



U.S. Department  
of Transportation  
Federal Aviation  
Administration

# Advisory Circular

**Subject:** Change 13 to STANDARDS FOR SPECIFYING  
CONSTRUCTION OF AIRPORTS

**Date:** 1/30/01  
**Initiated by:** AAS-200

**AC No:** 150/5370-10A  
**Change:** 13

**1. PURPOSE.** ITEM D-701 PIPE FOR STORM DRAINS AND CULVERTS has been revised to update material specifications and **ITEM D-705 PIPE UNDERDRAINS FOR AIRPORTS** has been revised to update material specifications and to add standards for **filter** fabric.

**2. PRINCIPAL CHANGES.** The following principal changes have been made:

a. Paragraph 701-2.1 has been revised to add a note to the engineer to indicate class, gage, schedule, SDR, and/or strength of ail pipe desired.

b. Paragraph 701-2.2 has been revised to update the AASHTO M 294 reference, which now includes specification for pipe diameters up to 1200 mm.

c. Paragraph 701-2.4 has been revised to add ". . . and polyethylene pipe. . ." and to **delete** reference to oakum.

d. Paragraph 705-2.8 CONTROLLED LOW STRENGTH MATERIAL (CLSM) has been added to specify requirements for flowable backfill.

e. Paragraph 70 I-3.4 has been revised to delete reference to oakum.

f. Paragraph **701-3.4c** has been revised to add AASHTO M 294M to fitting requirements.

g. Paragraph 705-2.1 has been divided into paragraphs 2. I GENERAL and paragraph 705-2.2 PIPE. The reference to AASHTO M 294M has been updated.

h. Paragraph 705-2.6 GRANULAR MATERIAL has been revised to include references to ASTM and AASHTO materials.

i. Paragraph 705-2.7 FILTER FABRIC meeting AASHTO requirements for Class 2 filter fabric has been added.

j. Paragraph 705-2.8 CONTROLLED LOW STRENGTH MATERIAL (CLSM) has been added to specify requirements for flowable backfill.

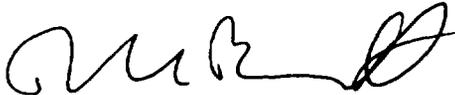
k. New paragraphs **705-3.3c** PVC or Polyethylene Pipe and **705-3.3e** Filter Fabric have been added.

l. New paragraphs **705-3.6c** Controlled Low Strength Material (CLSM) and **705-3.6d** Deflection Testing have been added.

m. Paragraph **705-4.3** has been added to provide a method of measurement for filter fabric and a basis of payment item for **filter** fabric has been added.

PAGE CONTROL CHART

Remove Pages	Dated	Insert Pages	Dated
261 to 265	2/17/89 or 5/20/98	261 to 265-1	1/30/01
267 to 272	2/17/89 or 5/20/98	267 to 272	1/30/01



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# 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

