READ THIS FIRST

The Engineer shall verify that the latest version of the Federal Aviation Administration Advisory Circular AC 150/5370-10, “Standards for Specifying Construction Of Airports” and that the latest version of the Federal Aviation Administration, Northwest Mountain Region Revision to AC 150/5370-10, “Standards for Specifying Construction Of Airports” are incorporated into this specification.

Notice to the Design Engineer, please refer to the Port of Seattle, Facilities and Infrastructure standards for reference before editing this specification.

This Project Spec Document may need additional modifications to suit your project. It is recommended that you proofread each section, paying attention to any “Notes” boxes such as this one--you should remove these “Notes” sections as you go. Also, do a search for all bracket characters “ [ ] “ as they are used to show you areas containing options or project specific details (you can use Microsoft Word’s Find feature {Ctrl-F} to jump to an open bracket “ [ “ character quickly). Again, these bracket characters should be removed.

It is important that every paragraph be numbered to allow for easy referencing. If you use the document’s built in styles and formatting your outline should be fine (turn on the formatting toolbar by going to View > Toolbars > Formatting). Most paragraphs will use the style “Numbered Material” and can be promoted (Shift) or demoted (Shift-Tab).

You should not have to manually enter extra spaces, carriage returns or outline characters such as A, B, C, or 1.01, 1.02; the formatting will do this for you. The entire document is 11 pt. Arial. If you paste items in, you may need to reapply the “Numbered Material” format.

1. GENERAL
   1. SUMMARY OF WORK
      1. The location and extent of “Pipe for Storm Drains and Culverts (FAA)” Work is indicated in the Contract Documents. Pipe for storm drains and culverts shall be accomplished in accordance with the provisions of FAA Item D-701, Pipe for Storm Drains and Culverts, attached hereto.
   2. GOVERNING CODES, STANDARDS, AND REFERENCES
      1. TBD
   3. SUBMITTALS
      1. Submit materials data in accordance with Section 01 33 00 - Submittals. Furnish manufacturers’ technical literature, standard details, product specifications, and installation instructions for all products.
      2. Submittals shall include the following:
2. NOT USED
3. NOT USED
4. NOT USED

End of Section

Revision History:

05/01/2014 Conversion to 2004 CSI Numbering System

10/15/2014 Added Sole Source and Salient Characteristics Note to Part 2 and revisions

# ITEM D-701 PIPE FOR STORM DRAINS AND CULVERTS

## DESCRIPTION

701-1.1 This item shall consist of the construction of pipe culverts and storm drains in accordance with these specifications and in reasonably close conformity with the lines and grades shown on the plans.

## MATERIALS

A. If only one product is acceptable (single or sole source product), obtain an approved Competition Waiver and submit to the CPO Construction, Contract Administrator. The language shall read as: “Manufacturer Name, Product # XXXXX, No Equal.” Refer to CPO-6 Competition Waiver Policy for more information.

B. If a Competition Waiver is not approved or more than one product is acceptable, this section must list a minimum of 2 products plus the language “Or Approved Equal,” along with salient characteristics. Refer to CPO Construction’s Salient Characteristics Guidelines for more information.

701-2.1 Materials shall meet the requirements shown on the plans and specified below.

The Engineer should indicate the required class, schedule, SDR, gauge, and/or strength of pipe desired.

701-2.2 PIPE. The pipe shall be of the type called for on the plans or in the proposal and shall be in accordance with the following appropriate requirements.

