725.05. ACCESSORIES FOR CASTINGS AND SPECIAL FABRICATED UNITS.

(a) **General.** Bolts required for casting assemblies shall meet the requirements of AASHTO M 164. They shall be machine bolts furnished galvanized (zinc-coated), cadmium plated, or stainless steel. Support beams required for casting assemblies shall meet the requirements of AASHTO M 183. Furnish "T" handles as shown on standard drawings for locking manhole covers. The minimum shall be two handles for up to and including 20 locking manhole covers and one for every 20 thereafter.

(b) **Special Fabricated Drainage Grates.** Welded steel drainage grates shall meet the material requirements of AASHTO M 183 for the load- bearing members. Stiffeners shall be specified by the manufacturer. Welding shall meet all applicable standards as covered in Section 724 and references.

Furnish grate units that have been galvanized after fabrication or painted with an inorganic zinc ethyl silicate base primer and vinyl finish coat. Galvanization shall be in accordance with the requirements of AASHTO M 111. Paint shall meet the materials requirements of Section 730.

Cleaning of grate units (for either procedure) and paint application shall be as covered in Subsection 506.04(d) Painting. Only those procedures which apply to grate sized units shall apply, and shop-applied paint shall be utilized for both coats.

Pipe for use in fabricated grates shall meet the requirements of ASTM A 53 and be furnished in standard mass, unthreaded mill finish unless otherwise stated. Hydrostatic pressure testing shall be waived. After welding, thoroughly clean the grate units, and for galvanized units only, punch or drill a pressure vent. See Plans for location of vent holes. See above for paint and painting requirements. Angle iron and strap iron used for end members or spacers shall meet the requirements of AASHTO M 183 mill-finish.

Butt welded pipe shall be acceptable for use as grate members with the approval of the Engineer.

725.06. BRONZE.

Bronze castings shall conform to the requirements of AASHTO M-107, Copper Alloy UNS No. C91100. Bronze bearings and expansion plates shall conform to the requirements of the Specifications for Rolled Phosphor Bronze Bearings and Expansion Plates for Bridges and Structures, AASHTO M 108 Copper Alloy UNS No. C51000. The class of metal shall be shown on the Plans.

SECTION 726
DRAINAGE CONDUITS

726.01. DESCRIPTION.

This section covers the materials requirements for surface and subsurface drainage conduits of the kind specified on the Plans and the requirements of Section 613.

726.02. MATERIALS.

(a) **Rigid Conduits.** Materials covered in this Subsection are as follows: nonreinforced concrete pipe, drain tile porous and perforated pipe, reinforced concrete circular, elliptical, and arch pipe, cast (ductile) iron, precast reinforced concrete box sections, manhole sections, inlet boxes, and junction boxes, all meeting the following requirements:

1. ***Concrete and Clay Culverts.***
   1.1. ***Concrete Sewer, Storm Drain, and Culvert Pipe*** shall conform to AASHTO M 86.
   1.2. ***Reinforced Concrete Culvert, Storm Drain and Sewer Pipe*** shall conform to AASHTO M 170.

   In addition to the Pipe Classes shown in AASHTO M 170, a special design Class IV/V conforming to AASHTO M 170M may also be used. Design criteria for Class IV/V is a midline interpolation between the design criteria shown for Class IV (Table 4) and Class V (Table 5) of AASHTO M 170.

   1.3. ***Reinforced Concrete Arch Culvert, Storm Drain, and Sewer Pipe*** shall conform to AASHTO M 206.
   1.4. ***Reinforced Concrete Elliptical Culvert, Storm Drain and Sewer Pipe*** shall conform to AASHTO M 207.
   1.5. ***Reinforced Concrete D-Load Culvert, Storm Drain, and Sewer Pipe*** shall conform to AASHTO M 242.
   1.6. ***Concrete Drain Tile*** shall conform to AASHTO M 178.
   1.7. ***Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated*** shall conform to AASHTO M 65.
   1.8. ***Clay Drain Tile*** shall conform to AASHTO M 179.
2. ***Rigid Metallic Culverts.***
   2.1. ***Ductile Iron Culvert Pipe*** shall conform to AASHTO M 64.
3. ***Precast Sewer Appurtenances and Box Sections for Culverts.***
   3.1. ***Precast Reinforced Concrete Manhole Sections*** shall conform to AASHTO M 199.
   3.2. ***Precast Reinforced Concrete Curb Inlet Boxes*** shall conform to ODOT approved Designs.
   3.3. ***Precast Reinforced Concrete Junction Boxes*** shall conform to ODOT approved Designs.
   3.4. ***Precast Reinforced Concrete Box Sections for Culverts, Storm Drains, and Sewers*** shall conform to AASHTO M 259.
   3.5. ***Precast Reinforced Concrete Box Sections for Culverts, Storm Drains, and Sewers With Less Than 2 feet (600 mm) of Cover Subject to Highway Loadings*** shall conform to AASHTO M 273.
4. ***DELETED.***
5. ***Inspection and Acceptance.*** Inspection and acceptance criteria will be as specified unless the manufacturer has established an approved quality control program with the Department.
6. ***Joint Filler.*** Joint filler for joints in concrete pipe culverts shall meet the requirements of one of the following materials:

