above the top of the pipe shall extend a distance of not less than twice the outside pipe diameter on each side of the pipe or 12 feet, whichever is less.

3.5.3 Movement of Construction Machinery

Operating heavy equipment parallel with the pipe, displacement of or injury to the pipe shall be avoided. Movement of construction machinery over a culvert or storm drain at any stage of the construction shall be at the Contractor's risk. Any pipe damaged thereby shall be repaired or replaced at the expense of the Contractor.

3.6 HYDROSTATIC TEST ON WATERTIGHT JOINTS

A hydrostatic test shall be made on the watertight joint types proposed. Only one sample joint of each type needs testing; however, if the sample joint fails because of faulty workmanship, an additional sample joint may be tested. During the test period the joint shall be protected from high temperatures that might soften or adversely affect the jointing materials. The possibility that some water may be absorbed by concrete pipes during this test will be considered before rejecting any rubber seals proposed. Performance requirements for joints in reinforced and nonreinforced concrete pipe shall conform to [ASTM C 443](#) or [AASHTO M 198](#), except that tests for either above-mentioned requirement shall be performed at an internal hydrostatic pressure of 10 psi for a 24-hour period. Upon completion of the test and for installations in which differential settlement may be expected, the distance between the coupled pipe ends shall be increased at least 2 inches by loosening the longitudinal tie rods holding the test joint and reapplying pressure. Without further adjustment of the band and gasket, the opened joint shall then be retested and required to withstand additionally internal hydrostatic pressure equivalent to 5 feet of head without visible leakage over a 24 hour period.

3.7 INSTALLATION OF SIDE DRAIN PIPE IN CHANNEL WALLS

At the option of the Contractor, side drain pipes may be either cast in place in the channel walls or installed through a blockout. The edge of the

pipe shall end approximately 3/4 inch back of the channel face of the wall. Pipe installed in blockouts shall be dry-packed in place.

3.7.1 Dry-Pack Installation

Dry-pack material shall consist of one part Portland cement, 2 parts aggregate, and water. Aggregate shall consist of sand and fine gravel. The water content shall be such that a ball of dry-pack may be squeezed in the hand without bringing free water to the surface. Materials shall conform to the applicable requirements of the SECTION: CAST-IN-PLACE STRUCTURAL CONCRETE. The dry-pack shall be tamped uniformly and symmetrically around the pipe and finished to match the channel wall.

3.8 AUTOMATIC DRAINAGE GATE

3.8.1 Material

Gate and fastening shall conform to the requirements of the SECTION: MISCELLANEOUS METALS. All gates shall be the product of the same manufacturer. The gate shall be rigidly secured in place with the seating surfaces vertical. The gate shall be cast in place, flush with the wall, and with the indicated recess for link clearance. Gates shall be secured to the headwall with galvanized steel or corrosion-resisting steel anchor bolts and bronze washers. The anchor bolts shall be of the size recommended by the gate manufacturer with the nuts tightened after the concrete has cured.

3.9 PAVING

Paving removed for the construction or modification of side drains shall be replaced to match the existing paving.

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SECTION 02750

SCOUR GAGES

1 GENERAL

1.1 GENERAL

The scour gages shall be of the dimensions shown on the drawing and constructed at the locations indicated. After completion of the scour gages, a third order location survey shall be made and all field notes, computations and other records relative to the location of the scour gages shall be recorded in duplicate and the original pages furnished to the Contracting Officer.

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01300 SUBMITTAL DESCRIPTIONS:

SD-01 Data

Stone; GA.

The color, quality, gradation and placement method of the stone granules shall be subject to approval by the Contracting Officer.

2 PRODUCTS

2.1 MATERIAL

2.1.1 Colored Stone

Stone granules shall be a bright red stone or crushed brick, well graded within the following limits.

Sieve Designation	Percent by Weight Passing Square Mesh Sieves
1-1/2"	100
3/8"	0

3 EXECUTION

3.1 DRILLING

The holes shall be drilled with a rotary type auger drill. Drilling equipment requiring the use of wash water will not be permitted. Casing shall be provided by the Contractor and used to protect the top of the holes from caving and to permit completion of drilling of holes to required depth. The casing shall be removed from the holes and from the site when placing of the stone granules is completed. The casing will become the property of the Contractor.