|  |  |
| --- | --- |
| ASTM A 760 | Metallic Coated Corrugated Steel Pipe (Type I, IR or II) |
| ASTM A 761 | Galvanized Steel Corrugated Structural Plates and Fasteners for Pipe, Pipe-Arches, and Arches |
| ASTM A 762 | Polymer Precoated Corrugated Steel Pipe for Sewers and Drains |
| ASTM A 849 | Post-Coated and Lined (Bituminous or Concrete) Corrugated Steel Sewer and Drainage Pipe |
| A885/A885M-96 | Steel Sheet, Zinc and Aramid Fiber Composite Coated for Corrugated Steel Sewer, Culvert, and Underdrain Pipe |
| ASTM B 745 | Corrugated Aluminum Alloy Culvert Pipe |
| ASTM C 14 | Non-Reinforced Concrete Pipe |
| ASTM C 76 | Reinforced Concrete Pipe |
| ASTM C 655 | Reinforced Concrete D-Load Pipe |
| ASTM C 506 | Reinforced Concrete Arch Pipe |
| ASTM C 507 | Reinforced Concrete Elliptical Pipe |
| C 789 and C 850 | Precast Reinforced Concrete Box Sections |
| ASTM F 667 | Large Diameter Corrugated Polyethylene Pipe and Fittings |
| ASTM F 714 | Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter |
| ASTM F 794 | Poly (Vinyl Chloride) Ribbed Drain Pipe & Fittings |
| ASTM F 894 | Based on Controlled Inside Diameter Polyethylene (PE) Large Diameter Profile Wall Sewer and Drain Pipe |
| ASTM F 949 | Poly (Vinyl Chloride) (PVC) Corrugated Sewer Pipe With a Smooth Interior and Fittings |
| ASTM F 2435 | Steel Reinforced Polyethylene (PE) Corrugated Pipe |
| ASTM F 2562 | Steel Reinforced Thermoplastic (HDPE) Ribbed Pipe and Fittings for Non-Pressure Drainage and Sewerage |
| AASHTO M 190 | Bituminous-Coated Corrugated Metal Pipe and Pipe Arches |
| AASHTO M 190 and M 196 | Bituminous-Coated Corrugated Aluminum Alloy Culvert Pipe |
| AASHTO M 167 and M 243 | Bituminous-Coated Structural Plate Pipe, Pipe Arch, and Arches |
| AASHTO M 219 | Aluminum Alloy Structural Plate for Pipe, Pipe Arch, and Arches |
| ASTM D 3034 | Polyvinyl Chloride (PVC) Pipe |
| AASHTO M 252 | Corrugated Polyethylene Drainage Tubing (all types) |
| AASHTO M 294M | Corrugated Polyethylene Pipe 300 to 1200 mm Diameter (all types) |
| AASHTO M 304 | Poly (Vinyl Chloride) (PVC) Profile Wall Drain Pipe and Fittings Based on Controlled Inside Diameter |
| AASHTO MP-20 | Steel Reinforced Polyethylene (PE) Ribbed Pipe |

The Engineer shall select the pipe used for the project and may delete inappropriate requirements from paragraph 701-2.2 and from the list of material requirements. The Engineer shall include industry standard references (for example, ASTM and/or AASHTO) for installation if necessary.

701-2.3 CONCRETE. Concrete for pipe cradles shall have a minimum compressive strength of 2000 psi (13.8 MPa) at 28 days and conform to the requirements of ASTM C 94.

701-2.4 RUBBER GASKETS. Rubber gaskets for rigid pipe shall conform to the requirements of ASTM C 443. Rubber gaskets for PVC pipe and polyethylene pipe shall conform to the requirements of ASTM F 477. Rubber gaskets for zinc-coated steel pipe and precoated galvanized pipe shall conform to the requirements of ASTM D 1056, for the “RE” closed cell grades. Rubber gaskets for steel reinforced thermoplastic (HDPE) ribbed pipe shall conform to the requirements of ASTM F 477.

701-2.5 JOINT MORTAR. Pipe joint mortar shall consist of one part Portland cement and two parts sand. The Portland cement shall conform to the requirements of ASTM C 150, Type I. The sand shall conform to the requirements of ASTM C 144.

701-2.6 JOINT FILLERS. Poured filler for joints shall conform to the requirements of ASTM D 1190.

701-2.7 PLASTIC GASKETS. Plastic gaskets shall conform to the requirements of AASHTO M 198 (Type B).

ASTM C 789 and C 850 are primarily manufacturing specifications. The box section dimensions, compressive strength of the concrete, and reinforcement details shown in the specifications have been designed for a combined earth dead load and AASHTO HS20 live load condition. A modified design will be necessary when aircraft loadings are greater than HS20 live loads.

