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SECTION 02220

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SECTION 02220

DEMOLITION

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to 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 and removal of an existing culvert, sanitary sewer, removal of existing rubbish and debris, and rubbish and debris resulting from construction. Rubbish and debris shall be removed from Government property daily, unless otherwise directed, to avoid accumulation at the site. Materials that cannot be removed daily shall be stored in areas specified by the Contracting Officer. In the interest of occupational safety and health, the work shall be performed in accordance with EM 385-1-1, Section 23, Demolition, and other applicable Sections. In the interest of conservation, salvage shall be pursued to the maximum extent possible; salvaged items and materials shall be disposed of as specified.

1.3 SUBMITTALS

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

SD-03 Product Data

Work Plan;

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 DUST CONTROL

The amount of dust resulting from demolition shall be controlled to prevent the spread of dust to occupied portions of the construction site and to avoid creation of a nuisance in the surrounding area. Use of water will not be permitted when it will result in, or create, hazardous or objectionable conditions such as ice, flooding and pollution.

1.5 PROTECTION

1.5.1 Protection of Personnel

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

1.5.2 Protection of Existing Property

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

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.1 UTILITIES

Existing utilities shall be removed as indicated. When utility lines are encountered that are not indicated on the drawings, the Contracting Officer shall be notified prior to further work in that area.

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.

3.2.1 Salvageable Items and Material

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

3.2.1.1 Material Salvaged for the Contractor

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

3.3 CLEAN UP

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

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SECTION 02230

CLEARING AND GRUBBING

PART 1 GENERAL

1.1 DEFINITIONS

1.1.1 Clearing

Clearing shall consist of the felling, trimming, and cutting of trees into sections and the satisfactory disposal of the trees and other 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.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.1 CLEARING

Trees, stumps, roots, brush, and other vegetation in areas to be cleared shall be cut off flush with or below the original ground surface, except such trees and vegetation as may be indicated or directed to be left standing. Trees designated to be left standing within the cleared areas shall be trimmed of dead branches 1-1/2 inches or more in diameter and shall be trimmed of all branches the heights indicated or directed. Limbs and branches to be trimmed shall be neatly cut close to the bole of the tree or main branches. Cuts more than 1-1/2 inches in diameter shall be painted with an approved tree-wound paint.

3.2 GRUBBING

Grubbing shall consist of the complete removal of stumps, and roots over 1 inch diameter. 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 TREE REMOVAL

Trees that are designated or directed to be removed from areas outside those areas designated for clearing and grubbing shall include the felling

of such trees and the removal of their stumps and roots as specified in paragraph GRUBBING.

3.4 DISPOSAL OF MATERIALS

Trees, logs, stumps, roots, brush, rotten wood, and other refuse from the clearing and grubbing operations shall be disposed of by the Contractor.

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SECTION 02300

EARTHWORK

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 117	(1995) Materials Finer Than 75 Micrometers (No. 200 Sieve) in Mineral Aggregates by Washing
ASTM C 136	(1996) Sieve Analysis of Fine and Coarse Aggregates
ASTM D 698	(1991; R 1998) Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft ³) (600 KN-m/m ³)
ASTM D 1556	(1996) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 2487	(1998) Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 2488	(1993) Description and Identification of Soils
ASTM D 2922	(1996) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 3017	(1988; R 1996) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
ASTM D 4318	(1998) Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D 4718	(1987; R 1994) Correction of Unit Weight and Water Content for Soils Containing Oversize Particles

1.2 SUBMITTALS

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

SD-01 Preconstruction Submittals

Excavation Staging Plan; G,GT

The submittal shall detail the excavation sequence, the equipment to be used for excavation and hauling, and locations of primary haul routes. Attach a copy of the project schedule with the submittal. The plan shall be in agreement with the dewatering scheme, and submitted with the channel excavation dewatering plan.

SD-06 Test Reports

Testing;

A summary of testing results indicated in PARAGRAPH: TESTING shall be submitted when the site work is substantially complete. The Contracting Officer shall be informed of test results daily for direction on corrective action required. Draft copies of field testing results shall be furnished to the Contracting Officer on a frequent and regular basis as directed, but do not need to be formally transmitted through the submittal process.

1.3 SUBSURFACE DATA

Reference the Physical Data clause in Section 00800.

PART 2 PRODUCTS

2.1 DEFINITIONS

2.1.1 Satisfactory Materials

Satisfactory materials shall be of a character and quality satisfactory for the purpose intended, and meet the applicable material specifications.

2.1.2 Cohesionless and Cohesive Materials

Cohesionless materials include materials classified in ASTM D 2487 as GW, GP, SW, and SP. Cohesive materials include materials classified as GC, SC, ML, CL, MH, and CH. Materials classified as GM and SM will be identified as cohesionless only when the fines are nonplastic.

2.1.3 Proctor

Degree of compaction required is expressed as a percentage of the maximum

density obtained by the test procedure presented in ASTM D 698. The maximum density is hereafter abbreviated as the "Standard Proctor" or "Proctor" value.

2.1.4 Embankment

The term "embankment" as used in these specifications is defined as the earth fill portions of the "disposal area", "berms" and "Texas Crossing". Embankment includes all types of earth fill materials for the embankments and all other specified or directed earth fills, (excepting those riprap and bedding materials used for slope protection, which are described in SECTION: STONE PROTECTION), within the limits of the embankment.

2.2 MATERIALS

2.2.1 Impervious Fill

Impervious fill material shall consist of material classified by ASTM D2487 as SM, SC, or CL with not less than 30 percent by weight passing the No. 200 sieve. Impervious fill shall have a plasticity index less than 50. Impervious fill shall have less than 40% retained on the No. 4 sieve, and less than 30% retained on the 3/4" sieve. The material shall be free of ice, snow, frozen earth, trash, debris, sod, roots, organic matter, or stones larger than 8 inches in any dimension. Material obtained from above elevation 836.00 in the cutoff channel excavation would be best utilized as impervious fill.

2.2.2 Topsoil

Material suitable for topsoils obtained from offsite areas or excavations shall be as defined in ASTM D 5268. Total depth of topsoil shall be 4 inches.

2.3 CONSTRUCTION EQUIPMENT

Compaction equipment shall consist of sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, or other approved equipment well suited to the soil type being compacted. Water flooding or jetting methods of compaction will not be permitted for any soil types. Sprinkling equipment for cohesive soils shall apply water uniformly, in controlled quantities, and be capable of variable application widths.

2.3.1 Berm

Use of sheepsfoot rollers (vibratory or non-vibratory), or scarification between lifts, is required for construction of dams, dikes, or levees (any water retaining structures). Construction equipment and methods shall avoid poor bonding between lifts, characterized by layered or laminated texture at the lift interfaces. Smooth surfaces (such as produced from smooth drum rollers, rubber tired rollers, and construction traffic) shall be scarified prior to placing subsequent lifts.

PART 3 EXECUTION

3.1 CLASSIFICATION OF SOIL MATERIALS

Classification of soil materials shall be performed by the Contractor in accordance with ASTM D 2488. The Contracting Officer reserves the right to revise the Contractor classifications. In the case of disagreement, the Contracting Officer's classification will govern unless the soils are classified in accordance with ASTM D 2487. All testing completed by the Contractor in conjunction with soil material classification will be considered incidental to the contract work.

3.2 STRIPPING OF TOPSOIL

Where indicated or directed, topsoil shall be stripped to a depth of 6 to 8 inches. Topsoil shall be spread on areas already graded and prepared for topsoil, or transported and deposited in stockpiles convenient to areas that are to receive application of the topsoil later, or at locations indicated or specified. Topsoil shall be kept separate from other excavated materials, brush, litter, objectionable weeds, roots, stones larger than 2 inches in diameter, and other materials that would interfere with planting and maintenance operations. Any surplus of topsoil from excavations and grading shall be placed in the disposal area.

3.3 EXCAVATION

After topsoil removal has been completed, excavation of every description, regardless of material encountered, within the grading limits of the project shall be performed to the lines and grades indicated. Excavation material suitable for use as fill shall be transported to and placed in fill areas within the limits of the work. Excavations carried below the depths indicated shall be refilled to the proper grade with satisfactory material.

3.3.1 Channel Excavation

During construction, excavation and fill shall be performed in a manner and sequence that will provide proper drainage at all times. Dewatering shall be implemented in a timely manner to provide drainage of granular soils. Excavation shall be staged to implement dewatering provisions as soon as practicable. Excavation cuts shall be made staged with proper equipment to minimize caving and sloughing of the face when water is seeping in the excavation. Excavation staging shall be modified to best adapt to the stratigraphy. Excavated soil which softened due to exposure water shall be placed in the disposal area at specific locations as directed.

3.3.2 Changes and Differing Site Conditions

Excavation subgrades in the berm and the Texas crossing are subject to approval of the Contracting Officer. In the event that it is necessary to remove material to a depth greater than specified, the Contracting Officer will provide direction for changed work; and an adjustment in the contract price will be considered in accordance with the contract. Determination of elevations and measurements of approved overdepth excavation of unsatisfactory material below grades indicated shall be done under the

direction of the Contracting Officer. The Contracting Officer shall be notified prior to proceeding with any unauthorized work. Additional work not authorized by the Contracting Officer shall be at the Contractor's expense.

3.4 DITCHES, GUTTERS, AND CHANNEL CHANGES

Ditches, gutters, and channel changes shall be cut accurately to the cross sections and grades indicated. Gutters and ditches shall be finished in a manner that will result in effective drainage. All roots, stumps, rock, and foreign matter in the sides and bottom of ditches, gutters, and channel changes shall be trimmed and dressed or removed to conform to the slope, grade, and shape of the section indicated. Care shall be taken not to excavate ditches and gutters below the grades indicated. Excessive ditch and gutter excavation shall be backfilled to grade with properly placed and compacted material. All ditches and gutters excavated under this section shall be maintained until final acceptance of the work. Satisfactory material excavated from ditches and channel changes shall be placed in fill areas.

3.5 BERM AND UTILITY TRENCH BACKFILL

Fill in the berm shall be constructed at the locations and to lines and grades indicated. Fill shall meet the material specifications for the zones indicated on the drawings. The material shall be placed in successive horizontal layers for the full width of the cross section and shall be compacted as specified. Each layer shall be compacted before the overlaying lift is placed.

3.5.1 Placement And Compaction

Each layer shall be spread uniformly on an acceptable soil surface. The type of fill, its maximum uncompacted lift thickness, and the minimum compaction requirements (Percent of Standard Proctor density) to which each type of fill shall be compacted shall be as listed below.

<u>Fill Zone</u>	<u>Maximum Uncompacted Lift Thickness (inches)</u>	<u>Percent of Standard Proctor Density</u>
Impervious Fill in Berm	8	95
Select Granular Bedding Material for Utility Backfill Above Elevation 850	12	95
Utility Backfill and Replacement of overexcavation in Channel and Texas Crossing areas	12	85

- a. Cohesive fill materials shall be placed in horizontal layers not exceeding 6 inches loose depth when hand operated compactors are used.

3.6 DISPOSAL AREA

It is the general intention of the specification to obtain the compaction of the disposal area to approximately match the density of the insitu soil to be excavated. Fill in the disposal area shall be constructed at the locations and to lines and grades indicated. The material shall be placed in successive horizontal layers not exceeding 12 inches in thickness. Each horizontal layer shall be compacted with at least 1 pass of a self driven vibratory sheepsfoot compactor. Alternate compactors shall be approved by the Contracting Officer, provided the Contractor demonstrates that the lift thickness and compactive energy is equivalent. Each layer shall be compacted before the overlaying lift is placed.

3.7 TEXAS CROSSING SUBGRADE PREPARATION

3.7.1 Subgrade Correction

The Texas crossing subgrade shall be scarified or plowed to a depth of 12 inches, dried to a moisture estimated to be near the plastic limit, or the optimum moisture content by the Standard Proctor test, and compacted. The soil shall be recompacted each day so that loose soil is not left overnight. Any areas that are seeping water, or are considered too wet or unstable to dry and compact shall be identified, marked, and brought to the Contracting Officer's attention. Previously placed aggregate for stabilizing haul roads is an acceptable subgrade.

3.10.1 Proof Rolling

The Texas crossing subgrade shall be proof-rolled immediately prior to placing aggregate base. The proof rolling shall be inspected by the Contracting Officer and the CQC System Manager. Proof-rolling shall be accomplished within the limits of the work by passing a loaded 20 ton dump truck or rubber tired heavy equipment over the entire subgrade at a slow rate of speed. The proofrolling shall continue until both inspectors are satisfied with the coverage and markings. Unusually soft or wet areas shall be identified and marked. Aggregate base shall not be placed in the identified soft areas until approved by the Contracting Officer.

3.8 FINISHING

All areas covered by the project, including excavated and filled sections and adjacent transition areas, shall be uniformly smooth-graded. The finished surface shall be reasonably smooth, compacted, and free from irregular surface changes. The degree of finish shall be that ordinarily obtainable from blade-grader operations, except as otherwise specified. Ditches and gutters shall be finished to permit adequate drainage. The surface of areas to be turfed shall be finished to a smoothness suitable for the application of turfing.

3.9 PLACING TOPSOIL

Topsoil placement is covered in SECTION: ESTABLISHMENT OF TURF. The finished grade shall be such that after subsequent treatment (tillage, topsoiling and planting) the planted grade shall join 1 inch below adjoining surfaced grade of walks, curbs and drives and even with adjoining

turfed areas.

3.10 TESTING

3.10.1 General

All testing expenses shall be the Contractor's responsibility. Prior to sampling and testing the work, testing laboratories shall be inspected and approved in accordance with SECTION 01451: CONTRACTOR QUALITY CONTROL. The Contracting Officer reserves the right to direct the location and select the material for samples to be tested and to direct where and when moisture-density tests shall be performed.

3.10.2 Field Density Tests

Report forms for summaries of field density tests shall include the minimum information. Additional data required by the applicable ASTM test methods shall be kept on file by the Contractor. Tests shall be numbered sequentially throughout the job, and retests shall reference the original test number (1A, 1B, etc.)

1. Test Number
2. Dry density, water content and gravel content of field test
3. Proctor Number, maximum dry density, optimum water content, and gravel content
4. Relative Compaction
5. Each test shall be plotted on the graphic presentation of the applicable Proctor test.

3.10.3 Proctor Tests

Report forms for summaries of Proctor tests shall include the minimum information. Additional data required by the applicable ASTM test methods shall be kept on file by the Contractor. Jar samples shall be retained by the testing laboratory for each Proctor test until field testing is completed.

1. Test Number and method
2. Sample location and visual soil description
3. maximum dry density, and optimum water content
4. gravel contents in sample and test specimens

3.10.4 Treatment of Oversize Particles for Density Tests

The fine gravel contents shall be corrected by selecting an appropriate Proctor sample. The fine gravel content shall be the particles retained on the No. 4 sieve and passing the 3/4" sieve. The fine gravel content of the field density test shall be within +5% of the fine gravel content of the Proctor sample.

The oversize fraction shall be particles retained on the 3/4" sieve. For oversize fractions greater than 5%, the oversize particles shall be corrected in accordance with the Finer Fraction Method specified in ASTM D

4718.

Each sand cone test shall report the gravel content retained on the No. 4, 3/8" and 3/4" sieve as appropriate for the proctor method referenced.

Where nuclear testing is used and lack of uniformity in the soil due to layering, rock or voids are suspected, the test volume site shall be dug up and visually examined to determine if the test material is representative of the full material in general and if rock correction is required.

3.10.5 Corrective Action

Tests of materials which do not meet the contract requirements (failing test) will not be counted as part of the required testing. Each such failing test must be retaken at the same location as the failing test was taken. If testing indicates material does not meet the contract requirements, the material represented by the failing test shall not be placed in the contract work or shall be recompacted or removed. The quantity of material represented by the failing test shall be determined by the Contracting Officer up to the quantity represented by the testing frequency. The Contractor may increase testing frequency in the vicinity of a failing test in order to reduce removal requirements, as approved by the Contracting Officer. Such increases in testing frequency shall be at the Contractor's expense and at no additional cost to the Government.

3.10.6 Testing Schedule

a. Moisture-Density Relations (ASTM D 698)

One test for each material variation.

b. In-Place Densities (ASTM D 1556 or ASTM D 2922)

Berm: 3 tests minimum.