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

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

Metallic Coated Corrugated Steel Pipe (Type I, IR or II)	ASTM A 760
Galvanized Steel <b>Corrugated Structural</b> Plates and <b>Fasteners</b> for Pipe, Pipe-Arches, and Arches	ASTM A 761
Polymer <b>Precoated</b> Corrugated Steel Pipe for Sewers and Drains	<b>ASTM A 762</b>
Post-Coated and Lined (Bituminous or Concrete) Corrugated Steel Sewer and Drainage Pipe	ASTM A 849
Steel Sheet, Zinc and <b>Aramid Fiber</b> Composite Coated for <b>Corrugated</b> Steel Sewer, Culvert, and <b>Underdrain</b> Pipe	<b>A885/A885M-96</b>
Corrugated Aluminum Alloy Culvert Pipe	ASTM B 745
Non-Reinforced Concrete Pipe	ASTM C 14
Reinforced Concrete Pipe	ASTM C 76
Reinforced Concrete D-Load Pipe	ASTM C 655
Reinforced Concrete Arch Pipe	ASTM C 506
Reinforced Concrete Elliptical Pipe	ASTM C 507
Precast Reinforced Concrete Box Sections	ASTM C 789 and <b>C 850</b>
Poly (Vinyl Chloride) Ribbed <b>Drain Pipe &amp; Fittings</b> Based on Controlled Inside Diameter	ASTM F 7%
Poly (Vinyl Chloride) (PVC) Corrugated Sewer Pipe With a <b>Smooth</b> Interior and Fittings	ASTM F 949
Bituminous-Coated Corrugated Metal Pipe and Pipe Arches	AASHTO M 190
Bituminous-Coated Corrugated Aluminum Alloy Culvert Pipe	AASHTOM 190andM 196
Bituminous-Coated Structural Plate Pipe, Pipe Arch, and Arches	AASHTO M 167 and M 243
Aluminum Alloy Structural Plate for Pipe, Pipe Arch, and Arches	<b>AASHTO M 219</b>
Polyvinyl Chloride (PVC) Pipe	ASTM D 3034
Corrugated Polyethylene Drainage Tubing (all types)	AASHTO M 252
Corrugated Polyethylene Pipe 300 to 1200 mm Diameter (all types)	AASHTO M 294M
Poly (Vinyl Chloride) (PVC) Profile Wall Drain Pipe and Fittings Based on Controlled Inside Diameter	AASHTO M 304

\*\*\*\*\*  
**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.**  
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701-23 **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 precast galvanized pipe shall conform to **the** requirements of ASTM D 1056, for the "RE" closed cell grades.

**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 detail 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.  
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**[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.

\*\*\*\*\*  
Engineering Brief No. 55 Controlled Low Strength **Material (CLSM)**, dated May 21, 1996 contains guidance for use of **CLSM**, and includes Interim specification Item **P-153**. The **locations** where CLSM is permitted **shall** be shown on the plans. **This** paragraph and the **option to allow** Item P-153 in paragraph 7013.5 must agree.  
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### CONSTRUCTION METHODS

**7013.1 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 inches (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 inches (300 mm) or one-half inch (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 foot (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 inches (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 inches (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** inch (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
<b>1</b>	<b>25.0</b>	<b>2</b>	<b>50.0</b>
2	50.0	3	75.0
<b>2-1/2</b>	62.5	<b>3-1/2</b>	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-inch** (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 inches (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.

**7013.4 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-inch (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 inch (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 inches (150 mm) on both sides of the pipe and shall be brought up one foot (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 inches (150 mm) and shall be brought up evenly on **both** sides of the pipe to 1 foot (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 of 12 feet (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 inches** (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-1 52.

**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 which 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)

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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 Steel Galvanized, Corrugated Structural Plates and Fasteners for Pipe, Pipe-Arches, and Arches