6.1. ***Cold Applied Mastic Type.*** This compound, when applied according to the manufacturer's directions, shall be resilient and adhesive and maintain an effective seal through repeated cycles of expansion and contraction. The material shall comply specifically with the following requirements:

	Minimum	Maximum
Soluble in Trichloroethylene, AASHTO T 44, %	45.0	—
Ash, AASHTO T 111, %	15.0	55.0
Penetration[a], AASHTO T 49, 150 g., 5 sec., 77°F (25EC)	150	275

[a] Penetration shall be in accordance with AASHTO T 49, except that a penetration cone shall be used in lieu of the standard penetration needle. The cone shall conform to the requirements given in the Standard Method of Test for Cone Penetration of Lubricating Grease (ASTM D 217), except that the interior construction may be modified as desired.

NOTE: This joint filler shall not be used for pipes larger than 60 inches (1524 mm) in diameter or for precast concrete boxes.

6.2. ***Flexible Watertight Gaskets.*** The joint materials shall meet the requirements of AASHTO M 198 and provide a proper fit for a satisfactory seal. When not on the approved list maintained by the Materials Engineer, a type A certification stating the material meets AASHTO M 198 shall be submitted.

NOTE: Butyl rubber sealant shall be used for all pipes in excess of 60 inches (1524 mm) in diameter.

6.3 ***Flexible Cellular Seals.*** The joint materials shall meet the requirements of ASTM D 1056 "Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber, Type 2C1."

NOTE: This joint material shall be one continuous piece, shall be applied in accordance with the manufacturer's recommendation, and shall not be used for pipes larger than 60 inches (1524 mm).

(b) **Flexible Conduits.** Materials covered in this Subsection are as follows: steel conduits, coated and clad steel conduits, structural plates, aluminum conduits, clad aluminum conduits, and nonmetallic conduits, all meeting the following requirements:

1. ***Steel Conduits-Culverts.***

1.1. ***Metallic (Zinc or Aluminum) Coated, Corrugated Steel Culverts*** shall conform to AASHTO M 36.

1.1.1. ***Sheets for Culverts.*** Zinc coated (Galvanized) steel sheets for culverts shall conform to AASHTO M 218. Steel sheet, aluminum-coated (type 2) by the hot-dip process for sewer and drainage pipe shall conform to AASHTO M 274. Aluminum-zinc alloy coated sheet steel for corrugated steel pipe shall conform to AASHTO M 289.

1.1.2. ***Types of Culverts.*** Culverts shall be type I (Circular) or type II (Arch) shape unless otherwise specified on the Plans.

1.1.3. ***Externally Coated or Clad Culverts.***

1.1.3.1. ***Bituminous Coated Corrugated Metal Culvert Pipe and Pipe Arches*** shall conform to AASHTO M 190. Type A bituminous coating shall be used unless type B, type C, or type D is specified.

1.1.3.2. ***Precoated Corrugated Steel Culverts*** shall conform to AASHTO M 245constructed from polymer coated sheet conforming to AASHTO M 246.

2. ***Aluminum Conduits-Culverts.***

2.1. ***Corrugated Aluminum Alloy Culverts*** shall conform to AASHTO M 196. If bituminous coating is specified it shall by type A coating unless type B or type C coating is specified, meeting the requirements of AASHTO M 190.

2.2. ***Clad Aluminum Alloy Sheets for Culverts*** shall conform to AASHTO M 197.

3. ***Nonmetallic Conduits-Culverts.***

3.1. ***Class PS 50 Polyvinyl Chloride (PVC) Pipe*** shall conform to AASHTO M 278.

3.2. ***Corrugated Polyethylene Pipe,*** shall conform to AASHTO M 294.

4. ***DELETED.***

5. ***DELETED.***

6. ***Nonmetallic Conduits-Underdrain.***

6.1. ***Polyvinyl Chloride (PVC) Pipe.*** Class PS 50 polyvinyl chloride (PVC) pipe shall conform to AASHTO M 278, or highway underdrain conforming to the requirements of ASTM F 758, Standard Specifications for Smooth-Wall Polyvinyl Chloride (PVC) Plastic Underdrain Systems for Highway, Airport, and Similar Drainage with material Specification of ASTM D 1784. This underdrain shall be furnished with a minimum pipe stiffness of 45 psi (317 kPa) (Type PS-46). Corrugated polyvinyl chloride (PVC) pipe shall meet the requirements of ASTM F 949.

6.2. ***Polyethylene Drainage Tubing.***

6.2.1. ***Corrugated Polyethylene Drainage Tubing.*** Corrugated polyethylene drainage tubing shall conform to AASHTO M 252 Type C or CP.

6.2.2. ***Smooth Interior Corrugated Polyethylene Drainage Tubing.*** Smooth wall corrugated polyethylene drainage tubing shall conform to AASHTO M 252 Types S or SP or AASHTO M 294 Type S. The polyethylene pipe shall be manufactured from High Density Polyethylene (HDPE), virgin compounds in accordance with ASTM D 3350, cell class 324420 C.