Select Granular Bedding Material for Utility Backfill: 1 test per 250 linear feet

Utility Trench Backfill, and Replacement of overexcavation in Channel and Texas Crossing areas: 1 test per 250 CY

c. Percent Passing No. 200 sieve (ASTM C 117)

Impervious Fill, 1 test for each 100 CY.

d. Sieve Analysis (ASTM C 136)

Select Granular Backfill, 1 test before delivery.

e. Plasticity Index (ASTM D 4318)

(1) Cohesive soils, 1 test for each Proctor test

3.11 NUCLEAR DENSITY TESTING EQUIPMENT

Nuclear density testing equipment shall be used in general accordance with

ASTM D 2922 and ASTM D 3017. In addition, the following conditions shall apply:

- a. Prior to using the nuclear density testing equipment on the site, the Contractor shall submit to the Contracting Officer a certification that the operator has completed a training course approved by the nuclear density testing equipment manufacturer, the most recent data sheet from the manufacturer's calibration, and a copy of the most recent statistical check of the standard count precision.
- b. The first test and every tenth test thereafter shall include a sand cone correlation test. The sand cone test shall be centered over the prepared surface for the nuclear test, shall include a nominal 6 inch diameter sand cone, and shall include a minimum wet soil weight of 6 pounds extracted from the hole. In addition, testing of aggregate base soils shall include a minimum of 3 sand cone correlations for each day of testing; and testing of bituminous shall include a minimum of 3 core densities for each day of testing. The density correlations shall be submitted with test results. Each transmittal including density test data shall include a summary of all density correlations for the job neatly prepared on a summary sheet including at a minimum:
 - (1) date, meter serial number and operators initials.
 - (2) standard count and adjustment data for each test.
 - (3) material type.
 - (4) probe depth.
 - (5) moisture content by each test method and the deviation.
 - (6) wet density by each test method and the deviation.
- c. The nuclear density testing equipment shall be capable of extending a probe 6 inches minimum down into a hole. The probe shall generally be extended to the maximum depth obtainable.
- d. Nuclear density testing equipment used within 2 vertical feet from the existing ground water level, 5 horizontal feet from a vertical wall or massive concrete structure, or in a trench shall have the standard count changed before and after each test, or the manufacturers published correction procedure shall be followed.
- e. Nuclear density testing equipment shall not be used during rain.

3.12 SUBGRADE AND EMBANKMENT PROTECTION

Compacted subgrades that are disturbed by the Contractor's operations or adverse weather shall be scarified and compacted as specified herein to the required density prior to further construction thereon. Subgrades not meeting the specifications for finish, material type and density at the time of surface material placement shall be corrected at the Contractor's expense. Cohesive embankments and subgrades shall be kept crowned or sloped for drainage. Newly graded areas shall be protected from traffic and erosion. Any settlement or washing away that may occur from any cause shall be repaired. No base course or pavement shall be laid until the subgrade has been checked and approved by the Contracting Officer. Ditches and drains along subgrade shall be maintained to provide effective

drainage. All work shall implement best management practices for erosion control.

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DIVISION 02 - SITE WORK

SECTION 02316

EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITY SYSTEMS

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SECTION 02316

EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITY SYSTEMS

PART 1 GENERAL

1.1 REFERENCES

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

ENGINEERING MANUALS (EM)

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

OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION(OSHA)

29 CFR 1926 Subpart P, Excavations

1.2 RELATED WORK OF OTHER SECTIONS

Dewatering is covered in SECTION 01000: GENERAL. Material definitions, backfill compaction and testing requirements are covered in SECTION 02300: EARTHWORK.

1.3 DEFINITIONS

Reference to pipes shall include conduits, cables, or other utility systems. Appurtenant structures include manholes, catch basins, inlets, outlets, energy dissipators, or similar structures.

PART 2 PRODUCTS

2.1 MATERIALS

In addition to the definitions below, material definitions shall be as specified in SECTION 02300: EARTHWORK.

2.1.1 Unyielding Material

Unyielding material shall consist of rock and gravelly soils with stones greater than 3 inches in any dimension or as defined by the pipe manufacturer, whichever is smaller.

2.1.2 Unstable Material

Unstable material shall consist of materials too soft and/or compressible to properly support the pipe or appurtenant structure.

2.1.3 Select Granular Backfill Material

Select granular material shall consist of well-graded sand, gravel, crushed gravel, crushed stone or crushed slag composed of hard, tough and durable particles, and shall contain not more than 5 percent by weight of material passing the No. 200 mesh sieve, not more than 20 percent by weight of material passing the No. 40 mesh sieve and no less than 95 percent by weight passing the 3/8 inch sieve. The maximum allowable aggregate size shall be 2 inches, or the maximum size recommended by the pipe manufacturer, whichever is smaller.

2.2 PLASTIC MARKING TAPE

Plastic marking tape shall be acid and alkali-resistant polyethylene film, 6 inches wide with minimum thickness of 0.004 inch. Tape shall have a minimum strength of 1750 psi lengthwise and 1500 psi crosswise. The tape shall be manufactured with integral wires, foil backing or other means to enable detection by a metal detector when the tape is buried up to 3 feet deep. The tape shall be of a type specifically manufactured for marking and locating underground utilities. The metallic core of the tape shall be encased in a protective jacket or provided with other means to protect it from corrosion. Tape color shall be as specified in TABLE 1 and shall bear a continuous printed inscription describing the specific utility.

TABLE 1. Tape Color

Red:	Electric
Yellow:	Gas, Oil, Dangerous Materials
Orange:	Telephone, Telegraph, Television, Police, and Fire Communications
Blue:	Water Systems
Green:	Sewer Systems

PART 3 EXECUTION

3.1 EXCAVATION

Unless otherwise indicated, trench excavation shall be by open cut except that short sections may be jacked or bored if the utility can be safely and properly installed and ground loss can be properly controlled. All excavation shall be constructed in accordance with the Safety and Health Requirements Manual (EM 385-1-1) and/or OSHA Standards. Allowable trench widths, depths, side slopes, sheet and bracing requirements, and other considerations are given in the OSHA Standard; and an abbreviated version is given in the Safety and Health Requirements Manual.

3.1.1 Trench Excavation

Excavation shall be performed to the lines and grades indicated. During excavation, material satisfactory for backfilling shall be stockpiled in a neat and orderly manner at a sufficient distance from the banks of the

trench to avoid overloading and to prevent slides or caving. Topsoil shall be stockpiled separately from suitable backfill material. Grading shall be done as may be necessary to prevent surface water from flowing into the excavation, and any water accumulating therein shall be removed to maintain the stability of the bottom and sides of the excavation. Unauthorized over excavation shall be backfilled at no additional cost to the Government.

3.1.1.1 Bottom Preparation

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

3.1.1.2 Unyielding Material

Where unyielding material is encountered in the bottom of the trench, such material shall be removed 8 inches below the required grade and replaced with select granular fill.

3.1.1.3 Unstable Material

Where wet, soft, unsuitable or otherwise unstable soil incapable of properly supporting pipe is encountered in the bottom of a trench or excavation, the Contractor shall immediately contact the Contracting Officer prior to proceeding with the associated work. When removal of unstable material is required due to inadequate shoring and sheeting, water removal, control of ground water or other similar operations, such unstable material shall be excavated and replaced with satisfactory material as directed at no additional cost to the Government.

3.1.1.4 Excavation for Appurtenances

Excavation for appurtenances shall be of sufficient size to permit the placement and removal of forms for the full length and width of structure footings and foundations as shown. Removal of unstable material shall be as specified above. When concrete or masonry is to be placed in an excavated area, special care shall be taken not to disturb the bottom of the excavation. Excavation to the final grade level shall not be made until just before the concrete or masonry is to be placed.

3.1.2 Stockpiles

Stockpiles shall be kept in a neat and well drained condition, giving due consideration to drainage at all times. The ground surface at stockpile locations shall be cleared, grubbed, and sealed. Satisfactory and unsatisfactory materials shall be separately stockpiled. Stockpiles of satisfactory materials shall be protected from contamination which may destroy the quality and fitness of the stockpiled material. If the Contractor fails to protect the stockpiles, and any material becomes contaminated, frozen or too wet for use, such material shall be removed and

replaced with satisfactory material from approved sources at no additional cost to the Government.

3.2 BACKFILLING AND COMPACTION

Backfill shall consist of satisfactory material meeting the requirements shown and specified. Compaction and testing requirements for backfill shall be as stated in SECTION 02300: EARTHWORK.

3.2.1 Backfill for Appurtenances

After the structure has been constructed and the concrete has been allowed to cure for 7 days, backfill shall be placed in such a manner that the structure will not be damaged by the shock of falling earth. The backfill material shall be deposited and compacted as specified for final backfill, and shall be brought up evenly on all sides of the structure to prevent eccentric loading and excessive stress.

3.3 SPECIAL REQUIREMENTS

3.3.1 Plastic Marking Tape

Warning tapes shall be installed directly above the pipe, at a depth of 18 inches below finished grade unless otherwise shown.

3.4 DISPLACEMENT OF SEWERS

The Contractor shall be responsible for verifying that installation methods meet common practice, recommendations of the pipe manufacturer, and are sufficient for the site conditions. Provisions should be made to prevent pipe floatation. If, in the judgement of the Contracting Officer, the interior of the pipe shows poor alignment or any other defects that would cause improper functioning of the system, the defects shall be remedied as directed at no additional cost to the Government.

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SECTION 02378

GEOTEXTILES USED AS FILTERS

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
(AASHTO)

AASHTO M 288 (1996) Geotextile Specification for
Highway Applications

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 4354 (1996) Sampling of Geosynthetics for
Testing

ASTM D 4632 (1991; R 1996) Grab Breaking Load and
Elongation of Geotextiles

ASTM D 4873 (1997) Identification, Storage, and
Handling of Geosynthetic Rolls

1.2 SUBMITTALS

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

SD-03 Product Data

Geotextile Data;

Catalog cuts or technical data sheet shall be submitted for the geotextile showing that the product meet the specifications.

SD-06 Test Reports

Geotextile Test Results;

Submitted signed copies of the geotextile testing. The first test

shall be submitted prior to installation.

SD-07 Certificates

Geotextile;

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.

1.3 SHIPMENT, HANDLING, AND STORAGE

1.3.1 Shipment and Storage

Only approved geotextile shall be delivered to the project site. All geotextile shall be labeled, shipped, stored, and handled in accordance with ASTM D 4873. No hooks, tongs, or other sharp instruments shall be used for handling geotextile.

PART 2 PRODUCTS

2.1 GEOTEXTILE

Geotextile shall meet the requirements of AASHTO M 288, permanent erosion control geotextile selected for an in-situ soil having greater than 50% passing the No. 200 sieve (0.075 mm), and having a permitivity not less than 0.7 per second.

2.1.1 Geotextile Fiber

Fibers used in the manufacturing of the geotextile shall consist of a long-chain synthetic polymer composed of at least 85 percent by weight of polyolefins, polyesters, or polamides. Stabilizers and/or inhibitors shall be added to the base polymer if necessary to make the filaments resistant to deterioration caused by ultraviolet light and heat exposure. Reclaimed or recycled fibers or polymer shall not be added to the formulation. Geotextile shall be formed into a network such that the filaments or yarns retain dimensional stability relative to each other, including the edges. The edges of the geotextile shall be finished to prevent the outer fiber from pulling away from the geotextile.

2.2 GEOTEXTILE TESTING

Two sample of the geotextile shall be obtained in accordance with ASTM D 4354 and tested for grab tensile strength in accordance with ASTM D 4632. One sample shall be obtained from the rolls prior to delivery, and one sample shall be obtained from the material delivered to the job site. Both samples shall be obtained in the presence of the Contracting Officer, unless waived.

PART 3 EXECUTION

Additional specific requirements for placing riprap are covered in Section 02388.

3.1 SURFACE PREPARATION

Surface on which the geotextile will be placed shall be prepared to a relatively smooth surface condition, in accordance with the applicable portion of this specification and shall be free from obstruction, debris, depressions, erosion feature, or vegetation. Any irregularities will be removed so as to insure continuous, intimate contact of the geotextile with all the surface. Any loose material, soft or low density pockets of material, will be removed; erosion features such as rills, gullies etc. must be graded out of the surface before geotextile placement.

3.2 INSTALLATION OF GEOTEXTILE

The geotextile shall be placed in the manner and at the locations shown. Geotextile shall be covered with the specified materials as soon as practicable after the geotextile is installed. All geotextile shall be covered with 7 days after installation.

3.3 PROTECTION

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 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. In no case shall any type of equipment be allowed on the unprotected geotextile. Any geotextile damaged shall be uncovered as necessary and replaced at no cost to the Government.

3.4 PLACEMENT OF MATERIAL ON GEOTEXTILE

The placement shall be performed in a manner that shall not damage the geotextile including tear, puncture, or abrasion. On sloping surfaces, granular fill or aggregate base materials shall be placed from the bottom of the slopes upward.

3.5 OVERLAPPING AND SEAMING

Seams may be sewn or overlapped. Overlaps shall be a minimum of 24 inches. Thread for sewing shall meet the chemical requirements given above for geotextile yarn. Alternate methods of seaming, such as bonding by cement or by heat, shall be submitted for approval, and (if approved) shall be accompanied by seam testing for verification.

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SECTION 02388

STONE PROTECTION (RIPRAP)

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 33	(1999) Concrete Aggregates
ASTM C 127	(1988; R 1993) Specific Gravity and Absorption of Coarse Aggregate
ASTM C 136	(1996a) Sieve Analysis of Fine and Coarse Aggregates
ASTM C 295	(1998) Petrographic Examination of Aggregates for Concrete
ASTM D 75	(1987; R 1997) Sampling Aggregates
ASTM D 4791	(1995) Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate
ASTM D 4992	(1994) Evaluation of Rock to be Used for Erosion Control
ASTM D 5312	(1992; R 1997) Evaluation of Durability of Rock for Erosion Control Under Freezing and Thawing Conditions

CORPS OF ENGINEERS (COE)

EM 1110-2-2302	(1990) Construction with Large Stone
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Minnesota Department of Transportation (MNDOT) Standard Specifications for Construction

MNDOT 2511	(1995) Riprap
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1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation;

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

SD-01 Preconstruction Submittals

Material Sources; G, GT

The Contractor shall designate in writing only one source or one combination of sources from which he proposes to furnish stone. The Contractor shall state in writing methods of processing and handling riprap, and shall notify the Contracting Officer when production methods are changed.

SD-06 Test Reports

Gradation Test;

Gradation Test Results for riprap and aggregates. Riprap gradation testing results shall be submitted on the WORKSHEET FOR GRADATION ANALYSIS OF RIPRAP and the gradation curve (form 4055). A blank copy of each form is included at the end of this section.

SD-07 Certificates

Certified Weight Scale Tickets;

Copies of all certified weight scale tickets shall be furnished to the Contracting Officer at a frequency as directed. The tickets do not need to be formally submitted through the submittal process.

PART 2 PRODUCTS

2.1 STONE SOURCES AND EVALUATION

Stone and aggregate materials shall be produced from the sources listed in SECTION 00830: ATTACHMENTS. If the Contractor proposes to furnish materials from a source not listed, the Government Geologist will make such investigations and evaluations as necessary to determine whether or not materials with acceptable durability can be produced from the proposed source. The rock supplied shall be produced from one rock formation to provide a product of uniform appearance. The Contractor shall not supply rock from various formations, or mix field stone with quarried rock, unless approved by the Contracting Officer. It is the Contractor's responsibility to determine that the stone source or combination of sources selected is capable of providing the quality, quantities and gradation needed and at the rate needed to maintain the scheduled progress of the work.

2.1.1 Alternate Sources

a. Evaluation by Site Inspection. If the Contractor proposes to furnish stone from an unlisted source, the Government will evaluate the alternate

source and reply within 30 days. A quarry investigation shall be performed by a Government geologist or engineer. If the source is an undeveloped quarry or if the operation has been dormant for more than one year such that the quarry face is weathered, the Contractor shall expose fresh rock for 20 feet horizontally and for the full height of the face proposed for production, prior to the field evaluation. The Government will consider service records for stone of a similar size, placed in a similar thickness and exposed to weathering under similar conditions as are anticipated for this contract. The Government may choose to accept the source based on rock classification, geologic evaluation, and service records show that the stone is durable to the satisfaction of the Government.

b. Evaluation by Test Data. If sufficient information is not available, the Government will reconsider the alternate source if evaluation is supplemented by sampling and testing. This will require an additional 60 day evaluation period. If the Contractor wishes to pursue the alternate source, the Government will notify the Contractor of required testing and evaluation criteria. Criteria for acceptance will consider criteria in EM 1110-2-2302, but will also consider characteristics of rock found in nearby quarries. Some common test procedures that may be considered include:

Unit Weight and Absorption (ASTM C 127).
Petrographic Examination (ASTM C 295 and ASTM D 4992).
Resistance to Freezing and Thawing (ASTM D 5312).

c. Sampling and Testing. Samples from alternate sources shall be taken by a representative of the quarry under the supervision of the Contracting Officer. Information provided with the samples shall include the location and stratigraphy within the quarry from which the sample was taken. The Contractor shall ship the samples to a laboratory identified by the Contracting Officer. The Government will be responsible for testing costs associated with one quarry per project; and the Contractor shall be responsible for testing costs for additional sources.