ASTM A 762	<b>Precoated</b> (Polymeric) <b>Galvanized</b> Steel Sewer and Drainage Pipe
<b>ASTM A 849</b>	Post-Coated and Lined (Bituminous or Concrete) <b>Corrugated</b> Steel Sewer and Drainage Pipe
ASTM A 885	Steel Sheet, Zinc and <b>Aramid</b> Fiber Composite Coated for Corrugated Steel Sewer, Culvert, and <b>Underdrain</b> Pipe
ASTM B 745	Corrugated Aluminum Alloy Culvert Pipe
<b>ASTM C 14</b>	<b>Concrete</b> Sewer, Storm Drain, and Culvert Pipe
ASTM C 76	<b>Reinforced</b> Concrete <b>Culvert</b> , Storm Drain, and Sewer Pipe
ASTMCW	Ready Mixed <b>Concrete</b>
ASTM C 144	Aggregate for Masonry Mortar
ASTM C 150	Portland Cement
ASTM C 443	Joints for <b>Circular</b> Concrete Sewer and Culvert Pipe, Using Rubber Gaskets
ASTM C 506	Reinforced <b>Concrete</b> Arch Culvert, <b>Storm Drain</b> , and Sewer Pipe
ASTM C 507	Reinforced Concrete Elliptical Culvert, Storm Drain and Sewer Pipe
ASTM C 655	<b>Reinforced</b> Concrete D-Load Culvert, Storm <b>Drain</b> and Sewer Pipe
ASTM C 789	Precast Reinforced Concrete Box Sections for Culverts, Storm <b>Drains</b> , and <b>Sewers</b>
ASTM C 850	Precast Reinforced Concrete Box Sections for Culverts, Storm Drains, and Sewers <b>with Less than 2 feet of Cover</b>
ASTM D 1056	Flexible Cellular Materials-Sponge or Expanded Rubber
<b>ASTM D 1190</b>	Concrete Joint Sealer, Hot Poured Elastic Type
ASTM D 3034	Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings
<b>ASTM D 3212</b>	Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric <b>Seals</b>
ASTM F 477	Elastomeric Seals (Gaskets) for Joining Plastic Pipe
<b>ASTM F 794</b>	Poly (Vinyl Chloride) Ribbed Drain Pipe <b>&amp;</b> Fittings Based on Controlled Inside Diameter
ASTM F 949	Poly (Vinyl Chloride) (PVC) Corrugated Sewer Pipe With a Smooth Interior and Fittings
AASHTOM 190	<b>Bituminous-Coated</b> Corrugated <b>Metal</b> Culvert Pipe and Pipe Arches
<b>AASHTO M 1%</b>	Corrugated Aluminum Alloy Culverts and Underdrains
AASHTO M 198	Joints for Circular Concrete Sewer and Culvert Pipe Using Flexible <b>Watertight</b> 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

**END ITEM D-701**

## ITEM D-705 PIPE UNDERDRAINS FOR AIRPORTS

### DESCRIPTION

**705-1.1** This item shall consist of the construction of pipe drains in accordance with these specifications and in reasonably close conformity with the lines and grades shown on the plans.

### MATERIALS

**705-2.1 GENERAL.** Materials shall meet the requirements shown on the plans and specified below.

**705-2.2 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.

Perforated Concrete Pipe	ASTM C 444
Porous Concrete Pipe	ASTM C 654
Polymer Precoated Perforated Corrugated Steel Pipe	ASTM A 762
Perforated Corrugated Aluminum Alloy Pipe	AASHTO M 196
Smooth-Wall Perforated PVC Pipe	ASTM F 758
<b>Poly</b> (Vinyl Chloride) Ribbed Drain Pipe & Fittings Based on Controlled Inside Diameter	ASTM F 794
Poly (Vinyl Chloride)(PVC) Corrugated Sewer Pipe With a Smooth Interior and Fittings	ASTM F 949
<b>Perforated</b> Corrugated Steel Pipe	ASTM A 760
Bituminous-Coated Perforated Corrugated <b>Aluminum Alloy</b> Pipe	<b>AASHTO M 196 and M 190</b>
Corrugated Polyethylene Drainage Tubing (all types)	AASHTO M 252
Corrugated Polyethylene Pipe, 300 to 1200 mm Diameter (all types)	AASHTO M 294M
Poly (Vinyl Chloride) (PVC) Profile Wall Drain Pipe and Fittings Based on Controlled Inside Diameter	AASHTO M 304

\*\*\*\*\*  
 The Engineer shall **select** the pipe used for the project and may delete inappropriate requirements from paragraph **705-2.2** and from the list of material requirements.  
 \*\*\*\*\*

**705-2.3 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.

**705-2.4 ELASTOMERIC SEALS.** Elastomeric seals shall conform to the requirements of ASTM F 477.

**705-2.5 POROUS BACKFILL.** Porous backfill shall be free of clay, humus, or other objectionable matter, and shall conform to the gradation in Table 1 when tested in accordance with ASTM C 136.

