U.S. Department of Transportation
Federal Aviation Administration

Advisory Circular

Subject: Change 21 to STANDARDS FOR SPECIFYING CONSTRUCTION OF AIRPORTS-- Incorporates new materials

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Change: 21

1. PURPOSE. Item D-701, Pipe for Storm Drains and Culverts, has been updated to include precast reinforced concrete box sections as an alternative material. Editorial changes have also been made.

The Change number and date of change are carried at the top of each page. The changed material is marked by asterisks in the margin.

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Director, Office of Airport Standards

ITEM D-701 PIPE FOR STORM DRAINS AND CULVERTS

1. DESCRIPTION. 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.

2. MATERIALS. Materials shall meet the requirements shown on the plans and specified below.

2.1 PIPE.

Zinc-Coated Corrugated Steel Pipe (Type I or II)	ASTM A 760
Galvanized Steel Corrugated Structural Plates and Fasteners for Pipe, Pipe-Arches, and Arches	ASTM A 761
Precoated (Polymeric) Galvanized Steel Sewer and Drainage Pipe	ASTM A 762
Vitrified Clay Pipe	ASTM C 700
Non-Reinforced Concrete Pipe	ASTM C-14
Reinforced Concrete Pipe	ASTM C 76
Reinforced Concrete D-Load Pipe	ASTM C 665
Reinforced Concrete Arch Pipe	ASTM C 506
Reinforced Concrete Elliptical Pipe	ASTM C 507
Precast Reinforced Concrete Box Sections	ASTM C 789 and C 850
Bituminous-Coated Corrugated Steel Pipe and Pipe Arches	AASHTO M 190
Corrugated Aluminum Alloy Culvert Pipe	AASHTO M 196
Bituminous-Coated Corrugated Aluminum Alloy Culvert Pipe	AASHTO 196 and M 190
Bituminous-Coated Structural Plate Pipe, Pipe Arch, and Arches	AASHTO M 167 and 243
Aluminum Alloy Structural Plate for Pipe, Pipe Arch, and Arches	AASHTO M 219
Asbestos-Cement Storm Drain Pipe	ASTM C 663
Polyvinyl Chloride (PVC) Pipe	ASTM D 3034
Corrugated Polyethylene Drainage Tubing	AASHTO M 252

2.2 CONCRETE. Concrete for pipe cradles shall have a minimum compressive strength of 2000 psi at 28 days and conform to the requirements of ASTM C 94.

2.3 RUBBER GASKETS. Rubber gaskets for rigid pipe shall conform to the requirements of ASTM C 443. Rubber gaskets for PVC pipe shall conform to the requirements of ASTM F477. Rubber gaskets for zinc-coated steel pipe and precoated galvanized pipe shall

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conform to the requirements of ASTM D1056, for the "RE" closed cell grades.

2.4 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.

2.5 OAKUM. Oakum for joints in bell and spigot pipe shall be made from hemp (Cannabis Sativa) line, or Benares Sunn fiber, or from a combination of these fibers. The oakum shall be thoroughly corded and finished.

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

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

2.8 COMPRESSION JOINTS. Materials for compression joints for vitrified clay pipe shall meet the requirements of ASTM C 425.

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ASTM C789 and C850 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 H520 live load condition. A modified design will be necessary when aircraft loadings are greater than the H520 loading.

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3. CONSTRUCTION METHODS.

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 inches 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 (12.7 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 (300 mm) 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

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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.

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 (9.5 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:

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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
2-1/2	62.5	3-1/2	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 (20mm). For pipes installed under paved areas, no more than 12 percent of the material shall pass the No. 200 (0.075mm) sieve. For all other areas, no more than 50 percent of the material shall pass the No. 200 (0.075mm) sieve. The bedding shall have a thickness of at least 6 inches (150mm) 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.

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.

3.4 JOINING PIPE. Joints shall be made with (1) portland cement mortar, (2) portland cement grout, (3) rubber gaskets, (4) oakum and mortar, (5) oakum and joint compound, or (6) plastic gaskets.