2.1.2 Acceptance of Materials

Acceptance of a source of stone is not to be construed as acceptance of all material from that source. The right is reserved to reject materials from certain localized areas, zones, strata, or channels, when such materials are unsuitable for stone as determined by the Contracting Officer. The Contracting Officer also reserves the right to reject individual units of produced specified materials in stockpiles at the quarry, all transfer points, and at the project construction site when such materials are determined to be unsuitable.

2.2 RIPRAP

Riprap gradation shall meet the requirements indicated on the attached FORM 4055. The stone shall be well graded within the limits specified.

2.2.1 General

All stone shall be durable material. Stone for riprap shall have a specific gravity not less than 2.55. Stone shall be of a suitable quality

to ensure permanence in the structure and in the climate in which it is to be used. It shall be free from cracks, blast fractures, bedding, seams and other defects that would tend to increase its deterioration from natural causes. A hairline crack that is defined as being detrimental shall have a minimum width of 4 mil and shall be continuous for one-third the dimension of at least two sides of the stone. The stone shall be clean and reasonably free from soil, quarry fines, and shall contain no refuse. Any foreign material adhering to or combined with the stone as a result of stockpiling shall be removed prior to placement. The maximum aspect ratio (greatest dimension:least dimension) of any piece of stone for size ranges shall be not greater than 3:1 when measured across mutually perpendicular axis. ASTM D 4791 shall be used as a guide to perform the test.

2.2.2 Production

As a minimum, all stone materials shall be handled once with an approved rock fork or processed over a vibrating grizzly. Riprap shall be handled and selectively loaded onto trucks in a manner to avoid segregation and provide a distribution of stone sizes consistent with the gradation band and test samples. Each truckload shall be representative of the gradation requirements.

2.3 BEDDING MATERIAL

Bedding material shall be composed of tough, durable particles, adequately free from thin, flat and elongated pieces, and shall contain no organic matter nor soft, friable particles in quantities considered objectionable by the Contracting Officer. The aggregates shall meet the quality requirements of ASTM C 33. The bedding material shall be well-graded between the limits shown. Gradation shall conform to the following requirements:

<u>Sieve Designation</u>	<u>Percent Passing by Weight</u>
3"	100
1-1/2"	60 - 87
3/4"	40 - 72
3/8"	25 - 55
#4	10 - 40
#10	0 - 25
#40	0 - 10
#200	0 - 4

2.4 GRANULAR FILL

The granular fill material shall consist of sand or gravel and shall have a uniform gradation meeting the requirements of MNDOT specification 3149.2(E), Aggregate Backfill. The material shall be composed of tough, durable particles; shall be free of thin, flat and elongated pieces and shall contain no organic matter or soft friable particles in quantities considered objectionable to the Contracting Officer.

2.5 SOURCE QUALITY CONTROL

Gradation tests shall be performed by the methods and at the frequency

listed below. A satisfactory gradation test shall be obtained prior to any hauling and delivery of materials. All tests, including failing tests shall be submitted. Tests performed on material which do not meet gradation and shape requirements will not be counted as part of the tests required. The Contracting Officer shall be informed immediately of test results and draft copies of test results shall be furnished at the Contracting Officers request.

2.5.1 Sampling Requirements

The Contracting Officer shall direct the time and location of sampling, unless waived. Samples shall be taken from stockpiles or loaded trucks, and not directly from conveyers or chutes.

2.5.2 Riprap Gradation Testing

a. Notification. The Contracting Officer shall be informed 24 hours before each riprap test.

b. Testing Frequency. Two (2), including one test prior to delivery of riprap to the project site and one test from stockpiled riprap at the project site.

c. Sample Size. The sample shall have a minimum gross weight not less than 6 tons.

2.5.2.1 Riprap Test Method A

Test method A shall consist of weighing all stones larger than 5 pounds in a sample. Five to seven weight classes shall be selected within the range of stone sizes. Each stone shall be weighed and recorded on the work sheet for method A. The weight of stones shall be summed for each weight class; after which calculations and a plot of the gradation shall be completed in accordance with accepted practice for soil and aggregate gradations.

2.5.2.2 Riprap Test Method B

Test method B shall consist of separating the stones into 5 to 7 piles, ordered by size. The sample shall be separated on a clean, hard surface that is free of smaller stones that could become mixed with the sample. The stones shall be visually screened to place them into appropriate piles.

All stones shall be separated and placed into a pile before weighing. After separating, the smallest and largest rock in each pile shall be weighed and recorded. The stones shall be adjusted as necessary so that the weight classes do not overlap. After adjustment is adequate and weight classes have been established, each pile of stone shall be weighed and recorded on the work sheet for method B. Calculations and a plot of the gradation shall be completed in accordance with accepted practice for soil and aggregate gradations.

2.5.3 Bedding Gradation Testing

The bedding and filter materials shall be sampled in accordance with ASTM D 75 and tested in accordance with ASTM C 136.

a. Testing Frequency. One gradation test prior to delivery of material to the project site and one test from stockpiled material at the job site at the discretion of the Contracting Officers Representative.

b. Sample Size. Aggregate samples shall have a minimum gross weight not less than 150 pounds

2.5.4 Granular Fill Testing

The granular fill shall be sampled in accordance with ASTM D 75 and tested in accordance with ASTM C 136.

a. Testing Frequency. One gradation test prior to delivery of material to the project site and one test from stockpiled material at the job site at the discretion of the Contracting Officers Representative.

b. Sample Size. Granular fill samples shall have a minimum gross weight not less than 50 pounds

2.6 STOCKPILES

Stockpiles shall be formed by a series of layers or truckload dumps, where the rock essentially remains where it is placed. Subsequent layers shall be started 10 feet from the edge of the previous layer so that the rock will not roll down the edges of the pile. Any stone which has become contaminated with soil or refuse shall not be put into the work unless the contaminating material has been removed prior to placement.

PART 3 EXECUTION

3.1 CONSTRUCTION TOLERANCES

Work shall generally meet the required elevations, slope and grade; and the outer surfaces shall be even and present a neat appearance.

a. Subgrades. Areas on which stone protection will be placed shall be graded and/or dressed to conform to cross sections shown on the contract drawings within 2 inches above or below the neat lines. The surface shall be reasonably smooth to match tolerances normally obtained by rough grading with bladed equipment. For subaqueous construction in greater than 3 feet of water, the tolerance shall be 6 inches.

b. Layer Thickness. Any layers found to be less than 80% of the specified thickness shall be corrected. This tolerance shall only be exceeded on isolated spot checks, and if the tolerance is commonly exceeded, the Contractor shall change his construction methods to improve the quality control. If it is necessary to estimate riprap quantities for changes, the volume shall be based on neat line dimensions and the plan dimension for thickness. A conversion factor of 1.5 tons/CY shall be used to determine quantity requirements, unless otherwise directed by the Contracting Officer.

c. Surface Tolerances. The finished surface tolerance above the neatline shall generally not deviate from the lines and grades shown by more than half (1/2) the average stone dimension of the gradation range. Riprap that has a rough and uneven surface shall be reworked by hand to stabilize stones that wobble and are out of tolerance, except where the Contracting Officer approves use of equipment. Rearranging of individual stones shall be required to the extent necessary to obtain a well-graded distribution of stone sizes.

3.2 FOUNDATION PREPARATION

Foundation areas shall be excavated or filled to the lines and grades shown. Filling shall be with earth similar to the adjacent material and shall be well compacted. Immediately prior to placing riprap, the prepared subgrade will be inspected by the Contracting Officer unless waived; and no material shall be placed thereon until that area has been approved.

3.3 PLACEMENT OF GRANULAR FILL

Granular fill shall be spread uniformly to the lines and grades shown or directed. Any damage to the geotextile shall be repaired before proceeding with the work. Compaction will not be required but granular fill shall be finished to a uniform surface, free from mounds and windrows.

3.4 PLACEMENT OF BEDDING LAYERS

Bedding material shall be spread uniformly on the prepared base to the lines and grades indicated and in such manner as to avoid disturbance to the subgrade. Placing by methods which tend to segregate the particle sizes or cause mixing of the separate layers will not be permitted. Placement shall begin at the bottom of the area to be covered and continue up slope. Subsequent loads of material shall be placed against previously placed material in such a manner as to ensure a relatively homogenous mass. Any damage to the surface of the prepared base during placing of the material shall be repaired before proceeding with the work. Compaction of bedding material will not be required, but the surface shall be finished to present an adequately even surface, free from mounds or windrows.

3.5 PLACEMENT OF GEOTEXTILE

Placement of geotextile shall be in accordance with MNDOT 2511.3.

3.5.1 Covering Geotextile

Overlying sand and aggregate layers shall be spread uniformly to the full lift thickness on the geotextile by methods that do not tear, puncture, or reposition the fabric. Sudden braking and sharp turning shall be avoided. Tracked equipment shall not turn to prevent tracks from shearing the geotextile. Construction equipment shall not be operated directly upon the geotextile.

3.6 PLACEMENT OF RIPRAP

3.6.1 Layer Requirements

Riprap shall be placed in a manner which will produce a well-graded mass of rock with the minimum practicable percentage of voids. The large stones shall be well distributed. The finished riprap shall be free from objectionable pockets of small stones and clusters of larger stones.

3.6.2 Construction Methods

Unsegregated stone shall be placed in a systematic manner. Riprap shall be placed to its full course thickness in one operation and in such manner as to avoid displacing underlying material. Placement shall typically begin at the bottom of the area to be covered and continue up slope. Subsequent loads of material shall be placed against previously placed material in such a manner as to ensure a relatively homogenous mass. Final finish of slope shall be performed as the material is placed.

Placing riprap in layers will not be permitted. Placing riprap by dumping it into chutes, or by any method likely to cause segregation of the various sizes, shall not be permitted. Placing riprap by dumping it at the top of the slope and pushing it down the slope shall not be permitted. No equipment shall be operated directly on the completed stone protection system. Dump trucks shall be equipped with bottom hinged tailgates if rock is directly placed into position with the trucks.

3.6.3 Riprap Placement on Geotextile

Riprap shall be placed over the geotextile by methods that do not tear, puncture, or reposition the fabric. Equipment shall be operated so as to minimize the drop height of the stone without contacting and damaging the geotextile. Generally this will be about 1 foot of drop from the bucket to the placement surface. Riprap shall be placed so that stones do not roll downhill.

3.6.4 Riprap Placement in Water

Riprap to be placed under water shall be placed in a systematic manner so as to ensure a continuous uniform layer of well-graded stone of the required thickness. Stone to be placed under water shall not be cast across the surface of the water.

3.7 MAINTENANCE

The Contractor shall maintain the stone protection and underlying works until accepted by the Contracting Officer. When appropriate, the Contractor shall place stone protection in a timely manner to reduce risk of scour. Any material displaced prior to acceptance and due to the Contractor's negligence or neglect shall be replaced at the Contractor's expense.

3.8 CONTRACTOR QUALITY CONTROL

The Contractor shall establish and maintain quality control for all work performed at the job site under this section to assure compliance with

contract requirements. He shall maintain records of his quality control tests, inspections and corrective actions. Quality control measures shall cover all construction operations including, but not limited to, the placement of all materials to the slope and grade lines shown and in accordance with this section.

In addition to the Contractor's system to establish and maintain quality control for stone placement operations, the following information shall be recorded and promptly provided to the Contracting Officer on request:

- a. Record tonnage of stone placed in completed sections of the work and check quantity for compliance with design sections.
- b. Check for uniform thickness of material layers.

-- End of Section --

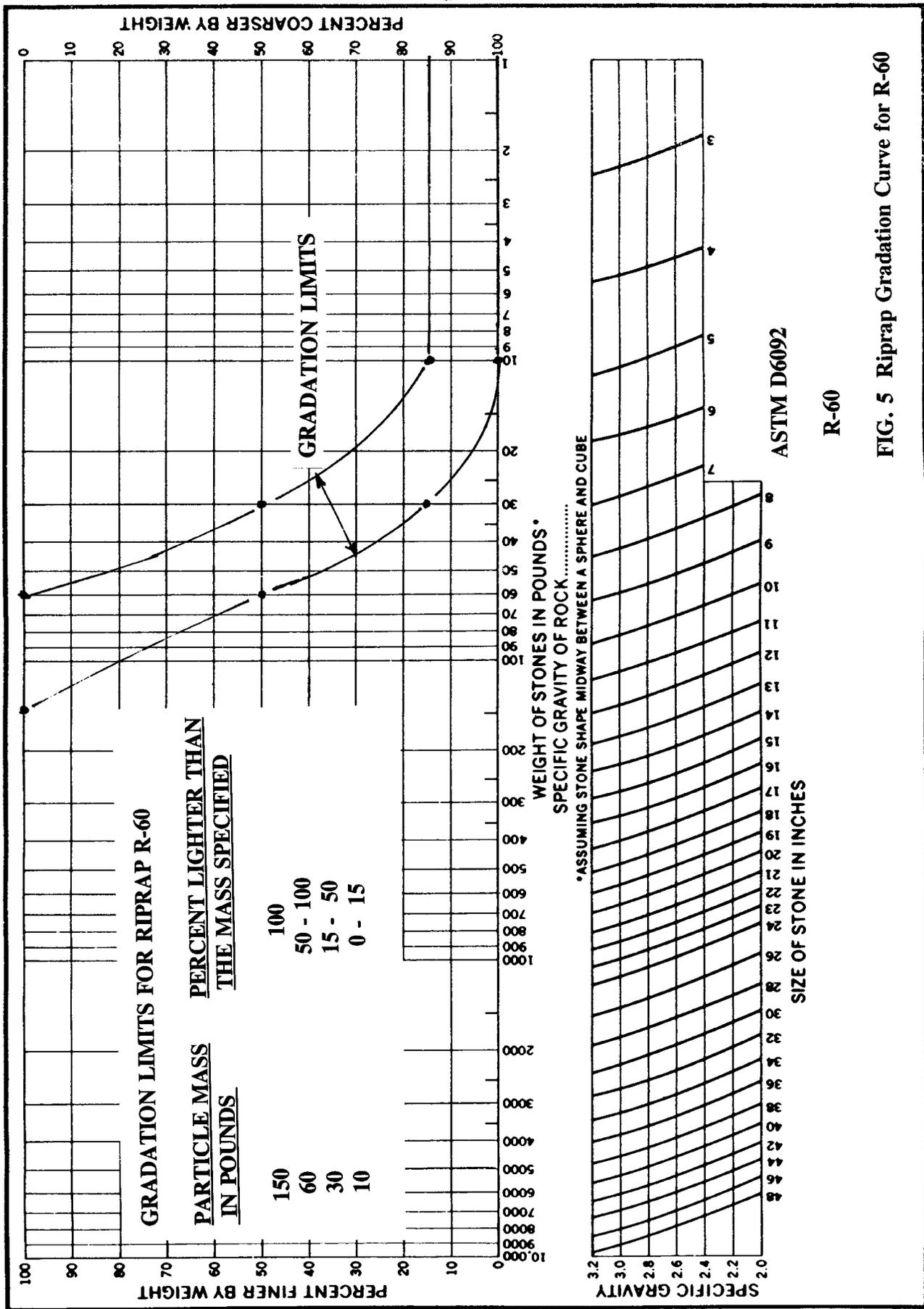


FIG. 5 Gradation Limits for Riprap R-60

WORK SHEET FOR GRADATION ANALYSIS OF RIPRAP METHOD B

Project Name:	Date:
Riprap Type:	Test No.
Source, Quarry, or Pit:	
Sample Location:	Test Made By:

Part 1. Separate rock into 5 to 7 piles, ordered by size. The largest pile should contain 2 to 5 stones. Intermediate piles between the largest stones and those smaller than 5 pounds should be approximately equal in total weight. Separate all stones before weighing.

Part 2. Summary Table.

(1) WEIGHT CLASSES		(2)	(3)	(4)
PASSING (stone wt. in lbs.)	RETAINED (stone wt. in lbs.)	TOTAL WEIGHT EACH CLASS (lbs.)	CUMMULATIVE WEIGHT PASSING (lbs.)	TOTAL PERCENT PASSING (%)
	5 lbs.			
5 lbs.	PAN			
SAMPLE TOTAL			-----	-----

Column (1) Weigh the smallest and largest stone in each pile. If weight classes overlap, adjust stones as necessary and repeat.
 Column (2) Weigh the total amount of rock in each pile and record.
 Column (3) Add column (2) from bottom up to get cumulative weight passing.
 Column (4) Divide column (3) by sample total to get total percent passing.