TABLE 1. GRADATION OF POROUS BACKFILL

Sieve Designation (square openings)	Percentage by Weight Passing Sieves	
	Porous Material No. 1	Porous Material No. 2
1-1/2 inch (38 mm)		100
1 inch (25 mm)		90-100
3/8 inch (9.5 mm)	100	25 - 60
No. 4 (4.75 mm)	95 - 100	5 - 40
No. 8 (2.36 mm)		0 - 20
No. 16 (1.18 mm)	45 - 80	
No. 50 (0.30 mm)	10 - 30	
No. 100(0.15 mm)	0 - 10	

When two courses of porous backfill are specified in the plans, the finer of the materials shall conform to particle size tabulated herein for porous material No. 1. The coarser granular material shall meet the gradation given in the tabulation for porous material No. 2.

**705-2.6. GRANULAR MATERIAL.** Granular material used for backfilling shall conform to the requirements of ASTM D 232 1 for Class IA, **IB**, or II materials, or shall meet the requirements of AASHTO Standard Specification for Highway Bridges Section 30.

**705-2.7. FILTER FABRIC.** The filter fabric shall conform to the requirements of AASHTO M 288-99, Class 2.

\*\*\*\*\*  
 The Engineer shall specify Class 2 unless sufficient **survivability** information is available for a reduction in minimum property requirements. Permittivity and Apparent Opening Size requirements shall be based on knowledge of in situ soil.  
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**705-2.8. 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 elastomeric seals.

\*\*\*\*\*  
 Engineering Brief No. 55 Controlled Low Strength Material (CLSM), dated May 21, 1996 contains guidance for use of CLSM, and includes interim specification Item P-153. The locations where CLSM is permitted shall be shown on the plans.  
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**CONSTRUCTION METHODS**

**705-3.1 EQUIPMENT.** All equipment necessary and required for the proper construction of pipe underdrains shall be on the project, in **first-class** working condition, and approved by the Engineer before construction is permitted to start.

**705-3.2 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 shall not be less than the external diameter of the pipe plus 6 inches (150 mm) on each side. The trench walls shall be approximately vertical.

Where rock, **hardpan**, or other unyielding material is encountered, it shall be removed below the foundation grade for a depth of at least 4 inches (100 mm). 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 inches (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.

Excavated material not required or acceptable for backfill shall **be** disposed of by the Contractor as **directed** by the Engineer. The excavation shall not be carried **below** the required depth; when this is done, the trench shall be backfilled at the Contractor's expense with material approved by the Engineer and compacted to the density of the surrounding earth material.

The **bed** for the pipe shall be so shaped that at least the lower quarter of the pipe shall be in continuous contact with the bottom of the trench. Spaces for the pipe bell **shall be** excavated accurately to size to clear the bell so that the barrel supports **the** entire weight of the pipe.

The Contractor shall do such trench bracing, sheathing, or shoring **necessary** to perform and protect the excavation as required for safety and conformance to governing laws. Unless otherwise provided, the bracing, sheathing, or shoring shall be removed by the **Contractor after** the completion of the backfill to at least 12 inches (300 mm) over the top of the pipe. The sheathing or shoring shall be pulled as the granular backfill is placed and compacted to avoid any unfilled spaces between the trench wall and the backfill material. The cost of bracing, sheathing, or shoring, and the removal of same, shall be included in the unit price bid per foot (meter) for the pipe.

### 705-3.3 LAYING AND INSTALLING PIPE.

a. **Concrete Pipe.** The laying of the pipe in the finished trench shall be **started at** the lowest point and laid upgrade. When bell and spigot pipe is used, the **bells shall be laid upgrade**. If tongue and groove pipe is used, the **groove** end shall be laid upgrade. Holes in perforated pipe shall be placed down, unless **otherwise** shown on the plans. The pipe shall be firmly and **accurately** set to line **and grade so that the invert will be smooth and** uniform. Pipe shall not be laid on frozen ground.