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SECTION 02831

CHAIN LINK FENCE

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 SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 153	(1996) Zinc-Coated (Hot Dip) on Iron and Steel Hardware
ASTM A 392	(1991b) Zinc-Coated Chain-Link Fence Fabric
ASTM A 491	(1994) Aluminum-Coated Steel Chain-Link Fence Fabric
ASTM A 824	(1992) Metallic-Coated Steel Marcellled Tension Wire for Use With Chain Link Fence
ASTM C 94	(1995) Ready-Mixed Concrete
ASTM F 626	(1994a) Fence Fittings
ASTM F 900	(1994) Industrial and Commercial Swing Gates
ASTM F 1043	(1995) Strength and Protective Coatings on Metal Industrial Chain-Link Fence Framework
ASTM F 1083	(1993) Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded for Fence Structures
ASTM F 1184	(1994) Industrial and Commercial Horizontal Slide Gates

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01300 SUBMITTAL PROCEDURES:

SD-13 Certificates

Chain Link Fence; FIO.

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.

2 PRODUCTS

2.1 MATERIALS

Materials 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 2.0 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.

2.1.2 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, 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. 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.

2.1.3 Posts

ASTM F 1083, zinc-coated. Group IA, with external coating Type A steel pipe. 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.

2.1.4 Braces and Rails

ASTM F 1083, zinc-coated, Group IA, steel pipe, size NPS 1-1/4. line posts are furnished.

2.1.5 Tension Wire

Tension wire shall be Type I or Type II, Class 2 coating, in accordance with ASTM A 824.

2.1.6 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. Tie wire for attaching fabric to rails, braces, and posts shall be 9 gauge steel wire and match the coating of the fence fabric. Miscellaneous hardware coatings shall conform to **ASTM A 153** unless modified herein.

2.1.7 Concrete

ASTM C 94, 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.

3 EXECUTION

3.1 GENERAL

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.

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 2 inch clearance between the bottom of the fabric and finish grade.

3.3 POSTS

Posts shall be set plumb and in alignment. Except where solid rock is encountered, line posts shall be set in concrete to the depth of 30 inches and intermediate, corner, end and gate posts shall be set in concrete to the depth of 36 inches. 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 a minimum depth of 36 inches unless a penetration of 18 inches in solid rock is achieved before reaching the 36-inch 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 12 inches in diameter for intermediate, corner, end and gate posts and 9 inches in diameter for line posts. Diameters of holes in solid rock shall be at least one inch greater than the largest cross section of the post. Concrete and grout shall be thoroughly consolidated around each post so as to 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.

3.4 RAILS, BRACES AND TRUSS RODS

Rails, braces and truss rods shall be installed as indicated and in conformance with the standard practice for the fence furnished. Rails, 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.

3.5 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 1 foot 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.

3.6 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 24 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 2 inches (plus or minus 1/2 inch) above the ground.

3.7 GATES

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.

3.8 GROUNDING

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.

3.9 TEMPORARY FENCE

Fabric shall be attached to the structural steel members on the sides facing the temporary bicycle path. Structural steel members and installation shall

conform to the applicable requirements of SECTION: MISCELLANEOUS METALS. Materials need not be new provided they are adequate for the intended purpose. Upon completion of the work, the fence materials shall become the property of the Contractor and shall be removed from the site.

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SECTION 02935

SEEDING

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.

AGRICULTURAL MARKETING SERVICE (AMS)

AMS-01 (Aug 95) Federal Seed Act Regulations Part 201

COMMERCIAL ITEM DESCRIPTIONS

CID A-A-1909 (Basic; Notice 1) Fertilizer

FEDERAL SPECIFICATIONS

FS JJJ-S-181 Seeds, Agricultural

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-08 Statements

Delivery; FIO.

Delivery schedule, at least 10 days prior to the intended date of the first delivery.

Application of Pesticide; GA.

Pesticide Treatment Plan with proposed sequence of pesticide treatment work. The pesticide trade name, chemical composition, formulation, concentration, application rate of active ingredients and method of application for all materials shall be furnished; and the name and state license number of the state certified applicator shall be included.