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 - 3.1.1 General Requirements
 - 3.1.2 Steel Ladder Anchorage
 - 3.1.3 Jointing, Plastering and Sealing
 - 3.1.4 Setting of Frames and Covers
 - 3.1.5 External Preformed Rubber Joint Seals

-- End of Section Table of Contents --

SECTION 02531

SANITARY SEWERS

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 270	(1997a) Mortar for Unit Masonry
ASTM C 478	(1997) Precast Reinforced Concrete Manhole Sections
ASTM C 972	(1995) Compression-Recovery of Tape Sealant
ASTM D 412	(1998a) Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers - Tension
ASTM D 624	(1991; R 1998) Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers

MINNESOTA DEPARTMENT OF TRANSPORTATION (MNDOT)

Standard Plate 3000L	Reinforced Concrete Pipe
Standard Plate 4011E	Precast Concrete Base
Standard Plate 4101D	Ring Casting for Manhole or Catch Basin
Standard Plate 4110F	Cover Casting for Manhole
Standard Plate 4180J	Manhole or Catch Basin Step

1.2 GENERAL REQUIREMENTS

The construction required herein shall include installation of new sanitary sewer manhole as shown on the drawings. The Contractor shall replace damaged material and redo unacceptable work at no additional cost to the Government. Excavation and backfilling is specified in Section 02316 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS. Backfilling shall be accomplished after inspection by the Contracting Officer. The

inverted siphon is specified in Section 02532 INVERTED SIPHONS; SEWER.

PART 2 PRODUCTS

2.1 FRAMES AND COVERS

Ring Casting for manhole shall be as indicated on the drawings and shall be in accordance with Mn/DOT Standard Plate 4101D. The cover for the casting shall be as indicated, suitable for the indicated casting and in accordance with Mn/DOT Standard Plate 4110F. The cover shall be provided without vent holes.

2.2 CEMENT MORTAR

Cement mortar shall conform to ASTM C 270, Type M with Type II cement.

2.2.1 Portland Cement

Portland cement shall conform to ASTM C 150, Type II for concrete used in manholes.

2.2.2 Portland Cement Concrete

Portland cement concrete shall conform to ASTM C 94, compressive strength of 4000 psi at 28 days. Concrete in place shall be protected from freezing and moisture loss for 7 days.

2.3 PRECAST REINFORCED CONCRETE MANHOLE SECTIONS

Precast reinforced concrete manhole sections shall conform to ASTM C 478, except that portland cement shall be as specified herein. Joints shall be cement mortar, an approved mastic, rubber gaskets, a combination of these types; or the use of external preformed rubber joint seals and extruded rolls of rubber with mastic adhesive on one side.

2.3.1 Steps

Steps in the manhole shall be provided in accordance with Mn/DOT Standard Plate 4180J, Manhole or Catch Basin Step.

PART 3 EXECUTION

3.1 MANHOLE DETAILS

3.1.1 General Requirements

Manholes shall be constructed of concrete or precast concrete manhole sections. The invert channels shall be smooth and semicircular in shape conforming to the inside of the adjacent sewer section. Changes in direction of flow shall be made with a smooth curve of as large a radius as the size of the manhole will permit. Changes in size and grade of the channels shall be made gradually and evenly. The invert channels shall be

formed directly in the concrete of the manhole base, or shall be built up with brick and mortar, or shall be half tile laid in concrete, or shall be constructed by laying full section sewer pipe through the manhole and breaking out the top half after the surrounding concrete has hardened. Pipe connections shall be watertight and shall be made to manhole using water stops, standard O-ring joints, special manhole coupling, or shall be made in accordance with the manufacturer's recommendation. The Contractor's proposed method of connection, list of materials selected, and specials required, shall be approved prior to installation. The floor of the manhole outside the channels shall be smooth and shall slope toward the channels not less than 1 inch per foot nor more than 2 inches per foot. Free drop inside the manholes shall not exceed 18 inches, measured from the invert of the inlet pipe to the top of the floor of the manhole outside the channels.

3.1.2 Steel Ladder Anchorage

Ladder shall be adequately anchored to the wall by means of steel inserts spaced not more than 6 feet apart vertically, and shall be installed to provide at least 6 inches of space between the wall and the rungs. The wall along the line of the ladder shall be vertical for its entire length.

3.1.3 Jointing, Plastering and Sealing

Mortar joints shall be completely filled and shall be smooth and free from surplus mortar on the inside of the manhole. Mortar and mastic joints between precast rings shall be full-bedded in jointing compound and shall be smoothed to a uniform surface on both the interior and exterior of the manhole. Installation of rubber gasket joints between precast rings shall be in accordance with the recommendations of the manufacturer. Precast rings may also be sealed by the use of extruded rolls of rubber with mastic adhesive on one side.

3.1.4 Setting of Frames and Covers

Unless otherwise indicated, tops of frames and covers shall be set 2 inches higher than finished grade in unpaved areas. Frame and cover assemblies shall be sealed to manhole sections using external preformed rubber joint seals that meet the requirements of ASTM D 412 and ASTM D 624, or other methods specified in paragraph Jointing, Plastering and Sealing, unless otherwise specified.

3.1.5 External Preformed Rubber Joint Seals

External preformed rubber joint seals and extruded rolls of rubber with mastic adhesive shall meet the requirements of ASTM D 412 and ASTM C 972. The seal shall be multi-section with neoprene rubber top section and all lower sections made of Ethylene Propylene Di Monomer (EPDM) rubber with a minimum thickness of 60 mils. Each unit shall consist of a top and a bottom section and shall have mastic on the bottom of the bottom section and mastic on the top and bottom of the top section. The mastic shall be non-hardening butyl rubber sealant and shall seal to the cone/top slab of the manhole/catch basin and over the lip of the casting. One unit shall seal a casting and up to six, 2 inch adjusting rings. The bottom section

shall be 12 inches in height. A 6 inch high top section will cover up to two, 2 inch adjusting rings. A 12 inch high bottom section will cover up to six, 2 inch adjusting rings. Extension sections shall cover up to two more adjusting rings. Each extension shall overlap the bottom section by 2 inches and shall be overlapped by the top section by 2 inches.

-- End of Section --

INTERNAL DIA. OF PIPE, INCHES	WEIGHT PER LN. FT. OF PIPE	MIN. WALL THICKNESS INCHES	CLASS I		CLASS II		CLASS III		CLASS IV		CLASS V	
			D - LOAD TO PRODUCE A 0.01 INCH CRACK (LBS./LIN. FT. OF DIA.)		D - LOAD TO PRODUCE A 0.01 INCH CRACK (LBS./LIN. FT. OF DIA.)		D - LOAD TO PRODUCE A 0.01 INCH CRACK (LBS./LIN. FT. OF DIA.)		D - LOAD TO PRODUCE A 0.01 INCH CRACK (LBS./LIN. FT. OF DIA.)		D - LOAD TO PRODUCE A 0.01 INCH CRACK (LBS./LIN. FT. OF DIA.)	
			800	1000	1350	1500	2000	2000	3000	2000	3000	3000
D	POUNDS	T	CONCRETE 4000 P.S.I.		CONCRETE 6000 P.S.I.							
			INNER CAGE	OUTER CAGE								
			MINIMUM REINFORCEMENT SQUARE INCHES PER LINEAR FOOT OF BARREL		MINIMUM REINFORCEMENT SQUARE INCHES PER LINEAR FOOT OF BARREL		MINIMUM REINFORCEMENT SQUARE INCHES PER LINEAR FOOT OF BARREL		MINIMUM REINFORCEMENT SQUARE INCHES PER LINEAR FOOT OF BARREL		MINIMUM REINFORCEMENT SQUARE INCHES PER LINEAR FOOT OF BARREL	
12	92	2	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.10	0.10
15	127	2-1/4	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.10	0.14
18	168	2-1/2	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.14	0.19
21	214	2-3/4	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.20	0.24
24	265	3	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.20	0.24
27	322	3-1/4	0.13	0.13	0.16	0.16	0.16	0.16	0.16	0.16	0.27	0.30
30	384	3-1/2	0.14	0.14	0.18	0.18	0.18	0.18	0.18	0.18	0.31	0.38
33	452	3-3/4	0.15	0.15	0.20	0.20	0.20	0.20	0.20	0.20	0.35	0.41
36	524	4	0.12	0.07	0.17	0.17	0.17	0.17	0.17	0.17	0.27	0.35
42	685	4-1/2	0.15	0.09	0.21	0.21	0.21	0.21	0.21	0.21	0.30	0.46
48	867	5	0.18	0.11	0.24	0.24	0.24	0.24	0.24	0.24	0.35	0.50
54	1070	5-1/2	0.22	0.13	0.29	0.29	0.29	0.29	0.29	0.29	0.42	0.60
			CONCRETE 5000 PSI		CONCRETE 5000 PSI		CONCRETE 5000 PSI		CONCRETE 5000 PSI		CONCRETE 5000 PSI	
60	1296	6	0.21	0.25	0.34	0.34	0.34	0.34	0.34	0.34	0.50	0.73
66	1542	6-1/2	0.25	0.31	0.41	0.41	0.41	0.41	0.41	0.41	0.50	0.73
72	1810	7	0.29	0.35	0.49	0.49	0.49	0.49	0.49	0.49	0.60	0.85
78	2098	7-1/2	0.32	0.40	0.57	0.57	0.57	0.57	0.57	0.57	0.73	1.00
84	2410	8	0.37	0.46	0.64	0.64	0.64	0.64	0.64	0.64	0.85	1.20
			CONCRETE 5000 PSI		CONCRETE 5000 PSI		CONCRETE 5000 PSI		CONCRETE 5000 PSI		CONCRETE 5000 PSI	
90	2740	8-1/2	0.41	0.51	0.69	0.69	0.69	0.69	0.69	0.69	0.94	1.20
96	3090	9	0.46	0.57	0.76	0.76	0.76	0.76	0.76	0.76	1.00	1.30
			CONCRETE 5000 PSI		CONCRETE 5000 PSI		CONCRETE 5000 PSI		CONCRETE 5000 PSI		CONCRETE 5000 PSI	
102	3470	9-1/2	0.54	0.61	0.90	0.90	0.90	0.90	0.90	0.90	1.20	1.50
108	3860	10	0.61	0.76	1.08	1.08	1.08	1.08	1.08	1.08	1.42	1.80

NOTES:

SEE SHEETS 2 TO 5 FOR ADDITIONAL INFORMATION ON PIPE SECTIONS AND GENERAL NOTES.

STANDARD PLATE 3006, GASKET JOINT R.C. PIPE, MAY BE FURNISHED IN LIEU OF 3000 PIPE. THE GASKET REQUIRED FOR 3006 PIPE WILL NOT BE REQUIRED; HOWEVER, THE APPROPRIATE PROVISIONS OF THE SPECIFICATIONS RELATING TO FILLING THE JOINT SPACE WITH AN APPROVED SEALER OR FULL CIRCUMFERENTIAL WRAP OF GEOTEXTILE MATERIAL SHALL APPLY.

① CLASS IV PIPE 78 INCHES OR MORE IN DIAMETER AND CLASS V PIPE 54 INCHES OR MORE IN DIAMETER ARE SPECIAL DESIGNS AND REQUIRE SHEAR STEEL. FOR SPECIAL DESIGNS SEE SHEET 4 OF 5.

② FOR THESE CLASSES AND SIZES, THE MINIMUM PRACTICAL STEEL REINFORCEMENT IS SPECIFIED. THE ACTUAL ULTIMATE STRENGTH IS GREATER THAN THE MINIMUM STRENGTH SPECIFIED FOR NONREINFORCED PIPE OF EQUIVALENT DIAMETERS IN AASHTO M86.

③ AS AN ALTERNATIVE, SINGLE CAGE REINFORCEMENT MAY BE USED. THE REINFORCEMENT AREA IN SQUARE INCHES PER LINEAR FOOT SHALL BE 0.30 FOR WALL B.

APPROVED Aug. 31, 1989

R.H. Sullivan

Director
Materials, Research and Standards

STATE OF MINNESOTA
DEPARTMENT OF TRANSPORTATION

REINFORCED CONCRETE PIPE

B WALL

SPECIFICATION
REFERENCE
2501, 2502, 2503

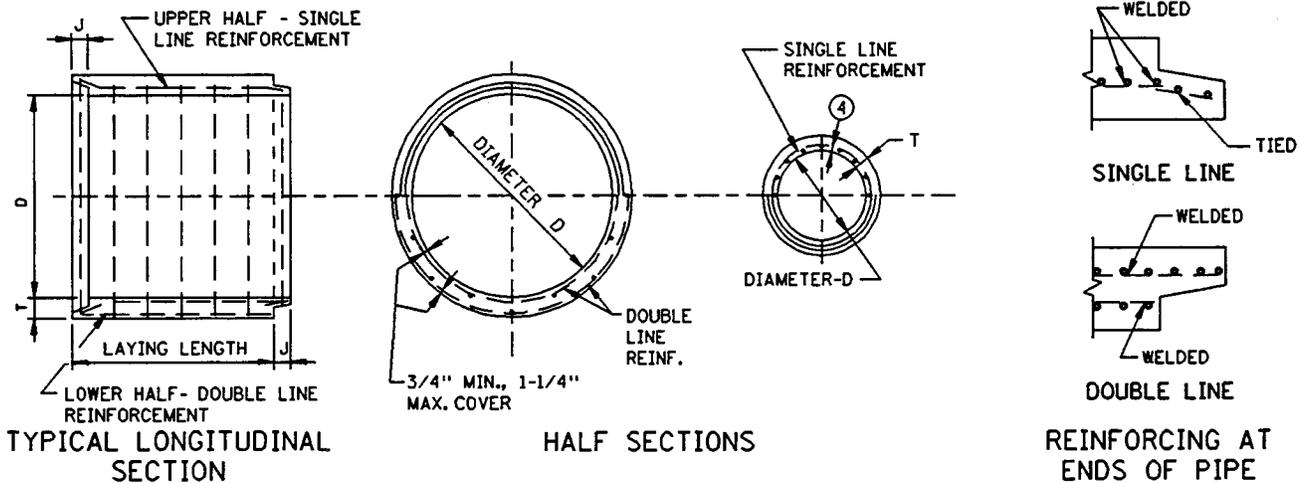
REVISED
4-30-99 A.K.J.

STANDARD
PLATE
NO.

3000L

1 OF 5

INTERNAL DIA. OF PIPE, (INCHES)	WEIGHT PER LIN. FT. OF PIPE	WALL THICKNESS T	CLASS II		CLASS III		CLASS IV		CLASS V		
			D - LOAD TO PRODUCE A 0.01 INCH CRACK (POUNDS PER LIN. FT. PER FT. OF DIA.)								
			1000		1350		2000		3000		
			D - LOAD TO PRODUCE ULTIMATE LOAD (LBS. PER LIN. FT. PER FT. OF DIA.)								
1500		2000		3000		3750					
CONCRETE 4000 P.S.I.		CONCRETE 4000 P.S.I.		CONCRETE 4000 P.S.I.		CONCRETE 6000 P.S.I.					
MINIMUM REINFORCEMENT SQUARE INCHES PER LINEAL FOOT OF BARREL (1)											
D	LBS.	INCHES	INNER CAGE	OUTER CAGE	INNER CAGE	OUTER CAGE	INNER CAGE	OUTER CAGE	INNER CAGE	OUTER CAGE	
12	140	2-3/4	—	—	—	—	—	—	0.08 (5)	—	
15	180	3	—	—	—	—	—	—	0.08 (5)	—	
18	230	3-1/4	—	—	—	—	—	—	0.10 (5)	—	
21	280	3-1/2	—	—	—	—	—	—	0.15 (5)	—	
24	340	3-3/4	—	—	—	—	0.07	0.07	0.12	0.07	
27	410	4	—	—	—	—	0.08	0.07	0.14	0.08	
30	480	4-1/4	—	—	—	—	0.09	0.07	0.18	0.11	
33	510	4-1/2	—	—	—	—	0.11	0.07	0.23	0.14	
36	630	4-3/4 (3)	0.07	0.07	0.08 (3)	0.07	0.14	0.08	0.27	0.16	
42	810	5-1/4	0.10	0.07	0.12	0.07	0.20	0.12	0.36	0.22	
48	1010	5-3/4	0.14	0.08	0.16	0.10	0.26	0.16	0.47	0.28	
54	1230	6-1/4	0.17	0.10	0.21	0.13	0.34	0.20	0.58	0.35	
60	1470	6-3/4	0.22	0.13	0.25	0.15	0.41	0.25	0.70 (1)	0.42	
66	1740	7-1/4	0.25	0.15	0.31	0.19	0.51	0.31	0.84 (1)	0.50	
							CONCRETE 5000 P.S.I.				
72	2010	7-3/4	0.30	0.18	0.36	0.22	0.61	0.37	0.99 (1)	0.59	
78	2330	8-1/4	0.35	0.21	0.42	0.25	0.71	0.43			
84	2640	8-3/4	0.41	0.25	0.50	0.30	0.85	0.51			
							CONCRETE 5000 P.S.I.				
90	3000	9-1/4	0.48	0.29	0.59	0.35					
96	3370	9-3/4	0.55	0.33	0.70	0.42					
			CONCRETE 5000 P.S.I.								
102	3760	10-1/4	0.62	0.37	0.83	0.50					
108	4170	10-3/4	0.70	0.42	0.99	0.59					



NOTES:

SEE SHEET 5 OF 5 FOR ADDITIONAL INFORMATION ON C WALL PIPE SECTIONS AND GENERAL NOTES.
 STANDARD PLATE 3006, GASKET JOINT R.C. PIPE, MAY BE FURNISHED IN LIEU OF 3000 PIPE. THE GASKET REQUIRED FOR 3006 PIPE WILL NOT BE REQUIRED; HOWEVER, THE APPROPRIATE PROVISIONS OF THE SPECIFICATIONS RELATING TO FILLING THE JOINT SPACE WITH AN APPROVED SEALER OR FULL CIRCUMFERENTIAL WRAP OF GEOTEXTILE MATERIAL SHALL APPLY.