701-2.8 CONTROLLED LOW STRENGTH MATERIAL (CLSM). Controlled low strength material shall conform to the requirements of Item P-153. When CLSM is used all joints shall have gaskets.

Specification Item P-153 Controlled Low Strength Material (CLSM) contains guidance for use of CLSM. The locations where CLSM is permitted shall be shown on the plans. This paragraph and the option to allow Item P-153 in paragraph 701-3.5 must agree.

## CONSTRUCTION METHODS

701-3.1 EXCAVATION. The width of the pipe trench shall be sufficient to permit satisfactory jointing of the pipe and thorough tamping of the bedding material under and around the pipe, but it shall not be less than the external diameter of the pipe plus 6 in (150 mm) on each side. The trench walls shall be approximately vertical.

Where rock, hardpan, or other unyielding material is encountered, the Contractor shall remove it from below the foundation grade for a depth of at least 12 in (300 mm) or ½ in (12 mm) for each foot of fill over the top of the pipe (whichever is greater) but for no more than three-quarters of the nominal diameter of the pipe. The width of the excavation shall be at least 1 ft (30 cm) greater than the horizontal outside diameter of the pipe. The excavation below grade shall be backfilled with selected fine compressible material, such as silty clay or loam, and lightly compacted in layers not over 6 in (150 mm) in uncompacted depth to form a uniform but yielding foundation.

Where a firm foundation is not encountered at the grade established, due to soft, spongy, or other unstable soil, the unstable soil shall be removed and replaced with approved granular material for the full trench width. The Engineer shall determine the depth of removal necessary. The granular material shall be compacted to provide adequate support for the pipe.

The excavation for pipes that are placed in embankment fill shall not be made until the embankment has been completed to a height above the top of the pipe as shown on the plans.

701-3.2 BEDDING. The pipe bedding shall conform to the class specified on the plans. When no bedding class is specified or detailed on the plans, the requirements for Class C bedding shall apply.

a. Rigid Pipe. Class A bedding shall consist of a continuous concrete cradle conforming to the plan details.

Class B bedding shall consist of a bed of granular material having a thickness of at least 6 in (150 mm) below the bottom of the pipe and extending up around the pipe for a depth of not less than 30 percent of the pipe’s vertical outside diameter. The layer of bedding material shall be shaped to fit the pipe for at least 10 percent of the pipe’s vertical diameter and shall have recesses shaped to receive the bell of bell and spigot pipe. The bedding material shall be sand or selected sandy soil, all of which passes a 3/8 in (9 mm) sieve and not more than 10 percent of which passes a No. 200 (0.075 mm) sieve.

Class C bedding shall consist of bedding the pipe in its natural foundation to a depth of not less than 10 percent of the pipe’s vertical outside diameter. The bed shall be shaped to fit the pipe and shall have recesses shaped to receive the bell of bell and spigot pipe.

b. Flexible Pipe. For flexible pipe, the bed shall be roughly shaped to fit the pipe, and a bedding blanket of sand or fine granular material shall be provided as follows:

|  |  |  |  |
| --- | --- | --- | --- |
| **PIPE CORRUGATION DEPTH** | | **MINIMUM BEDDING DEPTH** | |
| in. | mm | in. | mm |
| 1/2 | 12.5 | 1 | 25.0 |
| 1 | 25.0 | 2 | 50.0 |
| 2 | 50.0 | 3 | 75.0 |
| 2 ½ | 62.5 | 3 ½ | 87.5 |

c. PVC and Polyethylene Pipe. For PVC and polyethylene pipe, the bedding material shall consist of coarse sands and gravels with a maximum particle size of 3/4 in (13 mm). For pipes installed under paved areas, no more than 12 percent of the material shall pass the No. 200 (0.075 mm) sieve. For all other areas, no more than 50 percent of the material shall pass the No. 200 (0.075 mm) sieve. The bedding shall have a thickness of at least 6 in (150 mm) below the bottom of the pipe and extend up around the pipe for a depth of not less than 50 percent of the pipe’s vertical outside diameter.