Pipe which is not true in alignment, or which shows any settlement **after** laying, shall be taken up and **relaid** without extra compensation.

b. **Metal Pipe.** The metal pipe shall be laid with the separate sections joined firmly together with bands, with outside laps of **circumferential** joints pointing upgrade, **and with longitudinal laps on the sides. Any metal** in the pipe or bands which is not **protected thoroughly** by **galvanizing** shall be coated with a **suitable asphaltum** paint.

During installation, the asphalt-protected pipe shall be handled **without** damaging **the** asphalt coating. Any breaks in the bitumen or treatment of **the** pipe shall be refilled with the type and kind of bitumen used in coating the pipe originally.

c. **PVC or Polyethylene Pipe.** PVC or polyethylene pipe shall be installed **in accordance with the requirements** of ASTM D 232 I or AASHTO Standard **Specification for Highway Bridges Section 30**. Perforations shall meet the requirements of AASHTO M 252 or M 294 Class 2, unless otherwise **indicated** on the plans. The pipe shall be laid accurately to line and **grade**.

d. **All Types of Pipe.** The upgrade end of pipelines, not **terminating** in a structure, **shall be** plugged or capped as **approved** by the Engineer.

Unless otherwise shown on the plans, a Cinch (**100 mm**) **bed** of granular backfill material shall be spread **in the** bottom of the trench throughout **the** entire length under all perforated pipe underdrains.

Pipe outlets for the underdrains shall be constructed when required **or shown** on the plans. The pipe shall be laid with tight-fitting joints. Porous backfill is not required **around** or over pipe outlets for **underdrains**. All connections to other drainage pipes or structures shall be made as required and in a satisfactory manner. If **connections are not made to other pipes** or structures, the outlets shall be protected and constructed as **shown on the** plans.

e. **Filter Fabric.** The filter fabric shall be installed accordance with the **manufacturer's** recommendations, or in accordance with AASHTO M 288-99 APPENDIX, unless otherwise shown on the plans.

7053.4 **MORTAR.** The mortar shall be of the desired consistency for caulking and filling the joints of the pipe and for making connections to other pipes or to **structures**. Mortar that is not used within 45 minutes **after** water has been added shall be discarded. **Retempering** of mortar shall not be permitted.

**705-3.5 JOINTS IN CONCRETE PIPE.** When open or partly open joints are required or specified, they shall be constructed as indicated on the plans. The pipe shall be laid with the ends fitted together as designed. If bell and spigot pipe is used, mortar shall be placed along the inside bottom quarter of the bell to center the following section of pipe.

The open or partly open joints shall be surrounded with granular material meeting requirements of porous backfill No. 2 or as indicated on the plans. This backfill shall be placed so its thickness will be not less than 3 inches (75 mm) nor more than 6 inches (150 mm), unless otherwise shown on the plans.

When the original material excavated from the trench is impervious, commercial concrete sand or granular material meeting requirements of porous backfill No. 1 shall surround porous backfill No. 2, as shown on the plans or as directed by the Engineer.

When the original material excavated from the trench is pervious and suitable, it may be used as backfill in lieu of porous backfill No. 1, when indicated on the plans or as directed by the Engineer.

### **705-3.6 BACKFILLING.**

a. Earth. All trenches and excavations shall be backfilled within a reasonable time after the pipes are installed, unless other protection of the pipe is directed. The backfill material shall be selected material from excavation or borrow; material which is placed within a nominal pipe diameter distance at the sides of the pipe and 1 foot (30 cm) over the top shall be material which can be readily compacted. It shall not contain stones retained on a 3-inch (75 mm) sieve, frozen lumps, chunks of highly plastic clay, or any other material which is objectionable to the Engineer. The material shall be moistened or dried, if necessary to be compacted by the method in use. Backfill material shall be approved by the Engineer. Special care shall be taken in placing the backfill. Great care shall be used to obtain thorough compaction under the haunches and along the sides to the top of the pipe.