- ① AN INNER CIRCULAR CAGE PLUS AN ELLIPTICAL CAGE SUCH THAT THE AREA OF THE ELLIPTICAL CAGE SHALL NOT BE LESS THAN THAT SPECIFIED FOR THE OUTER CAGE IN THE TABLE AND THE TOTAL AREA OF THE INNER CIRCULAR CAGE PLUS THE ELLIPTICAL CAGE SHALL NOT BE LESS THAN THAT SPECIFIED FOR THE INNER CAGE IN THE TABLE.
- ② FOR THESE CLASSES AND SIZES, THE MINIMUM PRACTICAL STEEL REINFORCEMENT IS SPECIFIED. THE ACTUAL ULTIMATE STRENGTH IS GREATER THAN THE MINIMUM STRENGTH SPECIFIED FOR NONREINFORCED PIPE OF EQUIVALENT DIAMETERS IN AASHTO M86.
- ③ AS AN ALTERNATIVE, FOR CLASS II AND III A SINGLE CAGE REINFORCEMENT MAY BE USED. THE REINFORCEMENT AREA IN SQUARE INCHES PER LINEAL FOOT SHALL BE 0.20 FOR WALL C.
- ④ 35 TO 50 PERCENT OF T EXCEPT WHEN WALL THICKNESS IS LESS THAN 3-1/2 INCHES-THEN 3/4 INCHES OF COVER.
- ⑤ SINGLE LINE REINFORCEMENT.

APPROVED Aug. 31, 1989
R.H. Sullivan
 Director
 Materials, Research and Standards

STATE OF MINNESOTA
 DEPARTMENT OF TRANSPORTATION
REINFORCED CONCRETE PIPE
 C WALL

SPECIFICATION
 REFERENCE
 2501, 2502, 2503
 REVISED
 4-30-99 A.K.J.

STANDARD
 PLATE
 NO.
3000L
 2 OF 5

INTERNAL DIAMETER OF PIPE IN INCHES	CROSS SECTION WATER AREA	LENGTH OF JOINT	NOMINAL - A	D1	D2	D3	D4
D	SQ. FT.	INCHES					
12	0.79	1-3/4	3/16	13-1/4	13-5/8	13-7/8	14-1/4
15	1.23	2	3/16	16-1/2	16-7/8	17-1/4	17-5/8
18	1.77	2-1/4	3/16	19-5/8	20	20-3/8	20-3/4
21	2.40	2-1/2	3/16	22-7/8	23-1/4	23-3/4	24-1/8
24	3.14	2-3/4	3/16	26	26-3/8	27	27-3/8
27	3.98	3	3/16	29-1/4	29-5/8	30-1/4	30-5/8
30	4.91	3-1/4	3/16	32-3/8	32-3/4	33-1/2	33-7/8
33	5.94	3-1/2	1/4	35-1/2	36	36-3/4	37-1/4
36	7.07	3-3/4	1/4	38-3/4	39-1/4	40	40-1/2
42	9.62	4	1/4	45-1/8	45-5/8	46-1/2	47
48	12.57	4-1/4	1/4	51-1/2	52	53	53-1/2
54	15.90	4-1/2	1/4	57-7/8	58-3/8	59-3/8	59-7/8
60	19.63	5	1/4	64-1/4	64-3/4	66	66-1/2
66	23.76	5-1/2	1/4	70-5/8	71-1/8	72-1/2	73
72	28.27	6	1/4	77	77-1/2	79	79-1/2
78	33.18	6-1/2	1/4	83-3/8	83-7/8	85-5/8	86-1/8
84	38.48	7	1/4	89-3/4	90-1/4	92-1/8	92-5/8
90	44.18	7	1/4	95-3/4	96-1/4	98-1/8	98-5/8
96	50.27	7	1/4	102-1/8	102-5/8	104-1/2	105
102	56.75	7-1/2	1/4	109	109-1/2	111-1/2	112
108	63.62	7-1/2	1/4	115-1/2	116	118	118-1/2

TOLERANCES IN DIMENSIONS:

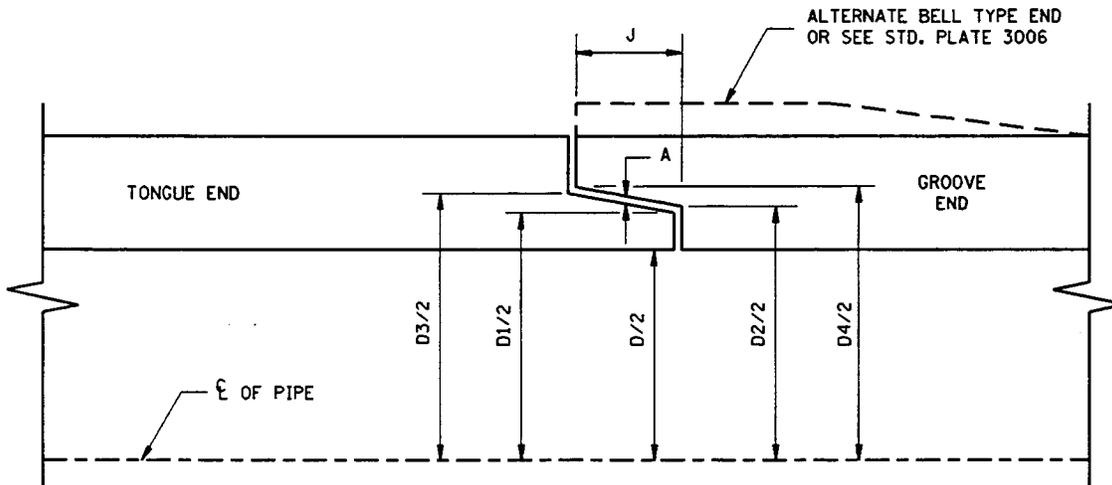
D: ± 1.5% FOR 12" TO 24" D. ± 1/4" OR 3/8" WHICHEVER IS GREATER FOR 27" TO 108" D.

D1, D2, D3, AND D4: ± 3/16" FOR 12" TO 30" D, ± 1/4" FOR 33" TO 108" D.

T: NOT LESS THAN THE DESIGN T BY MORE THAN 5% OR 3/16" WHICHEVER IS GREATER.

J: ALL SIZES ± 1/4".

LAYING LENGTH: SHALL NOT UNDERRUN BY MORE THAN 1/2".



SECTION AT PIPE JOINT

APPROVED Aug. 31, 1989

R.H. Sullivan

Director
Materials, Research and Standards

STATE OF MINNESOTA
DEPARTMENT OF TRANSPORTATION

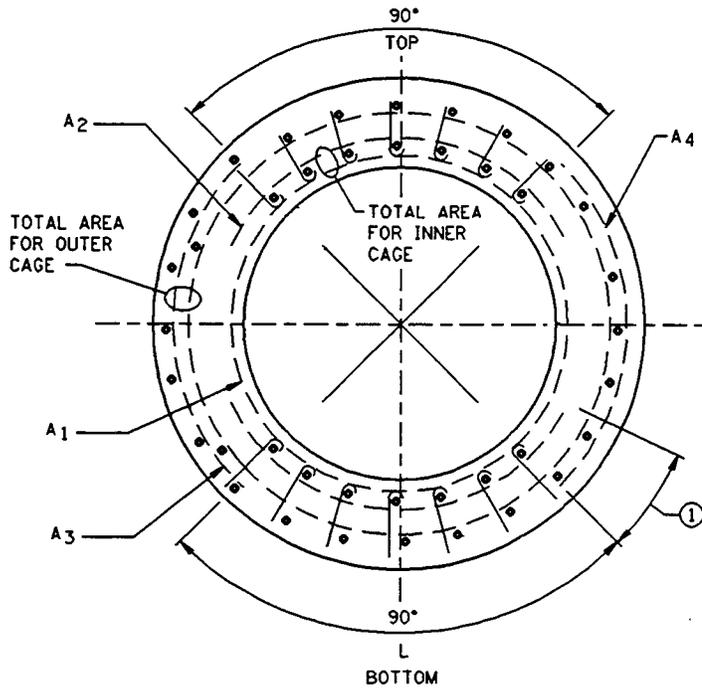
REINFORCED CONCRETE PIPE
JOINT DIMENSIONS FOR B-WALL AND C-WALL

SPECIFICATION
REFERENCE

2501
2502
2503

STANDARD
PLATE
NO.

3000L
3 OF 5



CROSS SECTION FOR
SPECIAL DESIGN PIPES

NOTES:

SEE SHEET 1 FOR INNER AND OUTER CAGE REINFORCEMENT.

$A_1 + A_2 =$ TOTAL INNER CAGE REINFORCEMENT.

$A_3 + A_4 =$ TOTAL OUTER CAGE REINFORCEMENT.

POINT OR INDENT LEGIBLE MARKS AT ONE END OF EACH SECTION ON THE INSIDE AND OUTSIDE OF OPPOSITE WALLS DESIGNATING THE CENTER OF STIRRUP REINFORCEMENT.

THE TOP OF THE PIPE SHALL BE APPROPRIATELY MARKED OR STENCILED BOTH ON THE INSIDE AND OUTSIDE SURFACES.

① THE CAGES MUST BE ASSEMBLED WITH THE OUTER MAT OVERLAPPING THE INNER MAT BY A DISTANCE EQUAL TO ONE PIPE WALL THICKNESS OR GREATER.

A_1 = REINFORCING OF FULL CIRCULAR INNER CAGE.

A_2 = REINFORCING OF INNER LAP SECTION, 90° MINIMUM ARC.

A_3 = REINFORCING OF FULL CIRCULAR OUTER CAGE.

A_4 = REINFORCING OF OUTER LAP SECTION, 90° MINIMUM ARC.

A_r = MINIMUM RADIAL REINFORCING REQUIRED IN SQUARE INCHES PER SQUARE FOOT OF PIPE OVER A MINIMUM 90° ARC AT TOP AND BOTTOM OF PIPE. HOOK DESIGN MUST BE APPROVED BY MATERIALS SECTION.

THE FULL CIRCULAR CAGES MUST HAVE AN AREA EQUAL TO AT LEAST 40% OF THE REQUIRED TOTAL AREA.

L = LENGTH OF 90° ARC MEASURED AT INNER CAGE.

N = MINIMUM NUMBER OF ROWS OF RADIAL REINFORCING AT TOP AND BOTTOM OF PIPE.

S = MAXIMUM CIRCUMFERENTIAL SPACING OF ROWS OR RADIAL REINFORCING AT OUTER CAGE.

INTERNAL DIA. OF PIPE	LENGTH OF 90° ARC	WALL THICKNESS	SHEAR STEEL					
			CLASS IV			CLASS V		
			N	S	A_r	N	S	A_r
D	L	T	N	S	A_r	N	S	A_r
54"	44"	5-1/2"	—	—	—	12	4"	0.22
60"	49"	6"	—	—	—	10	6"	0.22
66"	54"	6-1/2"	—	—	—	10	6"	0.22
72"	59"	7"	—	—	—	11	6"	0.23
78"	63"	7-1/2"	12	6"	0.25	12	6"	0.25
84"	68"	8"	13	6"	0.28	13	6"	0.28
90"	73"	8-1/2"	13	6"	0.31	13	6"	0.31
96"	77"	9"	14	6"	0.34	14	6"	0.34
102"	82"	9-1/2"	15	6"	0.37	15	6"	0.37
108"	87"	10"	16	6"	0.40	16	6"	0.40

APPROVED Aug. 31, 1989

R.H. Sullivan

Director

Materials, Research and Standards

STATE OF MINNESOTA
DEPARTMENT OF TRANSPORTATION

REINFORCED CONCRETE PIPE

REINFORCEMENT INFORMATION
SPECIAL DESIGN PIPES

SPECIFICATION
REFERENCE

2501
2502
2503

STANDARD
PLATE
NO.

3000L

4 OF 5

REINFORCEMENT:

REINFORCING STEEL SHALL CONFORM TO THE REQUIREMENTS AASHTO M 170.

IF THE SPLICES ARE NOT WELDED, CIRCUMFERENTIAL REINFORCEMENT SHALL BE LAPPED NOT LESS THAN 20 DIAMETERS FOR DEFORMED BARS AND DEFORMED COLD-WORKED WIRE, AND 40 DIAMETERS FOR PLAIN BARS AND COLD-DRAWN WIRE. IN ADDITION, WHERE LAPPED CAGES OF WELDED-WIRE FABRIC ARE USED WITHOUT WELDING, THE LAP SHALL CONTAIN A LONGITUDINAL WIRE. ALL CIRCULAR AND LONGITUDINAL REINFORCEMENT SHALL BE ASSEMBLED AND SECURELY FASTENED CAGE FASHION SO AS TO MAINTAIN REINFORCEMENT IN EXACT SHAPE AND CORRECT POSITION WITHIN THE FORM.

REINFORCEMENT WILL BE CONSIDERED AS MEETING THE DESIGN REQUIREMENTS IF THE AREA, COMPUTED ON THE BASIS OF NOMINAL AREA OF THE WIRE OR BARS USED, EQUALS OR EXCEEDS THE ABOVE REQUIREMENT. ACTUAL AREA OF THE REINFORCING USED MAY VARY FROM THE NOMINAL AREA ACCORDING TO PERMISSIBLE VARIATIONS OF THE STANDARD SPECIFICATIONS FOR THE REINFORCING.

THE COVER OVER THE CIRCUMFERENTIAL STEEL SHALL BE AS SHOWN ON THIS PLATE BUT IN NO CASE SHALL THE COVER BE LESS THAN 3/4 INCHES AS MEASURED TO THE INSIDE WALL SURFACE OR THE OUTSIDE WALL SURFACE, EXCEPT IN THE TONGUE AND GROOVE. REINFORCING STEEL MAY BE OMITTED FROM EITHER THE TONGUE OR GROOVE ENDS OF 12 INCH THRU 33 INCH DIAMETER PLAIN ROUND PIPE ONLY OF B WALL SINGLE CAGE. BELL ENDS WITH O-RING GASKETS SHALL HAVE REINFORCEMENT IN THEM.

THE SPACING CENTER TO CENTER OF ADJACENT RINGS OF CIRCUMFERENTIAL REINFORCEMENT IN A CAGE SHALL NOT EXCEED 4 INCHES FOR PIPE UP TO AND INCLUDING PIPE HAVING A 4 INCH WALL THICKNESS NOR EXCEED THE WALL THICKNESS FOR LARGER PIPE, AND SHALL IN NO CASE EXCEED 6 INCHES. THE CONTINUITY OF THE CIRCUMFERENTIAL REINFORCING STEEL SHALL NOT BE DESTROYED DURING THE MANUFACTURE OF THE PIPE.

GENERAL NOTES:

THE STRENGTH TEST REQUIREMENTS IN POUNDS-FORCE PER LINEAL FOOT OF PIPE UNDER THE THREE-EDGE-BEARING METHOD SHALL BE COMPUTED BY MULTIPLYING THE INTERNAL DIAMETER OF THE PIPE IN FEET BY THE D-LOADS (EXPRESSED IN POUNDS-FORCE PER LINEAL FOOT OF DIAMETER) TO PRODUCE THE 0.01 INCH CRACK AND THE ULTIMATE LOAD SPECIFIED ON SHEETS 1 AND 5 OF THIS STANDARD PLATE.

PIPES 60 INCHES IN DIAMETER OR GREATER AND ALL CENTER LINE CULVERTS SHALL HAVE TIED JOINTS.

NOT MORE THAN TWO LIFT HOLES WILL BE PERMITTED IN EACH SECTION OF PIPE. TAPERED PLUGS SHALL BE FURNISHED FOR CLOSING LIFT HOLES.

GASKET LUBRICATION SHALL BE AS PER MANUFACTURER'S RECOMMENDATIONS.

LAYING LENGTH:

THE NOMINAL LAYING OF ALL PIPE SHALL NOT BE LESS THAN 6 FEET EXCEPT THAT NOT MORE THAN TWO 4 FOOT LENGTHS OF PIPE WILL BE PERMITTED IN A LINE OF PIPE TO MAKE THE REQUIRED TOTAL LENGTH. FOR ALL DIAMETERS OF PIPE ONE SECTION OF ANY ODD LENGTH GREATER THAN 4 FEET WILL BE PERMITTED IN EACH LINE OR REACH OF PIPE TO MAKE THE REQUIRED TOTAL LENGTH. PIPE SECTIONS SHORTER THAN THE NOMINAL LAYING LENGTH SHALL BE INSTALLED NEAR THE MIDDLE OF THE LINE OR AS DIRECTED BY THE ENGINEER.