701-3.3 LAYING PIPE. The pipe laying shall begin at the lowest point of the trench and proceed upgrade. The lower segment of the pipe shall be in contact with the bedding throughout its full length. Bell or groove ends of rigid pipes and outside circumferential laps of flexible pipes shall be placed facing upgrade.

Paved or partially lined pipe shall be placed so that the longitudinal center line of the paved segment coincides with the flow line.

Elliptical and elliptically reinforced pipes shall be placed with the manufacturer’s top of pipe mark within five degrees of a vertical plane through the longitudinal axis of the pipe.

701-3.4 JOINING PIPE. Joints shall be made with (1) Portland cement mortar, (2) Portland cement grout, (3) rubber gaskets, (4) plastic gaskets, or (5) coupling bands.

Mortar joints shall be made with an excess of mortar to form a continuous bead around the outside of the pipe and shall be finished smooth on the inside. Molds or runners shall be used for grouted joints in order to retain the poured grout. Rubber ring gaskets shall be installed to form a flexible watertight seal.

a. Concrete Pipe. Concrete pipe may be either bell and spigot or tongue and groove. The method of joining pipe sections shall be such that the ends are fully entered and the inner surfaces are reasonably flush and even. Joints shall be thoroughly wetted before mortar or grout is applied.

b. Metal Pipe. Metal pipe shall be firmly joined by form fitting bands conforming to the requirements of ASTM A 760 for steel pipe and AASHTO M 196 for aluminum pipe.

c. PVC and Polyethylene Pipe. Joints for PVC and Polyethylene pipe shall conform to the requirements of ASTM D 3212 when water tight joints are required. Joints for PVC and Polyethylene pipe shall conform to the requirements of AASHTO M 304 when soil tight joints are required. Fittings for polyethylene pipe shall conform to the requirements of AASHTO M 252 or M 294M.

701-3.5 BACKFILLING. Pipes shall be inspected before any backfill is placed; any pipes found to be out of alignment, unduly settled, or damaged shall be removed and relaid or replaced at the Contractor’s expense.

Material for backfill shall be fine, readily compatible soil, granular material selected from the excavation or a source of the Contractor’s choosing [or shall meet the requirements of Item P-153]. . It shall not contain frozen lumps, stones that would be retained on a 2 in (50.0 mm) sieve, chunks of highly plastic clay, or other objectionable material. No less than 95 percent of a granular backfill material shall pass through a 1/2 in (12 mm) sieve, and no less than 95 percent of it shall be retained on a No. 4 (4.75 mm) sieve.

When the top of the pipe is even with or below the top of the trench, the backfill shall be compacted in layers not exceeding 6 in (150 mm) on both sides of the pipe and shall be brought up 1 ft (30 cm) above the top of the pipe or to natural ground level, whichever is greater. Care shall be exercised to thoroughly compact the backfill material under the haunches of the pipe. Material shall be brought up evenly on both sides of the pipe.

When the top of the pipe is above the top of the trench, the backfill shall be compacted in layers not exceeding 6 in (150 mm) and shall be brought up evenly on both sides of the pipe to 1 ft (30 cm) above the top of the pipe. The width of backfill on each side of the pipe for the portion above the top of the trench shall be equal to twice the pipe’s diameter or 12 ft (3.5 m), whichever is less.

For PVC and polyethylene pipe, the backfill shall be placed in two stages; first to the top of the pipe and then at least 12 in (300 mm) over the top of the pipe. The backfill material shall meet the requirements of paragraph 701-3.2c.

All backfill shall be compacted to the density required under Item P-152.

## METHOD OF MEASUREMENT

701-4.1 The length of pipe shall be measured in linear feet (meters) of pipe in place, completed, and approved. It shall be measured along the centerline of the pipe from end or inside face of structure to the end or inside face of structure, whichever is applicable. The several classes, types and size shall be measured separately. All fittings shall be included in the footage as typical pipe sections in the pipe being measured.