The backfill shall be placed in loose layers not exceeding 6 inches (150 mm) in depth under and around the pipe, and not exceeding 8 inches (200 mm) over the pipe. Successive layers shall be added and thoroughly compacted by hand and pneumatic tampers, approved by the Engineer, until the trench is completely filled and brought to the proper elevation. Backfilling shall be done in a manner to avoid injurious top or side pressures on the pipe.

In embankments and for other areas outside of pavements, the backfill shall be compacted to the density required for embankments in unpaved areas under Item P-152. Under paved areas, the subgrade and any backfill shall be compacted to the density required for embankments for paved areas under Item P-152.

h. **Granular Material.** When granular backfill is required, its placement in the trench and about the pipe shall be as shown on the plans. Special care shall be taken in placing the backfill. The granular backfill shall not contain a damaging amount of foreign matter, nor shall earth from the sides of the trench or from the windrow be allowed to filter into the backfill. When required by the Engineer, a template shall be used to properly place and keep separate the two sizes of backfill. The backfill shall be placed in loose layers not exceeding 6 inches (150 mm) in depth and compacted by hand and pneumatic tampers to the requirements as given for earth backfill. Backfilling shall be done in a manner to avoid injurious top or side pressure on the pipe. The granular backfill shall be made to the elevation of the trench, as shown on the plans.

When perforated pipe is specified, granular backfill material shall be placed along the full length of the pipe. The position of the granular material shall be as shown on the plans. If the original material excavated from the trench is pervious and suitable, it shall be used in lieu of porous backfill No. 1.

When porous backfill is to be placed in paved or adjacent areas prior to the completion of grading or subgrade operations, the backfill material shall be placed immediately after laying the pipe. The depth of this granular backfill shall be not less than 12 inches (300 mm), measured from the top of the underdrain. During subsequent construction operations, this minimum backfill of 12 inches (300 mm) of depth shall not be disturbed until such time as the underdrains are to be completed. When the underdrains are to be completed, the unsuitable material shall be removed until the porous backfill is exposed. That part of the porous backfill which contains objectionable material shall be removed and replaced with suitable material. The cost of removing and replacing any such unsuitable material shall be borne by the Contractor.

Whenever a granular subbase blanket course is to be used under pavements which extends several feet beyond the edge of paving to the outside edge of the underdrain trench, the granular backfill material over the underdrains shall be

placed in the trench up to an elevation of 2 inches (50 mm) above the bottom surface of the granular subbase blanket course. Immediately prior to the placing of the granular subbase blanket course, the Contractor shall blade this excess trench backfill from the top of the trench onto the adjacent **subgrade** where it can be incorporated into the granular subbase blanket course. Any unsuitable material which remains over the underdrain trench shall be removed and replaced. The subbase material shall be placed to provide clean contact between the subbase material and the underdrain granular **backfill** material for the **full** width of the **underdrain** trench.

**c. Controlled Low Strength Material (CLSM).** Controlled low strength material shall conform to the requirements of Item P-153.

**d. Deflection Testing.** The Engineer may at any time, notwithstanding previous material acceptance, reject or require re-installation of pipe that exceeds 5 percent deflection when measured in accordance with ASTM D 232 I, including Appendices.

**705-3.7 CONNECTIONS.** When the plans call for connections to existing or proposed pipe or structures, these connections shall be watertight and made so that a smooth **uniform** flow line will be obtained throughout the drainage system.

**705-3.8 CLEANING AND RESTORATION OF SITE.** After the backfill is completed, the Contractor shall dispose of all surplus material, dirt, and rubbish **from** the site. Surplus dirt may be deposited in embankments, shoulders, or as ordered by the Engineer. Except for paved areas of the airport, the Contractor shall restore all disturbed areas to their original condition.