BASIS FOR DESIGN: AASHTO M170

APPROVED Aug. 31, 1989

R. H. Sullivan

Director

Materials, Research and Standards

STATE OF MINNESOTA
DEPARTMENT OF TRANSPORTATION

REINFORCED CONCRETE PIPE
GENERAL NOTES

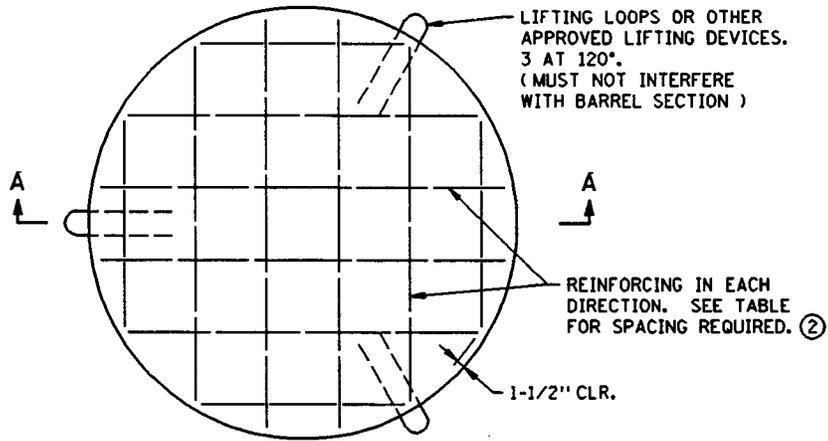
SPECIFICATION
REFERENCE

2501
2502
2503

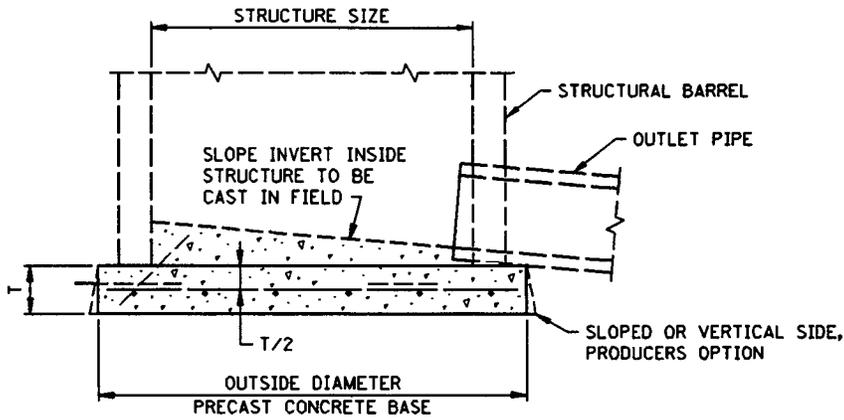
STANDARD
PLATE
NO.

3000L

5 OF 5



TOP VIEW



SECTION A-A

STRUCTURE SIZE (INCHES)	PRECAST CONCRETE BASE				APPROX. WEIGHT (POUNDS)
	OUTSIDE DIAMETER (INCHES)	T (INCHES)	MINIMUM REINF. ②		
			BAR NUMBER	SPACING (INCHES)	
30	44	6	13	12	790
48	64	6	13	12	1,680
54	72	8	13	12	2,830
60	78	8	13	12	3,320
66	85	8	13	12	3,940
72	92	8	13	12	4,620
78	100	8	13	12	5,460
84	106	8	13	8	6,130
90	114	8	13	8	7,090
96	120	8	13	8	7,850
102	127	8	13	8	8,800
108	132	9	13	8	10,690
120	146	12	13	8	17,440
132	160	12	13	8	20,940
144	174	12	13	6	24,770

①

NOTES:
 ALL REBARS ARE IN METRIC DESIGNATIONS

- ① ALTERNATE T = 10" WITH NO. 13 BAR SPACED AT 10".
- ② EQUIVALENT WIRE MESH MAY BE USED.

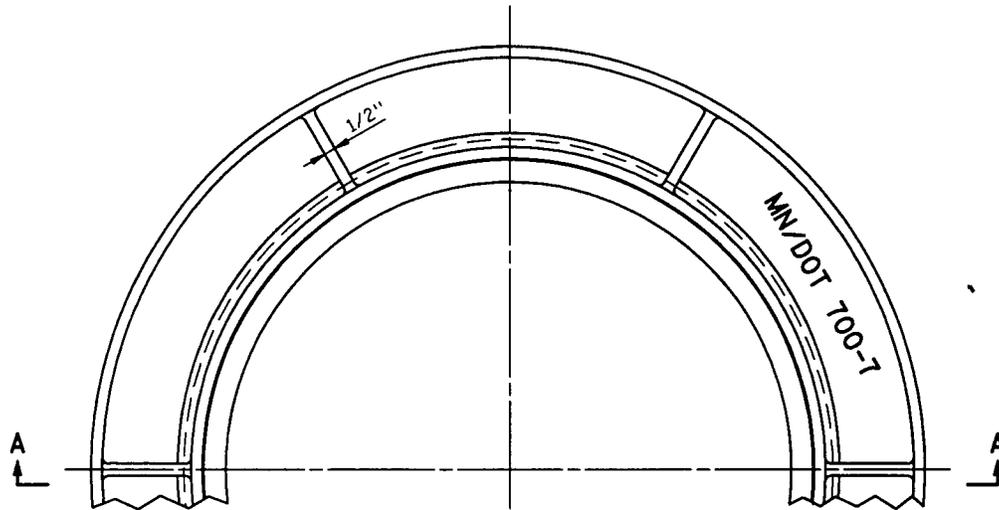
APPROVED OCTOBER 17, 1994
Gerald J. Robinson
 STATE DESIGN ENGINEER

STATE OF MINNESOTA
 DEPARTMENT OF TRANSPORTATION

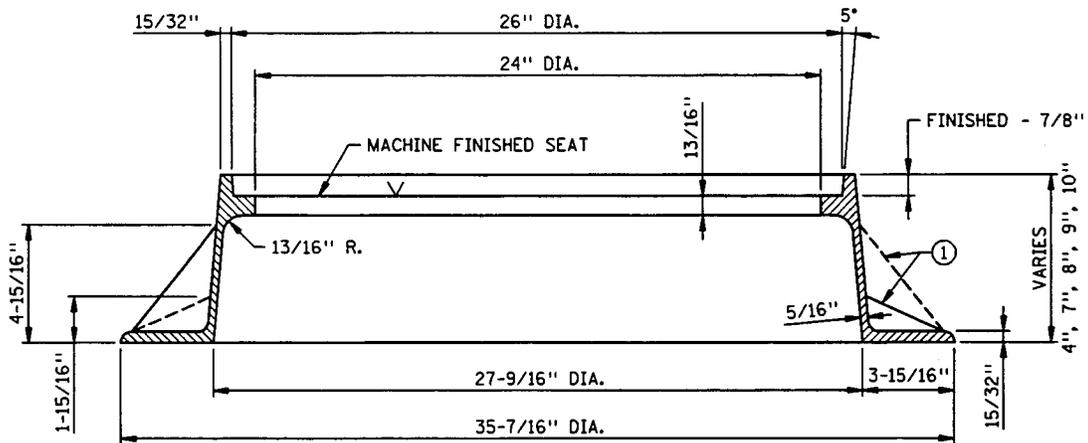
PRECAST CONCRETE BASE

SPECIFICATION REFERENCE
 2506
 REVISED
 2-10-2000 A.K.J.

STANDARD PLATE NO.
 4011E



HALF TOP VIEW



SECTION A-A
(NO. 700-7 SHOWN)

NOTES:

THIS RING CASTING TO BE USED IN CONJUNCTION WITH ANY OF THE FOLLOWING CASTINGS:
 MANHOLE COVER NO. 715 OR NO. 716
 MANHOLE OR CATCH BASIN GRATES NO. 720 OR NO. 721.

① ALTERNATING GUSSETS (3 EACH).

4" CASTING NO. 700-4 (98 LBS.)
 7" CASTING NO. 700-7 (118 LBS.)
 8" CASTING NO. 700-8
 9" CASTING NO. 700-9
 10" CASTING NO. 700-10

APPROVED OCTOBER 25, 1996

Gerald J. Rohrbach

STATE DESIGN ENGINEER

STATE OF MINNESOTA
 DEPARTMENT OF TRANSPORTATION

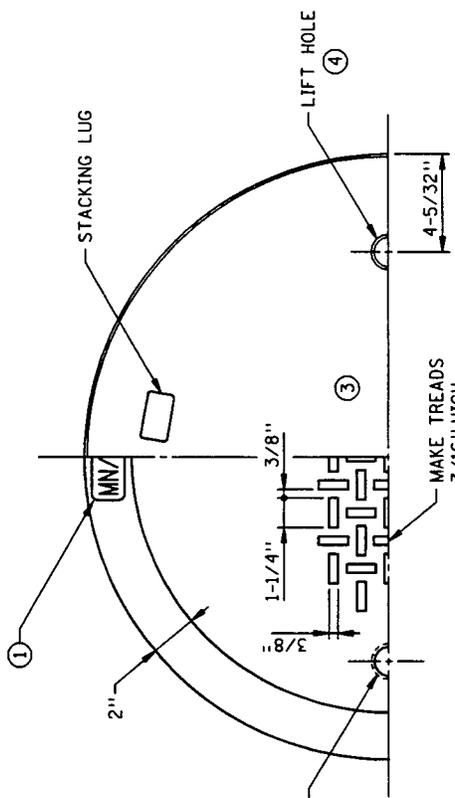
RING CASTING FOR MANHOLE
 OR CATCH BASIN

SPECIFICATION
 REFERENCE

2506

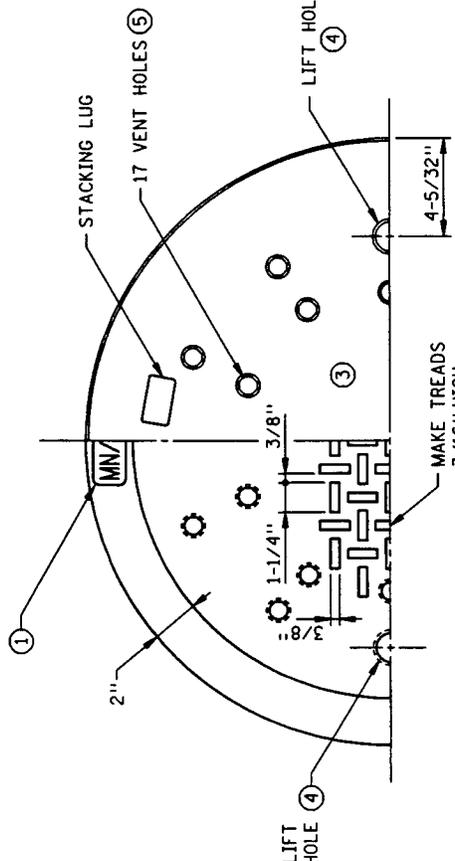
STANDARD
 PLATE
 NO.

4101D



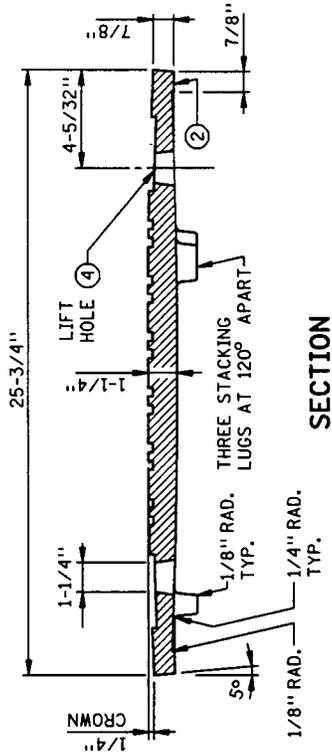
TOP VIEW
BOTTOM VIEW

CASTING NO. 715

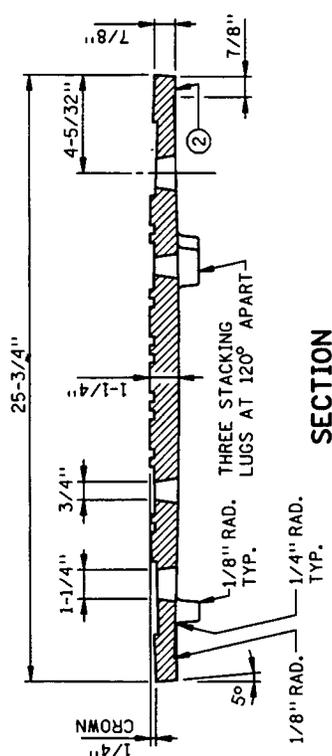


TOP VIEW
BOTTOM VIEW

CASTING NO. 716



SECTION



SECTION

NOTES:

- THESE COVERS TO BE USED WITH RING CASTING NO. 700-7 TO 700-10 OR FRAME CASTING NO. 770.
- ① ON OPPOSITE SIDE OF TOP SURFACE PLACE CASTING NUMBER, LETTERS (MN/DOT) AND NUMERALS TO BE 3/4" IN HEIGHT AND DEPRESSED 1/8".
- ② MACHINE FINISHED THICKNESS TO BE 13/16".
- ③ COVER SHALL BE MADE OF GRAY IRON, CLASS 35B.
- ④ LIFT HOLE 1-1/4" DIA. AT THE TOP, 1-1/2" AT THE BOTTOM.
- ⑤ EIGHT (8) VENT HOLES IN OUTER CIRCLE, NINE (9) VENT HOLES IN INNER CIRCLE. HOLES ARE 3/4" DIA. AT THE TOP AND 1" DIA. AT THE BOTTOM. INNER CIRCLE IS 2" FROM THE OUTER CIRCLE.

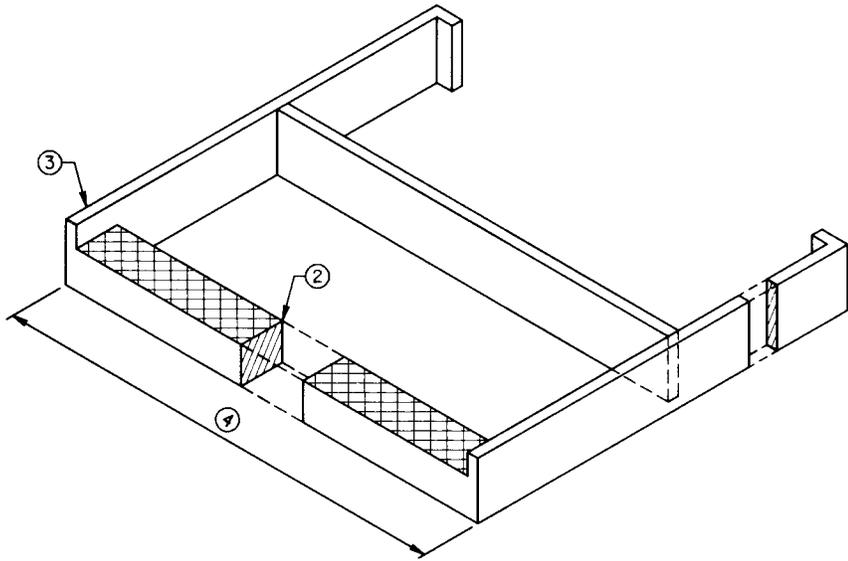
CASTING NO. 715 - 115 LBS.
CASTING NO. 716 - 118 LBS.