701-4.2 The volume of concrete for pipe cradles to be paid for shall be the number of cubic yards (cubic meters) of concrete that is completed in place and accepted.

701-4.3 The volume of rock to be paid for shall be the number of cubic yards (cubic meters) of rock excavated. No payment shall be made for the cushion material placed for the bed of the pipe.

## BASIS OF PAYMENT

701-5.1 Payment will be made at the contract unit price per linear foot (meter) for each kind of pipe of the type and size designated; at the contract unit price per cubic yard (cubic meter) of concrete for pipe cradles; and at the contract unit price per cubic yard (cubic meter) for rock excavation.

These prices shall fully compensate the Contractor for furnishing all materials and for all preparation, excavation, and installation of these materials; and for all labor, equipment, tools, and incidentals necessary to complete the item.

Payment will be made under:

Item 701-5.1 [ ] inch [ ] per linear foot (meter)

Item 701-5.2 Concrete for pipe cradles-per cubic yard (cubic meter)

Item 701-5.3 Rock excavation-per cubic yard (cubic meter)

The Engineer shall specify the size and type of pipe for each pipe size specified in the plans.

## MATERIAL REQUIREMENTS

|  |  |
| --- | --- |
| ASTM A 760 | Corrugated Steel Pipe, Metallic-Coated for Sewers and Drains |
| ASTM A 761 | Corrugated Steel Structural Plate, Zinc Coated, for Field-Bolted Pipe, Pipe-Arches, and Arches |
| ASTM A 762 | Corrugated Steel-Pipe, Polymer Precoated for Sewers and Drains |
| ASTM A 849 | Post-Applied Coatings, Pavings, and Linings for Corrugated Steel Sewer and Drainage Pipe |
| ASTM A 885/A 885M-96 | Steel Sheet, Zinc and Aramid Fiber Composite Coated for Corrugated Steel Sewer, Culvert, and Underdrain Pipe |
| ASTM B 745 | Corrugated Aluminum Alloy Culvert Pipe |
| ASTM C 14 | Concrete Sewer, Storm Drain, and Culvert Pipe |
| ASTM C 76 | Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe |
| ASTM C 94 | Ready Mixed Concrete |
| ASTM C 144 | Aggregate for Masonry Mortar |
| ASTM C 150 | Portland Cement |
| ASTM C 443 | Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets |
| ASTM C 506 | Reinforced Concrete Arch Culvert, Storm Drain, and Sewer Pipe |
| ASTM C 507 | Reinforced Concrete Elliptical Culvert, Storm Drain and Sewer Pipe |
| ASTM C 655 | Reinforced Concrete D-Load Culvert, Storm Drain and Sewer Pipe |
| ASTM C 1433 | Precast Reinforced Concrete Box Sections for Culverts, Storm Drains, and Sewers |
| ASTM D 1056 | Flexible Cellular Materials-Sponge or Expanded Rubber |
| ASTM D 3034 | Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings |
| ASTM D 3212 | Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals |
| ASTM D 6690 | Joint and Crack Sealants, Hot-Applied, for Concrete and Asphalt Pavements |
| ASTM F 477 | Elastomeric Seals (Gaskets) for Joining Plastic Pipe |
| ASTM F 667 | Large Diameter Corrugated Polyethylene Pipe and Fittings |
| ASTM F 714 | Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter |
| ASTM F 794 | Poly (Vinyl Chloride) Ribbed Drain Pipe & Fittings Based on Controlled Inside Diameter |
| ASTM F 894 | Polyethylene (PE) Large Diameter Profile Wall Sewer and Drain Pipe |
| ASTM F 2435 | Steel Reinforced Polyethylene (PE) Corrugated Pipe |
| ASTM F 2562 | Steel Reinforced Thermoplastic Ribbed Pipe and Fittings for Non-Pressure Drainage and Sewerage |
| ASTM F 949 | Poly (Vinyl Chloride) (PVC) Corrugated Sewer Pipe With a Smooth Interior and Fittings |
| AASHTO M 190 | Bituminous-Coated Corrugated Metal Culvert Pipe and Pipe Arches |
| AASHTO M 196 | Corrugated Aluminum Alloy Culverts and Underdrains |
| AASHTO M 198 | Joints for Circular Concrete Sewer and Culvert Pipe Using Flexible Watertight Gaskets |
| AASHTO M 219 | Aluminum Alloy Structural Plate for Pipe, Pipe-Arches, and Arches |
| AASHTO M 243 | Field Applied Coating of Corrugated Metal Structural Plate for Pipe, Pipe-Arches, and Arches |
| AASHTO M 252 | Corrugated Polyethylene Drainage Tubing |
| AASHTO M 294M | Corrugated Polyethylene Pipe, 300 to 1200 mm Diameter |
| AASHTO M 304 | Poly (Vinyl Chloride) (PVC) Profile Wall Drain Pipe and Fittings Based on Controlled Inside Diameter |
| AASHTO MP-20 | Steel Reinforced Polyethylene (PE) Ribbed Pipe |