Maintenance Report; FIO.

Written record of maintenance work performed.

Hydroseed Establishment Period; FIO.

Written calendar time period for the turf establishment period. When there is more than one hydroseed establishment period, describe the boundaries of the seeded area covered for each period.

Endomycorrhizal Inoculant Instructions; FIO.

Manufacturer's written instructions for application rates for intended use.

SD-09 Reports

Soil Test; GA.

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. Soil tests and any subsequent soil tests required by the Government shall be made at the Contractor's expense.

SD-13 Certificates

Seed; GA. Imported Top Soil; GA. Fertilizer; FIO. Endomycorrhizal Inoculant; FIO. Pesticide; GA.

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. Imported Topsoil. Particle size, pH, organic matter content, textural class, soluble salts, chemical and mechanical analyses.
- d. Fertilizer. Chemical analysis and composition percent.
- e. Endomycorrhizal Inoculant: Chemical analysis and composition percent.
- i. Pesticide. EPA registration number and registered uses.

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 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.

1.4.1.2 Pesticides

Pesticide material shall be delivered to the site in the original, unopened containers bearing legible labels indicating the EPA registration number and the manufacturer's registered uses.

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.

2 PRODUCTS

2.1 SEED

2.1.1 Seed Classification

State-approved 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-01** and applicable state seed laws.

2.1.2 Seed Mixtures

Seed species and mixtures shall be proportioned by weight as follows:

Botanical Name	Common Name	Percent Pure Live Seed
Bromus Carinatus	California Brome	5.0 lbs/acre
Deschampsia caespitosa	Tufted Hairgrass	3.8 lbs/acre
Deschampsia elongatum	Hairgrass	2.2 lbs/acre
Eschscholzia californica	Calif. Poppy	2.0 lbs/acre
Hordeum c. prostrate	Calif. Barley	6.0 lbs/acre
Melica Imperfecta	Coast Range Melica	2.0 lbs/acre
Lupinus bicolor	Lupines	3.0 lbs/acre
Poa secunda	Bluegrass	1.3 lbs/acre
Stipa Lepida	Foothill NeedleGrass	1.0 lbs/acre
Vulpia microstacys	Zorro Fescue	4.3 lbs/acre

Total lbs. p.l.s. per acre 30.6

2.1.3 Quality

Seed shall conform to FS JJJ-S-181. Weed seed shall be a maximum 1 percent by weight of the total mixture. Wet, moldy, or otherwise damaged seed shall be rejected.

2.1.4 Seed Mixing

The field mixing of seed shall be performed on site in the presence of the Contracting Officer.

2.1.5 Substitutions

Substitutions will not be allowed without written request and approval from the Contracting Officer.

2.2 TOPSOIL FILL MATERIAL

Topsoil fill material shall be a natural, friable soil representative of productive soils in the vicinity. It shall be obtained from required excavation and shall be free of any admixture of subsoil, foreign matter, objects larger than 1/2 inch in any dimension, toxic substances, and any material or substance that may be harmful to plant growth. The pH range shall be 6.0 to 7.6. Topsoil that does not meet this pH range shall be amended by the addition of pH adjusters, at a rate recommended based on soil tests..

2.3 SOIL AMENDMENTS

Soil amendments shall consist of gypsum, sulfur, fertilizer, organic soil amendments, and endomycorrhizal inoculant meeting the following requirements.

2.3.1 Gypsum

The gypsum is to be supplied in a finely ground form. 100% of the ground material shall pass through a 10 mesh screen and 50% of the material shall pass through a 100 mesh screen. The gypsum shall be free-flowing, commercially packaged, minimum 92 percent calcium sulfate by volume, free of any toxic material.

2.3.2 Sulfur

The sulfur shall be applied in the flour of sulfur finely ground form, and shall be commercial grade.

2.3.3 Granular Fertilizer

Fertilizer shall be commercial grade, free flowing, uniform in composition, and conforming to CID A-A-1909. Granular Fertilizer: Consists of nitrogen-phosphorous-potassium 5-3-1 and 14-4-9 ratio.

2.3.4 Organic Soil Amendments

Delivered topsoil shall be amended as recommended by a soil test provided by the contractor for the plants specified (subject to the Contracting Officer's approval).