APPROVED OCTOBER 25, 1996
Gerald J. Rodensch
STATE DESIGN ENGINEER

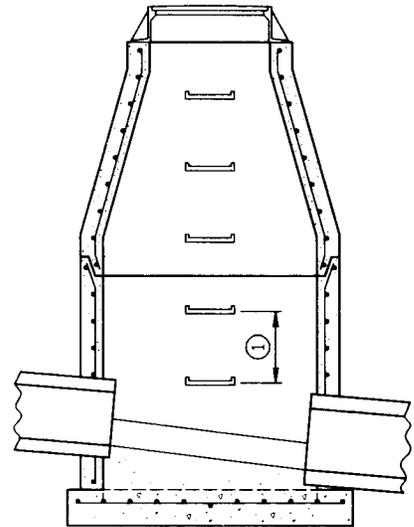
STATE OF MINNESOTA
DEPARTMENT OF TRANSPORTATION
COVER CASTING FOR MANHOLE
(FOR USE IN ALL TRAFFIC AREAS)

SPECIFICATION
REFERENCE
2506

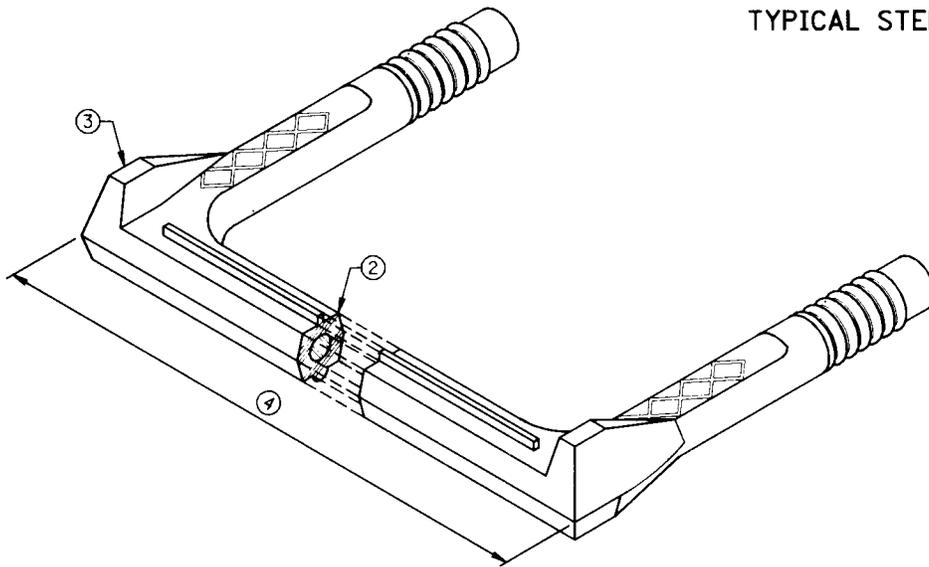
STANDARD
PLATE
NO.
4110F



TYPICAL METAL STEP



TYPICAL STEP ALIGNMENT



TYPICAL REINFORCED PLASTIC STEP

NOTES:

STEPS SHOWN ARE BASIC DESIGNS ONLY. FINAL CONFIGURATIONS MAY VARY FROM THESE DRAWINGS. VARIATIONS IN THE ABOVE DESIGNS WHICH WILL NOT DECREASE STRENGTH WILL BE PERMITTED.

THE OFFICE OF MATERIALS, RESEARCH AND ENGINEERING WILL MAINTAIN A LISTING OF APPROVED MANHOLE STEPS. CURRENTLY APPROVED STEPS ARE ALUMINUM, CAST IRON AND STEEL REINFORCED PLASTIC. SELECTION OF APPROVED STEP DESIGN IS THE OPTION OF THE CONTRACTOR OR SUPPLIER.

ALUMINUM STEPS SHALL CONFORM TO ASTM B26-64A, ALLOY AA 514.0. EMBEDDED LEG SECTIONS SHALL BE GIVEN A NEOPRENE PROTECTIVE COATING OR EQUIVALENT FOR CORROSION PROTECTION. COATINGS SHALL BE APPROVED BY MATERIALS ENGINEERING.

EXCEPT AS OTHERWISE NOTED ON THIS PLATE, STEPS SHALL CONFORM TO THE REQUIREMENTS OF ASTM C478.

STEPS SHALL BE EMBEDDED IN THE RISER OR CONICAL TOP SECTION WALL A MINIMUM DISTANCE OF 3 IN.

THE RUNG OR CLEAT SHALL PROJECT A MINIMUM CLEAR DISTANCE OF 4 IN. FROM THE WALL OF THE RISER OR CONE SECTION MEASURED FROM THE POINT OF EMBEDMENT.

THE MIN. CLEAR DISTANCE BETWEEN THE RUNG OR CLEAT AND THE OPPOSITE WALL OF THE MANHOLE RISER OR CONE SHALL BE 18 IN. MEASURED AT THE CENTER FACE OF THE STEP.

- ① STEPS SHALL BE SPACED AT A MAXIMUM DESIGN DISTANCE OF 16 IN. APART.
- ② STEPS SHALL HAVE A MINIMUM CROSS SECTION DIMENSION OF 1 IN.
- ③ MINIMUM VERTICAL SIDE DIMENSION TO PREVENT FOOT FROM SLIPPING OFF IS 1/2".
- ④ THE MINIMUM WIDTH OF RUNGS OR CLEATS SHALL BE 10 IN.

APPROVED DEC. 30, 1996

Gerald J. Robinson

STATE DESIGN ENGINEER

STATE OF MINNESOTA
DEPARTMENT OF TRANSPORTATION

MANHOLE OR CATCH BASIN STEP

SPECIFICATION
REFERENCE

2506

STANDARD
PLATE
NO.

4180J

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DIVISION 02 - SITE WORK

SECTION 02532

INVERTED SIPHONS; SEWER

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SUBMITTALS
- 1.3 DELIVERY AND STORAGE

PART 2 PRODUCTS

- 2.1 PIPE AND FITTINGS
 - 2.1.1 Polyethylene Plastic Pipe

PART 3 EXECUTION

- 3.1 INSTALLATION
 - 3.1.1 Cutting
 - 3.1.2 Laying
 - 3.1.3 Jointing
- 3.2 CONNECTING TO MANHOLES

-- End of Section Table of Contents --

SECTION 02532

INVERTED SIPHONS; SEWER

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 2657 (1997) Heat Fusion Joining Polyolefin Pipe and Fittings

ASTM D 2774 (1994) Underground Installation of Thermoplastic Pressure Piping

ASTM D 3350 (1998a) Polyethylene Plastics Pipe and Fittings Materials

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C 906 (1990) Polyethylene (PE) Pressure Pipe, 4 In. Through 63 In., for Water Distribution

1.2 SUBMITTALS

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

SD-01 Preconstruction Submittals

Manufacturers Instructions;

Printed copies of the manufacturer's recommendations for installation procedures of the material being placed.

Shop Drawings; G,STR

Shop drawings shall be submitted for the following items: Pipe, Pipe layout; Pipe joints; Manhole connection details. Include manufacturers literature that shows material specifications and recommended use.

1.3 DELIVERY AND STORAGE

All material delivered and stored shall be handled and stored in such a manner that pipe, fittings and accessories, and pipe coatings are not damaged.

PART 2 PRODUCTS

2.1 PIPE AND FITTINGS

Piping for inverted siphon shall be high density polyethylene pipe (HDPE). Pipe shall conform to the respective specifications and other requirements specified below.

2.1.1 Polyethylene Plastic Pipe

The pipe shall be class 345434C in accordance with ASTM D 3350. Pipe for the inverted siphon shall have an inside diameter of 20", shall be smooth walled, and shall be dimension ratio (DR) 21. Pipe and fittings shall conform to AWWA C 906.

PART 3 EXECUTION

3.1 INSTALLATION

Pipe, pipe fittings, and appurtenances shall be installed at the locations indicated. Excavation, trenching, and backfilling shall be as specified in Section 02316 EXCAVATION, TRENCHING AND BACKFILLING FOR UTILITIES SYSTEMS.

3.1.1 Cutting

Pipe shall be cut in a neat manner with mechanical cutters. Sharp and rough edges shall be ground smooth and loose material removed from the pipe before laying.

3.1.2 Laying

Before lowering and while suspended, the pipe shall be inspected for defects. Defective material shall be rejected. Pipe shall be laid in compliance with manufacturer's instructions and ASTM D 2774.

3.1.3 Jointing

Heat Fusion Joints in accordance with ASTM D 2657. Heat fusion joints shall comply with the manufacturer's instructions concerning equipment, temperature, melt time, heat coat, and joining time.

3.2 CONNECTING TO MANHOLES

Pipe connections to existing manholes shall be watertight and made so that finish work will conform as nearly as practicable to the applicable

requirements specified for new manholes, including all necessary concrete work, cutting, and shaping. The connection shall be centered on the manhole. Holes for the new pipe shall be of sufficient diameter to allow packing grout around the entire periphery of the pipe, or to allow adequate space for mechanical connections, but no larger than 1.5 times the diameter of the pipe. Cutting the manhole shall be done in a manner that will cause the least damage to the walls.

-- End of Section --

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SECTION 02630

STORM-DRAINAGE SYSTEM

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- 1.2 SUBMITTALS
- 1.3 DELIVERY, STORAGE, AND HANDLING
 - 1.3.1 Delivery and Storage
 - 1.3.2 Handling

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- 2.1 PIPE FOR CULVERTS AND STORM DRAINS
 - 2.1.1 Concrete Pipe
 - 2.1.2 Reinforced Arch Culvert and Storm Drainpipe
- 2.2 GEOTEXTILE FOR CULVERTS AND STORM DRAINS

PART 3 EXECUTION

- 3.1 EXCAVATION FOR PIPE CULVERTS, STORM DRAINS, AND DRAINAGE STRUCTURES
- 3.2 BEDDING
 - 3.2.1 Concrete Pipe Requirements
- 3.3 PLACING PIPE
- 3.4 JOINTING
 - 3.4.1 Flexible Watertight Joints
 - 3.4.2 Geotextile Joint Wrap

-- End of Section Table of Contents --

SECTION 02630

STORM-DRAINAGE SYSTEM

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 76 (1999) Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe

ASTM C 506 (1999) Reinforced Concrete Arch Culvert, Storm Drain, and Sewer Pipe

1.2 SUBMITTALS

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

SD-03 Product Data

Placing Pipe;

Printed copies of the manufacturer's recommendations for installation procedures of the material being placed, prior to installation.

SD-07 Certificates

Pipeline Testing;

Certified copies of test reports demonstrating conformance to applicable pipe specifications, before pipe is installed.

1.3 DELIVERY, STORAGE, AND HANDLING

1.3.1 Delivery and Storage

Materials delivered to site shall be inspected for damage, unloaded, and stored with a minimum of handling. Materials shall not be stored directly

on the ground. The inside of pipes and fittings shall be kept free of dirt and debris. Contractor shall have a copy of manufacturer's instructions available at the construction site at all times and shall follow these instructions unless directed otherwise by the Contracting Officer.

1.3.2 Handling

Materials shall be handled in a manner that ensures delivery to the trench in sound, undamaged condition. Pipe shall be carried to the trench, not dragged.

PART 2 PRODUCTS

2.1 PIPE FOR CULVERTS AND STORM DRAINS

Pipe for culverts and storm drains shall be of the sizes indicated and shall conform to the requirements specified.

2.1.1 Concrete Pipe

ASTM C 76, Class II.

2.1.2 Reinforced Arch Culvert and Storm Drainpipe

ASTM C 506, Class A-II.

2.2 GEOTEXTILE FOR CULVERTS AND STORM DRAINS

Geotextile for wrapping around arch culvert joints is specified in SECTION 02388

PART 3 EXECUTION

3.1 EXCAVATION FOR PIPE CULVERTS, STORM DRAINS, AND DRAINAGE STRUCTURES

Excavation of trenches, and for appurtenances and backfilling for culverts and storm drains, shall be in accordance with the applicable portions of Section 02316 "Excavation, Trenching, and Backfilling for Utilities Systems", and Section 02300 "Earthwork".

3.2 BEDDING

The bedding surface for the pipe shall provide a firm foundation of uniform density throughout the entire length of the pipe.

3.2.1 Concrete Pipe Requirements

When no bedding class is specified or detailed on the drawings, concrete pipe shall be bedded in a soil foundation accurately 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 pipe arch. When necessary, the bedding shall be tamped. Bell holes and

depressions for joints shall be not more than the length, depth, and width required for properly making the particular type of joint.

3.3 PLACING PIPE

Each pipe shall be thoroughly examined before being laid; 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. Pipe shall not be laid in water, and pipe shall not 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.

3.4 JOINTING

3.4.1 Flexible Watertight Joints

Gaskets and jointing 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 pushed home. If, while the joint is being made the gasket becomes visibly dislocated the pipe shall be removed and the joint remade.

3.4.2 Geotextile Joint Wrap

Joints in concrete arch culvert for Texas crossing culvert shall be wrapped in geotextile. Geotextile wrap shall be a minimum of two feet wide. Geotextile shall extend a minimum of one foot beyond each side of each joint in the culvert. The geotextile for the wrap shall be one continuous piece around the joint. Geotextile shall be overlapped a minimum of one foot.

-- End of Section --

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SECTION 02720

AGGREGATE SURFACE COURSE

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- 2.1 AGGREGATE BASE
- 2.2 MATERIAL SOURCES

PART 3 EXECUTION

- 3.1 GENERAL
 - 3.1.1 Definitions
- 3.2 EQUIPMENT
- 3.3 WEATHER LIMITATION
- 3.4 STOCKPILING MATERIAL
- 3.5 PREPARATION OF SUBGRADE
 - 3.5.1 Chinking
- 3.6 GRADE CONTROL
 - 3.6.1 Grade and Cross Section Tolerances
- 3.7 PLACING
- 3.8 COMPACTION
 - 3.8.1 Requirements
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- 3.11 MAINTENANCE

-- End of Section Table of Contents --

SECTION 02720

AGGREGATE SURFACE COURSE

PART 1 GENERAL

1.1 REFERENCES

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

MINNESOTA DEPARTMENT OF TRANSPORTATION (MNDOT)

MNDOT 3138 (1995)Aggregates for Surface and Base Course, Standard Specifications for Construction

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 117 (1995) Materials Finer Than 75 micrometers (No. 200 Sieve) in Mineral Aggregates by Washing

ASTM C 136 (1996a) Sieve Analysis of Fine and Coarse Aggregates

ASTM D 698 (1991; R 1998) Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³) (600 KN-m/m³)

ASTM D 1556 (1996) Density and Unit Weight of Soil in Place by the Sand-Cone Method

ASTM D 2922 (1996) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)

1.2 SUBMITTALS

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

SD-01 Preconstruction Submittals

Aggregate Sources;

Material sources as specified in Paragraph SOURCE AND SAMPLING.

SD-06 Test Reports

Testing;

Testing results as specified in Paragraph TESTING shall be promptly furnished to the Contracting Officer.

PART 2 PRODUCTS

2.1 AGGREGATE BASE

MNDOT 3138, Class 5.

2.2 MATERIAL SOURCES

It shall be the responsibility of the Contractor to make its own investigations for a source of suitable materials and to make its own arrangements with the owners of the pits for procuring the required quantity of suitable material. The Contractor shall designate in writing only one source or one combination of sources from which it proposes to furnish aggregate. A 50 pound sample shall be provided to the Contracting Officer. Approval of samples from a source of aggregate is not to be construed as approval of all materials from that source. The right is reserved to reject materials from certain localized areas, zones, strata, or channels when such materials are unsuitable for aggregate as determined by the Contracting Officer. Materials produced from an approved source shall meet all the requirements of this section.

PART 3 EXECUTION

3.1 GENERAL

Aggregate base course shall be constructed in accordance with the requirements of the referenced state standard specification sections unless specified otherwise.

3.1.1 Definitions

The term "Engineer" referenced in the state standard specifications shall mean the Contracting Officer.

3.2 EQUIPMENT

All plant, equipment, and tools used in the performance of the work will be subject to approval and shall be maintained in satisfactory working condition at all times. The equipment shall meet the requirements of the referenced state standard specification sections. The base course shall be compacted using a steel-wheeled roller, vibratory smooth drum roller,

pneumatic-tired roller, unless other special compaction equipment is approved.

3.3 WEATHER LIMITATION

Base courses shall be placed when the atmospheric temperature is above 35 degrees F. Base shall not be constructed on subgrades that are frozen or contain frost. Areas of completed base course that are damaged by freezing, rainfall, or other weather conditions shall be corrected to meet specified requirements.

3.4 STOCKPILING MATERIAL

Prior to stockpiling of material, storage sites shall be cleared and leveled by the Contractor. Materials obtained from different sources shall be stockpiled separately.

3.5 PREPARATION OF SUBGRADE

Prior to constructing the aggregate base course, the subgrade shall be proofrolled as specified in Section 02300. The finished subgrade shall not be disturbed by traffic or other operations and shall be maintained by the Contractor in a satisfactory condition until the base course is placed.

3.5.1 Chinking

Chinking will be required where the roadway surface coincides with the riprap channel. Chinking involves placing the aggregate base material flush with the top surface of the riprap. The typical plan dimension for aggregate base course thickness does not apply in the chinking area.

3.6 GRADE CONTROL

During construction, the lines and grades, including crown and cross slope indicated for the base course, shall be maintained by means of line and grade stakes placed by the Contractor. Grade stakes shall be in lines parallel to the centerline of the area under construction and suitably spaced for string lining. The Contractor may use an approved laser system in lieu of a grade stake system. Adequate drainage shall be provided during the entire period of construction to prevent water from collecting or standing on the area to be constructed.

3.6.1 Grade and Cross Section Tolerances

Subgrade. 0.05 foot above or below prescribed elevation.

Base Courses. 0.05 foot below prescribed elevation.

3.7 PLACING

The mixed material shall be placed on the prepared subgrade or subbase in loose lifts not exceeding 6 inches in thickness. The layers, when compacted, shall be true to the grades or levels required, with the least possible surface disturbance. If base course becomes contaminated by

traffic or sedimentation, the surface shall be cleaned prior to completing subsequent work by sweeping with power sweepers, power brooms, or hand brooms.