End of Item D-701

## REFERENCES

1. AASHTO H 520 live load condition
2. AASHTO H520 loading modified design
3. AASHTO M 190 Bituminous-Coated Corrugated Metal Pipe and Pipe Arches
4. AASHTO M 190 Bituminous-Coated Corrugated Aluminum
5. AASHTO M 196 Corrugated Aluminum Alloy Culvert Pipe
6. M 196 Alloy Culvert Pipe and
7. AASHTO M 196 form fitting bands for aluminum pipe
8. AASHTO M 198 plastic gaskets
9. AASHTO M 219 Aluminum Alloy Structural Plate for Pipe, Pipe Arch and Arches
10. M 243 AASHTO M 167 Bituminous-Coated Structural Plate Pipe, Pipe Arch and Arches and
11. AASHTO M 252 Corrugated Polyethylene Drainage Tubing
12. AASHTO M 252 fittings for polyethylene pipe
13. AASHTO M 294 Corrugated Polyethylene Pipe
14. ASTM A 672 Polymer Pre-coated Corrugated Steel Pipe for Sewers and Drains
15. ASTM A 760 Metallic Coated Corrugated Steel Pipe (Type I, IR or II)
16. ASTM A 760 form fitting bands for steel pipe
17. ASTM A 761 Galvanized Steel Corrugated Structural Plates and Fasteners for Pipe, Pipe-Arches, and Arches
18. ASTM A 885 Fiber-Bonded Asphalt, Composite Coated, Corrugated Steel Pipe
19. ASTM A 899 Post-Coated and Lined (Bituminous or Concrete) Corrugated Steel Sewer and Drainage Pipe
20. ASTM B 745 Corrugated Aluminum Alloy Culvert Pipe
21. ASTM C 14 Non-Reinforced Concrete Pipe
22. ASTM C 76 Reinforced Concrete Pipe
23. ASTM C 94 concrete for pipe cradles
24. ASTM C 144 sand
25. ASTM C 150 Portland cement
26. ASTM C 425 compression joints
27. ASTM C 425 vitrified clay pipe compression joints
28. ASTM C 443 rubber gaskets rigid pipe
29. ASTM C 506 Reinforced Concrete Arch Pipe
30. ASTM C 507 Reinforced Concrete Elliptical Pipe
31. ASTM C 655 Reinforced Concrete D-Load Pipe
32. ASTM C 700 Vitrified Clay Pipe
33. ASTM C 700 fittings for vitrified clay pipe
34. ASTM C 789 manufacturing specifications
35. C-850 ASTM C 789 Precast Reinforced Concrete Box Sections and
36. ASTM C 850 manufacturing specifications
37. ASTM D 1056 rubber gaskets
38. ASTM D 1190 poured filler for joints
39. ASTM D 3034 Polyvinyl Chloride (PVC) Pipe
40. ASTM D 3212 joints for PVC pipe
41. ASTM F 477 rubber gaskets PVC pipe
42. FAA Item D-701 Pipe Storm Drains and Culverts pipe for storm drains and culverts