6.2.3. **Perforations.** When perforations are specified, they shall meet the requirements of Class 2 unless otherwise noted on the Plans.

6.2.4. **Materials Certification, Testing, and Acceptance.** Materials certification, testing, and acceptance shall be in accordance with the requirements of AASHTO M 252, AASHTO M 294, and the Department's acceptance policy, published as: "Procedure for Inspection,

Sampling, Testing, and Acceptance of Corrugated Polyethylene Pipe." Copies of the procedure are available at the office of the Materials Engineer.

6.2.5. **Inspection.** Inspection criteria will be specified by the manufacturer's approved quality control program with the Oklahoma Department of Transportation.

7. ***Structural Plate for Pipe, Pipe Arches, and Arches.***

7.1. ***Corrugated Galvanized or Coated Steel.***

7.1.1. ***Description.*** This Subsection covers galvanized corrugated steel structural plate structures for use as culverts, drainage structures, underpasses, and special shapes for field assembly of sizes and dimensions as shown on the Plans.

7.1.2. ***Materials.*** The materials shall comply with the requirements of AASHTO M 167. The minimum thickness shall be as shown on the standard drawings for the design live load on the project, or on special detail sheets.

7.1.3. ***Fabrication.*** All structural plate structures shall conform to the requirements of applicable sections of AASHTO Standard Specifications for Highway Bridges. Plate sizes and shapes, forming and punching, radius of curvature, gauge, mass, tolerances, corrugation pitch and depth, and workmanship shall be as specified therein. The minimum plate thickness shall be as shown on the Plans.

7.1.4. ***Sampling and Testing.*** Sample and test all sheets or plates used in the fabrication of structural plate structures as provided in AASHTO M 167.

7.2. ***Aluminum Alloy.***

7.2.1. ***Description.*** This Subsection covers aluminum alloy structural plate structures for use as culverts, drainage structures, underpasses, and special shapes for field assembly of sizes and dimensions as shown on the Plans.

7.2.2. ***Materials.*** The materials shall comply with the requirements of AASHTO M 219. The minimum plate thickness shall be as shown on the standard drawings for the design live load on the project, or on special detail sheets.

7.2.3. ***Fabrication.*** All structural plate structures shall conform to the requirements of applicable sections of AASHTO Standard Specifications for Highway Bridges. Plate sizes and shapes, forming punching, radius of curvature, gauge, mass, tolerances, corrugation pitch and depth, and workmanship shall be as specified therein. The minimum plate thickness shall be as shown on the Plans.

7.2.4. ***Sampling and Testing.*** Sample and test all sheets or plates used in the fabrication of structural plate structures as provided in AASHTO M 219.

7.3. ***Steel End Sections.***

7.3.1. ***Description.*** This Subsection covers metal culvert end sections for attachment to the inlet and outlet of corrugated galvanized steel pipe and corrugated galvanized steel pipe arch culverts.

7.3.2. ***Materials.*** The materials shall comply with the requirements of AASHTO M 36 for base metal, spelter coatings, rivets, riveting and sampling, accepted brands of metal,

sheet manufacturer's certified analysis, sheet manufacturer's guarantee, and thickness determination and tolerance.

7.3.3. ***Fabrication.***

7.3.3.1. ***Shape, Dimensions, and Masses.*** The units, to the shape and dimensions and number of pieces as shown in the standard drawing or special details in the Plans for steel culvert end sections, shall be manufactured as integral units so they can be readily assembled and erected in place.

7.3.3.2. ***Bolts.*** Galvanized bolts may be used for assembly of end sections where more than one piece is used to form the skirt, when sections have not been riveted together.

7.3.3.3. ***Workmanship.*** It is the intent of these Specifications that in addition to compliance with the details of construction, the completed unit show carefully finished workmanship in all particulars. This requirement applies not only to the individual unit, but to the shipment as a whole.

The following defects are specified as constituting poor workmanship, and the presence of any of them in an individual unit in any shipment shall constitute sufficient cause for rejection: not of the specified dimensions, not of the specified shape, uneven laps, ragged sheared edge, loose, unevenly lined or spaced rivets, poorly formed rivet heads, illegible brands, lack of rigidity, or dents or bends in the metal itself.

7.3.4. ***Sampling and Testing.*** All steel culvert end sections will be inspected for compliance with the provisions governing fabrication heretofore given. Sample and test all sheet stock going into such end sections as provided in AASHTO M 36M and T 65.

SECTION 727
TIMBER AND LUMBER

This Subsection covers treated or untreated timber and lumber for use in the construction of timber bridges.

727.01 TIMBER AND LUBMER.

(a) **Species of Wood.** Timber and lumber furnished under these Specifications shall be Douglas Fir of the coast region only, or Southern Yellow Pine.

(b) **Grades.** The grades of timber and lumber covered herein are as follows:

Stress Grades:
1700 F
1600 F
1450 F
1200 F
1100 F

The particular stress grade governing shall be that specified on the Plans.