3.8 COMPACTION

3.8.1 Requirements

Each layer shall be compacted until there is no further evidence of consolidation. Water shall be applied to the base material during the mixing, spreading, and compacting operations when and in the quantities the Contracting Officer considers necessary for proper compaction.

3.8.2 Finishing

The surface of the top layer shall be finished to grade and cross section shown. Finished surface shall be of uniform texture. Light blading during compaction may be necessary for the finished surface to conform to the lines, grades, and cross sections. Should the surface for any reason become rough, corrugated, uneven in texture, or traffic marked prior to completion, such unsatisfactory portion shall be scarified, reworked, or replaced as directed.

3.9 THICKNESS CONTROL

The thickness of the base course shall be measured at intervals of one measurement for at least each 500 square yards of base course. The depth measurement shall be made by test holes at least 6 inches in diameter. The work shall be scheduled when the Contracting Officer can observe the testing; and the Contracting Officer shall select the locations of the test holes, unless waived.

3.10 TESTING

The following tests shall be performed by and at the expense of the Contractor. Samples shall be taken when and where directed. Tests of materials not meeting the requirements specified will not be counted as part of the required tests. There are no compaction requirements for the density tests: the results shall be used to aid the evaluation of the required compaction equipment passes. Copies of test results shall be submitted to the Contracting Officer.

3.10.1 Testing Schedule

- a. Sieve Analysis (ASTM C 117 and ASTM C 136).

One test prior to placing or hauling and one test per 500 cy or fraction thereof (in place measure)

- b. Moisture-Density Relations (ASTM D 698)

One test for each material variation.

- c. In-Place Densities (ASTM D 1556 or ASTM D 2922)

One test per 500 cy or fraction thereof (in place measure)

3.10.2 Correction

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

3.11 MAINTENANCE

The base course shall be maintained in a condition that will meet specification requirements until accepted.

-- End of Section --

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SECTION 02920

ESTABLISHMENT OF TURF

PART 1 GENERAL

Wherever possible, all seed shall be drilled except where the turf reinforcement mat is used. Other seeding methods are subject to approval. Existing turf areas which have been damaged during the contract operations, and which are outside of the limits designated to be seeded, shall be restored following the requirements in this section, at no additional cost to the Government.

The Government furnished erosion control matting (Enkamat) to be installed is currently stored at Orwell Dam near Fergus Fall, Minnesota. The Contractor shall coordinate with the Contracting Officer's Representative for the exact location of the storage site and to arrange for pick up and delivery. The Contractor shall be responsible for delivery of the erosion control matting and accessories to the project site including, but not limited to loading, transporting, and unloading the materials. Ground fasteners for the erosion control matting shall be provided by the Contractor.

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

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 4972 (1995a) pH of Soils

ASTM D 5268 (1992; R 1996) Topsoil Used for Landscaping Purposes

1.2 SUBMITTALS

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

SD-01 Preconstruction Submittals

Experience for Native Grasses;

The Contractor shall submit a statement indicating that the work to establish the turf will be supervised by an individual with a minimum of 5 years experience with establishment and restoration of native plant communities.

Erosion Control Matting Plan; G,GEN

The Contractor shall submit a plan with a layout of erosion control matting sections and ground fastener locations.

SD-03 Product Data

Manufacturer's Literature;

The Contractor shall submit manufacturer's literature discussing physical characteristics, applications, guarantees, and installation of the seed and mulch. The Contractor shall submit manufacturer's literature for equipment showing application and installation instructions.

SD-06 Test Reports

Soil Test;

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.

Seed Test;

The Contractor shall submit test reports for a purity and germination test following the Association of Official Seed Analysts (AOSA) rules for each seed mixture. The test reports shall indicate the purity percentage and germination percentage for each species.

Quantity Check;

Bag count or bulk weight measurements of material used compared with area covered to determine the application rate and quantity installed.

Maintenance Record;

Maintenance work performed, area repaired or reinstalled, diagnosis for unsatisfactory stand of grass plants.

1.3 SOURCE INSPECTION

The source of delivered topsoil shall be subject to inspection.

1.4 DELIVERY, INSPECTION, STORAGE, AND HANDLING

1.4.1 Inspection

Seed shall be inspected upon arrival at the job site for conformity to species and quality. Seed materials shall be delivered in manufacturer's original, unopened containers with labels and tags intact and legible. 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.

1.4.2 Storage

Materials shall be stored in areas provided by the Contractor. The storage areas shall be made accessible to the Contracting Officer so that application rates can be verified. Seed shall be stored in cool, dry locations away from contaminants. Chemical treatment materials shall be stored according to manufacturer's instructions and not with seed.

1.4.3 Handling

Except for bulk deliveries, materials shall not be dropped or dumped from vehicles.

1.4.4 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.

PART 2 PRODUCTS

2.1 SEED

Substitutions will not be allowed without written request and approval from the Contracting Officer. The mixing of seed may be done by the seed supplier prior to delivery, or on site in the presence of the Contracting Officer. Seed for native grass and Forbes species shall be gathered from within 500 miles of the jobsite.

2.1.1 Seed Classification

State-certified seed of the latest season's crop shall be provided in original sealed packages bearing the producer's guaranteed analysis for

mixture percentage, purity, germination, weed seed content, and inert material. Labels shall be in conformance with AMS-01 and applicable state seed laws.

2.1.2 Permanent Seed Species and Mixtures

Permanent seed species and mixtures shall be proportioned by weight as follows: Seed mix for cutoff channel invert, low flow cutoff channel invert, and low flow cutoff channel slopes shall be MNDOT seed mix 25B. Seed mix for cutoff channel slopes, and other areas to be seeded not listed above, shall be MNDOT seed mix 15B. Seed application rate for both mixes shall be 30 pounds per acre. The seed mixes are available on the internet at the the following address:
<http://www.dot.state.mn.us/environment/index.html>.

2.1.3 Temporary Seed Species

If planting of seed is performed in the Fall, add winter wheat at the rate of 20 pounds per acre to each seed mix. If planting of seed takes place in the Spring, add oats at the rate of 20 pounds per acre to each seed mix.

2.1.4 Quality

Weed seed shall be a maximum 1 percent by weight of the total mixture. Inoculant shall consist of the proper bacteria applied in the amount and manner recommended by the manufacturer to all legumes in the seed mix.

2.2 MULCH

2.2.1 Straw Mulch

Straw mulch materials shall consist of wheat, oat, or rye straw, hay, grass, or other plants approved by the Contracting Officer. Mulch materials shall be native to the region. The mulch material shall be air dry, reasonably light in color, and shall not be musty, moldy, caked, or otherwise of low quality. The mulch shall be seed free or fumigated to prevent introduction of weeds. The use of mulch that contains noxious weeds will not be accepted. Dry mulching material which breaks and does not bend is unacceptable. Mulch shall have a consistency for placing with commercial mulch blowing equipment.

2.2.2 Paper Fiber

Paper fiber mulch shall be recycled news print that is shredded for the purpose of mulching seed.

2.3 HERBACIDE AND PESTICIDE

Herbicide and pesticide shall not be applied without written approval of the Contracting Officer.

2.4 EROSION CONTROL MATTING

Erosion control matting will be furnished by the Government. Government

furnished materials are addressed in clause 52.245-4002. Extra material for overlaps, anchorage, etc. will be Government furnished, and unused material shall remain Government property.

The Contractor shall pick up the material and deliver it to the project site. Erosion Control Matting shall be installed as shown. The Erosion control matting to be furnished is Enkamat 7010 manufactured by Colbond Geosynthetics. The contact information for Colbond Geosynthetics is listed below.

Colbond Geosynthetics
P.O. Box 1057
Sand Hill Road, Enka, NC 28728
1-800-365-7391, 828-665-5050
Fax: 828-665-5009
www.colbond-usa.com

Ground fasteners for the erosion control matting shall be provided by the Contractor. Ground fasteners shall be as recommended by the erosion control matting manufacturer but at the minimum shall be 12 inch long metal staples. A layout of erosion control matting and fasteners shall be submitted as specified in Paragraph: SUBMITTALS.

PART 3 EXECUTION

3.1 INSTALLING SEED TIME AND CONDITIONS

3.1.1 Notification

The Contractor shall notify the Contracting Officer 24 hours in advance of beginning seeding or any changes in turf establishment operations.

3.1.2 Seeding Time

Seed shall be sown from April 15 to July 20. Seed may be dormant seeded from October 20 until the ground freezes. No finished construction area shall be left untopsoiled and unseeded during the winter months. When substantially complete areas are not seeded within the specified seeding times for fall planting, a temporary winter cover shall be placed.

3.1.3 Seeding Conditions

Seeding operations shall be performed only during periods when beneficial results can be obtained. When drought, excessive moisture, or other unsatisfactory conditions prevail, the work shall be stopped when directed.

When special conditions warrant a variance to the seeding operations, proposed alternate times shall be submitted for approval.

3.2 SOIL TEST

Delivered topsoil, existing soil in smooth graded areas, and stockpiled topsoil shall be tested in accordance with ASTM D 5268 and ASTM D 4972 for determining the particle size, pH, and organic matter content. One test

shall be sampled and tested. The sample shall be taken at a location directed by the Contracting Officer, unless waived. The tests shall determine the quantities and type of soil amendments required to meet local growing conditions for the seed species specified.

3.3 SITE PREPARATION

3.3.1 Finished Grade and Topsoil

The Contractor shall verify that finished grades are as indicated on drawings, and the placing of topsoil, smooth grading, and compaction requirements have been completed prior to the commencement of the seeding operation. All vegetation, including live roots, shall be completely removed or treated with herbicide prior to spreading topsoil or placing sod.

3.3.2 Spreading Topsoil

Topsoil shall be distributed and spread uniformly to one half the thickness shown on the plans and tilled to a depth of 4 inches into the subgrade. The remaining half of the topsoil shall then be placed. Surface irregularities resulting from topsoiling or other operations shall be leveled to prevent depressions.

3.3.2.1 Equipment

Topsoil shall be spread using a bladed dozer having ground pressure less than 4.5 psi and operating weight less than 35,000 pounds, or with rubber tired equipment having operating weight less than 10,000 pounds. The work shall be coordinated such that equipment for hauling the topsoil does not travel over the topsoil in place. Areas compacted by construction operations shall be completely pulverized by tillage.

3.3.2.2 Stripped Materials.

Topsoil obtained from stripping operations shall be kept separate from other unusable excavated materials, brush, litter, objectionable weeds, roots, stones, and other materials that would interfere with planting and maintenance operations. Unusable material shall be removed and properly disposed of.

3.3.3 Tillage

Topsoil on slopes up to a maximum 3H:1V slope shall be tilled to a nominal 4 inch depth by plowing, disking, harrowing, rototilling or other approved method. On slopes between 3H:1V and 1:1, the soil shall be tilled to a minimum 2 inch depth by scarifying with heavy rakes, or other method. On slopes 1:1 and steeper, no tillage is required.

3.3.4 Prepared Surface

The prepared surface shall be 1 inch below the adjoining grade of any surfaced area. New surfaces shall be blended to existing areas. The prepared surface shall be completed with a light raking to remove debris. Debris and stones over a minimum 3 inch in any dimension shall be removed

from the surface. Drainage patterns shall be maintained as indicated on drawings. Tolerance for drainage ditches and swales shall be within 1 inch of the plan elevation. The prepared surface shall be protected from compaction or damage by vehicular or pedestrian traffic and surface erosion.

3.4 SEEDING

Wherever possible, all seed shall be drilled except where the turf reinforcement mat is used. Other seeding methods are subject to approval. Prior to installing seed, any previously prepared surface compacted or damaged shall be reworked to meet the requirements of paragraph SITE PREPARATION. Seeding operations shall not take place when the wind velocity will prevent uniform seed distribution.

3.4.1 Equipment

Gravity feed applicators, which drop seed directly from a hopper onto the prepared soil, shall not be used because of the difficulty in achieving even coverage, unless otherwise approved.

3.4.2 Broadcast Seeding

In areas inaccessible to drill seeding, seed shall be broadcast by hand. Seed shall be uniformly broadcast at the rate specified for the mix. Half the total rate of seed application shall be sown with sower moving in one direction, and the remainder with sower moving at right angles to first sowing. Seed shall be covered a maximum 1/4 inch depth by disk harrow, steel mat drag, cultipacker, or other approved device. Seed shall not be broadcast when wind speed exceeds 5 miles per hour.

3.4.3 Drill Seeding

Seed shall be uniformly drilled to a depth of 1/2 to 3/4 inches at the rate specified for the mix. Equipment shall have drills a maximum 6 inches distance apart. Row markers shall be used with the drill seeder. Seed shall be drilled in two directions, applying approximately half the seed in each direction. The drilling equipment shall be maintained with half full seed boxes during the seeding operations. When slopes exceed 1 vertical on 5 horizontal, baffle plates spaced not more than 6 inches apart shall be installed in the seed box.

3.4.4 Hydroseeding

The hydroseeding operation shall apply the seed and mulch simultaneously. The mulch shall be applied at a rate of about 1 ton per acre. During application, the spray shall be directed to obtain a uniform material distribution as evidenced by a formation of a "blotter-like" cover, with about 5% void area. The mulch shall permit percolation of water to the underlying soil.

3.4.5 Mulching

3.4.5.1 Hay or Straw Mulch

Mulch shall be spread by hand, blower-type mulch spreader, or other approved method. Mulching shall be started on the windward side of relatively flat areas or on the upper part of steep slopes, and continued uniformly until the area is covered. The mulch shall not be bunched or clumped. Sunlight shall not be completely excluded from penetrating to the ground surface. All areas installed with seed shall be mulched on the same day as the seeding. Mulch shall be anchored immediately following spreading.

3.4.5.2 Mechanical Anchor

Mechanical anchor shall be a V-type-wheel land packer; a scalloped-disk land packer designed to force mulch into the soil surface; or other suitable equipment.

3.4.5.3 Wood Cellulose Fiber, Paper Fiber, and Recycled Paper

Wood cellulose fiber, paper fiber, or recycled paper shall be applied as part of the hydroseeding operation. The mulch shall be mixed and applied in accordance with the manufacturer's recommendations.

3.4.6 Native Grasses

Hay or straw mulch shall be spread uniformly at the rate of 3 tons per acre.

Areas seeded with native grasses, except slopes steeper than 3H:1V, shall be firmed with a roller not exceeding 90 pounds per foot roller width. Seed drills equipped with rollers are acceptable.

3.5 RESTORATION AND CLEAN UP

Immediately upon completion of the seeding operation in an area, the area shall be protected against traffic or other use by erecting barricades, providing signage, or as directed. Existing turf areas, pavements, and facilities that have been damaged from the seeding operation shall be restored to original condition at Contractor's expense. Excess and waste material shall be removed from the seeded areas and shall be disposed offsite. Adjacent paved areas shall be cleaned.

3.6 MAINTENANCE

3.6.1 Mowing

Native Grasses: Areas seeded with native grasses shall be mowed during the first growing season to control pioneering weeds and other competition. For the purposes of this project a weed is defined as any plant not included in the seed mix. Mowing should be done before the general height is 6 to 10 inches, when the weedy foliar cover reaches 50 percent of the seeded area, or when the weed species begin to flower. The first mowing shall be at a height of 3 inches with the following mowings to be set at a height of 4 to 8 inches. Rotary, flail, or sickle bar type mowing equipment is acceptable.

3.6.2 General Maintenance

Maintenance of the seeded areas shall include eradicating weeds, protecting embankments and ditches from surface erosion, maintaining erosion control materials and mulch, protecting installed areas from traffic, and mowing. If any portion of the surface becomes rilled, gullied, damaged, or destroyed, that portion shall be repaired to re-establish the area without additional cost to the government. The Contractor shall control erosion during the maintenance period by using ditch checks, sod swales, silt fences or other methods until a proper stand of turf is established.

3.6.2.1 Repair or Reinstall

Unsatisfactory stand of grass plants and mulch shall be repaired or reinstalled, and eroded areas shall be properly filled. Mulch material that has been removed by wind or other causes shall be replaced and secured. Maintenance shall include protecting embankments and ditches from erosion and maintaining erosion control material.

3.6.3 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.

3.7 ACCEPTANCE

Grass plants shall be evaluated for species and health when the grass plants are a minimum 1 inch high.

Native Grasses. A proper stand of turf from the seeding of native grasses is defined as a minimum of 2 to 4 plants per square foot and where no gaps larger than 6 inches in diameter occur anywhere in the turfed area. Only plants specified in the seed mix table will be considered.

3.8 SURFACE EROSION CONTROL

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. When directed during contract delays affecting the seeding operation or when a quick cover is required to prevent surface erosion, the areas designated shall be seeded with a temporary seed crop.

-- End of Section --