### METHOD OF MEASUREMENT

**705-4.1** The length of pipe to be paid for shall be the number of linear feet (meters) of pipe **underdrains in place**, completed, and approved; 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 sizes shall be measured separately. All fittings shall be included in the footage as typical pipe sections in the pipeline being measured.

**705-4.2** The quantity of porous backfill to be paid for shall be the number of cubic yards (cubic metm) of porous backfill No. 1 and No. 2, complete in place and accepted, and shall **be** determined from the dimensions given on the plans by typical trench **sections indicating the placement** of porous backfill or dimensions ordered by the Engineer.

**705-4.3** The quantity of filter fabric to be paid for shall **be** the number of square yards (square meters) of filter fabric in place, completed, and approved; and shall be determined from the dimensions given on the plans by typical trench sections indicating the placement **of** filter fabric or dimensions ordered by the Engineer.

### BASIS OF PAYMENT

**705-5.1** Payment will be made at the contract unit price per linear **foot** (meter) for pipe underdrains of the type, class, and size designated; at **the** contract unit price [**per cubic yard (cubic meter)]**[**per ton (metric ton)**] for porous backfill **No.1**; the contract unit price [**per cubic yard (cubic meter)]**[**per ton (metrk ton)**] for porous backfill No. 2. and at the contract unit price per square yard (square meter) for filter fabric. [**per linear foot (meter) COMPLETE (including porous backfill and filter fabric.)**] These prices **shall** be full compensation 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 D-705-5.1	[ ] inch pipe (mm pipe) [ ] per linear foot (meter)
Item D-705-5.2	Porous Backfill No. 1-- <b>[per cubic yard (cubic meter)]</b> [ <b>per ton (metric ton)</b> ]
Item D-705-5.3	Porous Backfill No. 2-- <b>[per cubic yard (cubic meter)]</b> [ <b>per ton (metric ton)</b> ]
Item D-705-5.4	Filter Fabric-per square yard (square meter)

[Item D-705-5.5 { } inch pipe (mm pipe) [ ] per linear foot (meter) COMPLETE (including porous backfill and filter fabric)

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The Engineer shall specify the size and type of pipe, filter fabric, and backfill material for each pipe size and type specified in the plans.

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MATERIAL REQUIREMENTS

- ASTM A 760 Corrugated Steel Pipe, Metallic-Coated for Sewers and Drains
ASTM A 762 Corrugated Steel Pipe, Polymer Precoated for Sewers and Drains
ASTM C 136 Sieve or Screen Analysis of Fine and Coarse Aggregates
ASTM C 144 Aggregate for Masonry Mortar
ASTM C 150 Portland Cement
ASTMC444 Perforated Concrete Pipe
ASTM C 654 Porous Concrete Pipe
ASTM D 2321 Underground Installation of Flexible Thermoplastic Sewer Pipe
ASTM D 3034 Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM F 477 Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM F 758 Smooth-Wall Poly(Vinyl Chloride) (PVC) Plastic Underdrain Systems for Highway, Airport, and Similar Drainage
ASTM F 949 Poly (Vinyl Chloride)(PVC) Corrugated Sewer Pipe with a Smooth Interior and Fittings
AASHTOM 190 Bituminous Coated Corrugated Metal Culvert Pipe and Pipe Arches
AASHTOM 1% Corrugated Aluminum Alloy Culverts and Underdrains
AASHTO M 252 Corrugated Polyethylene Drainage Tubing
AASHTO M 288-99 Geotextile Specification for Highway Applications
AASHTO M 294M Corrugated Polyethylene Pipe, 300 to 1200 mm Diameter
AASHTO Standard Specifications for Highway Bridges

END OF ITEM D-705

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U.S. Department  
of Transportation

**Federal Aviation  
Administration**

800 Independence Ave., S.W.  
Washington, D.C. 20591

**FORWARDING SERVICE REQUESTED**