2.3.4.1 Decomposed Wood Derivatives

Decomposed wood derivatives shall be ground bark, sawdust, or other wood waste material that is free of stones, sticks, and toxic substances harmful to plants, and is fully composted or stabilized with nitrogen and having the following properties:

Particle size	Minimum % by weight passing
-----	-----
No. 4 mesh screen	95
No. 8 mesh screen	80

Nitrogen Content	Minimum % based on dry weight
-----	-----
Redwood Sawdust	0.5
Fir Sawdust	0.7
Fir or Pine Bark	1.0

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 Wood Cellulose Fiber

Wood cellulose fiber shall not contain any growth or germination-inhibiting factors and shall be dyed an appropriate color to facilitate placement during application. Composition on air-dry weight basis: 9 to 15 percent moisture, pH range from 4.5 to 6.0.

2.4.2 Endomycorrhizal Inoculant

Endomycorrhizal inoculant use as a soil amendment shall be a granular calcined clay based product.

2.5 WATER

Water shall be the responsibility of the Contractor, unless otherwise noted. Water shall not contain elements toxic to plant life.

2.6 PESTICIDE

Pesticide shall be insecticide, herbicide, fungicide, nematocide, rodenticide or miticide. For the purpose of this specification, a soil fumigant shall have the same requirements as a pesticide. The pesticide material shall be EPA registered and approved.

2.7 SURFACE EROSION CONTROL MATERIAL

Surface erosion control material shall be Ecology Control M-binder

3 EXECUTION

3.1 SEEDING TIMES AND CONDITIONS

3.1.1 Seeding Time

Seed shall be sown from October 1st to March 1st. Seeding at times other than this recommended time will be at the risk of the Contractor..

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 to and approved by the Contracting Officer.

3.1.3 Equipment Calibration

The equipment to be used and the methods of seeding shall be subject to the inspection and approval of the Contracting Officer prior to commencement of seeding operations. Immediately prior to the commencement of seeding operations, calibration tests shall be conducted on the equipment to be used in the presence of the Contracting Officer. These tests shall confirm that the equipment is operating within the manufacturer's specifications and will meet the specified criteria.

3.2 SITE PREPARATION

3.2.1 Finished Grade

The Contractor shall verify that finished grades are as indicated on drawings, and the smooth grading, and compaction requirements have been completed in accordance with Section 02250 FILLS AND SUBGRADE PREPARATION, prior to the commencement of the seeding operation.

3.2.2 Application of Soil Amendments and Fertilizer

All soil amendments, conditioners, and fertilizers shall be incorporated into the soil to a depth of at least the top 4 inches, as applicable, and may be incorporated as part of the tillage operation or as part of the topsoil fill operation, using a rotary tiller or similar type of equipment to obtain a uniform and well-pulverized soil mix.

3.2.2.1 Applying Fertilizer

The fertilizer (5-3-1) shall be applied at the rate of 150 pounds per 1000 square feet.

3.2.2.2 Applying Soil Amendments

The gypsum shall be applied at the rate of 200 pounds per 1000 square feet. The Decomposed Wood Derivative shall be applied at the rate of 200 cubic yards per acre.

3.2.2.3 Applying Endomycorrhizal Inoculant

Endomycorrhizal inoculant shall be applied at the rates recommended by the manufacturer's written instructions for its intended use. Endomycorrhizal inoculant shall be incorporated into the soil to a depth of at least the top 4 inches, as applicable, and may be incorporated as part of the tillage operation. However, the inoculant shall not be incorporated into the ground more than six weeks prior to seeding operations and shall not be placed on top of the ground for more than six hours prior to incorporation into the soil.

3.2.3 Application of Soil Treatment Chemicals

When soil treatment becomes necessary to remove a pest, a state certified applicator shall apply required chemicals in accordance with EPA label restrictions and recommendations. Hydraulic equipment shall be provided for the liquid application of chemicals with a lead-proof tank, positive agitation methods, controlled application pressure, and metering gauges.

3.2.4 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. Undulations or irregularities in the surface shall be compacted to 80-85 percent. During tillage operations, all sticks, roots and other objectionable material shall be removed and the soil restored to an even condition immediately before seeding. 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.

3.2.5 Prepared Surface

3.2.5.1 Preparation

The prepared surface shall be a maximum 1/2 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.

3.2.5.2 Field Area Debris

Debris and stones over a minimum 3 inch in any dimension shall be removed from the surface.

3.2.5.3 Protection

Areas with the prepared surface shall be protected from compaction or damage by vehicular or pedestrian traffic and surface erosion.

3.3 SEEDING

Prior to seeding, any previously prepared surface compacted or damaged by interim rain, traffic, or other causes 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 Hydroseeding

Seed and mulch shall be added to the required amount of water and thoroughly mixed to meet the following rates rates per acre:

- a. Seed: As specified for each mix
- b. Wood: Wood cellulose fiber mulch - 400 lbs.

The time period for the seed to be held in the slurry shall be a maximum 3 hours. Slurry shall be uniformly applied under pressure over the entire area. The hydroseeded area shall not be rolled.

3.3.2 Mulching

3.3.2.1 Hydroseeded Area

After the hydroseeding operation, fertilizer, erosion control material, and wood cellulose fiber mulch shall be mixed in the required amount to water to produce a homogeneous slurry and then hydromulched under pressure at the following rates per acre (dry weight).

- a. Wood cellulose fiber - 1,400 lbs.
- b. 14-4-9 commercial fertilizer - 300 lbs.
- c. Erosion Control material - 130 lbs.

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.

3.5 APPLICATION OF PESTICIDE

When application of a pesticide becomes necessary to remove a pest or disease, a pesticide treatment plan shall be submitted and coordinated with the installation pest management program.

3.5.1 Application

A state certified applicator shall apply required pesticides in accordance with EPA label restrictions and recommendations. Hydraulic equipment shall be provided for the liquid application of pesticides with a leak-proof tank, positive agitation methods, controlled application pressure and metering gauges.

3.6 RESTORATION AND CLEAN UP

3.6.1 Restoration

Existing planting 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.

3.7 PROTECTION OF SEEDED 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 work under this contract and shall end four (4) months after the last day of the seeding operation. 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.

3.8.2 Satisfactory Stand of Grass Plants

An acceptable seeded area from the seeding operation is defined as a solid soil surface ground covering of plants from the required seed mix. The total bare spots shall not exceed 2 percent of the total seeded area. No bare spots shall exceed 6 in dia.

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; watering; post-fertilization; and any other operation necessary to promote healthy plant establishment.

3.8.3.1 Watering

Watering shall be at intervals to obtain a moist soil condition to a minimum depth of 2 inches. Frequency of watering and quantity of water shall be adjusted in accordance with the growth of the seeded material. Run-off, puddling and wilting be prevented.

3.8.3.2 Post-Fertilization

Granular fertilizer with the composition of 5% nitrogen, 3% phosphorous, 1% potassium shall be applied at the rate of 25 pounds per 1000 square feet 45 days after the commencement of the maintenance period. The application shall be timed prior to the advent of winter dormancy and shall avoid excessively high nitrogen levels.

3.8.3.3 Pesticide Treatment

Treatment for disease or pest shall be in accordance with paragraph APPLICATION OF PESTICIDE.

3.8.3.4 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.

3.8.3.5 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.

3.9 FINAL ACCEPTANCE

3.9.1 Preliminary Inspection

Prior to the completion of the Plant Establishment Period, a preliminary inspection will be held by the Contracting Officer. Time for the inspection will be established in writing. The acceptability of the seeded areas in accordance with the Plant Establishment Period shall be determined. An

unacceptable stand of seeded planting, as determined by the Contracting Officer, shall be repaired as soon as seeding conditions permit.

3.9.2 Final Inspection

A final inspection will be held by the Contracting Officer to determine that deficiencies noted in the preliminary inspection have been corrected. Time for the inspection will be established in writing.

3.9.3 Maintenance

Once the hydro-seeded area is established and after the grasses have gone to seed (as determined by the Contracting Officer), the Contractor shall mow or weed-whip the entire area with approved equipment. The vegetation shall be mowed to 2 inches above finish grade and the material removed from the project site. The area shall be kept weed-free until the project is accepted by the Contracting Officer.

-- End of Section --