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. Where oakum is used, the joint shall be calked with the oakum and then sealed with joint compound or mortar.

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(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 pipe shall conform to the requirements of ASTM D 3212. Fittings for polyethylene pipe shall conform to the requirements of AASHTO M 252.

(d) Asbestos-Cement Pipe. Fittings for asbestos cement pipe shall conform to the requirements of ASTM C 663.

(e) Vitrified Clay Pipe. Fittings for vitrified clay pipe shall conform to the requirements of ASTM C 700. Materials for compression joints shall conform to the requirements of ASTM C 425.

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.

Materials for backfill shall be fine, readily compactible soil, or granular material selected from the excavation or a source of the Contractor's choosing. 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 (12.5 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 (300 mm) 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 (150mm) and shall be brought up evenly on both sides of the pipe to 1 foot (300mm) 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 feet (3 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 (300mm) over the top of the pipe. The backfill material shall meet the requirements of paragraph 3.2(c).

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

4. METHOD OF MEASUREMENT.

4.1 The length of pipe shall be measured in linear feet 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 sizes shall be measured separately. All fittings shall be included in the footage as typical pipe sections in the pipe being measured.

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.

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.

5. BASIS OF PAYMENT.

5.1 Payment will be made at the contract unit price per linear foot 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 D-701.5.1 [**_____] inch [**_____] per linear foot (meter).

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

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Item D-701-5.3 Rock excavation - per cubic yard (cubic meter). 317
********** 321.1
The Engineer shall specify the size and type of pipe for 322
each pipe size specified in the plans. 322
********** 323.2

6. MATERIAL REQUIREMENTS. 328

ASTM A 760	Pipe, Corrugated Steel, Zinc Coated	330
ASTM A 761	Steel Galvanized, Corrugated Structural Plates and Fasteners for Pipe, Pipe-Arches, and Arches	332 333 334
ASTM A 762	Precoated (Polymeric) Galvanized Steel Sewer and Drainage Pipe	336 337
ASTM C 14	Concrete Sewer, Storm Drain, and Culvert Pipe	339
ASTM C 76	Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe	341 342
ASTM C 94	Ready Mixed Concrete	344
ASTM C 144	Aggregate for Masonry Mortar	346
ASTM C 150	Portland Cement	348
ASTM C 425	Compression Joints for Vitrified Clay Pipe	350
ASTM C 443	Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets	352 353
ASTM C 506	Reinforced Concrete Arch Culvert, Storm Drain, and Sewer Pipe	355 356
ASTM C 507	Reinforced Concrete Elliptical Culvert, Storm Drain and Sewer Pipe	358 359
ASTM C 655	Reinforced Concrete D-Load Culvert, Storm Drain and Sewer Pipe	361 362
ASTM C 663	Asbestos-Cement Storm Drain Pipe	364

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	ASTM C 700	Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated	368 369
*	ASTM C 789	Precast Reinforced Concrete Box Sections for Culverts, Storm Drains, and Sewers	371 372
	ASTM C 850	Precast Reinforced Concrete Box Sections for Culverts, Storm Drains, and Sewers With Less Than 2 Ft of Cover	374 375 376 *
	ASTM D 1056	Flexible Cellular Materials - Sponge or Expanded Rubber	378 379
	ASTM D 1190	Concrete Joint Sealer, Hot Poured Elastic Type	381
	ASTM D 3034	Type PSMPoly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings	383 384
	ASTM D 3212	Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals	386 387
	ASTM F 477	Elastomeric Seals (Gaskets) for Joining Plastic Pipe	389 390
	AASHTO M 190	Bituminous-Coated Corrugated Metal Culvert Pipe and Pipe Arches	392 393
	AASHTO M 196	Corrugated Aluminum Alloy Culverts and Underdrains	395 396
	AASHTO M 198	Joints for Circular Concrete Sewer and Culvert Pipe Using Flexible Watertight Gaskets	398 399
	AASHTO M 219	Aluminum Alloy Structural Plate for Pipe, Pipe-Arches, and Arches	401 402
	AASHTO M 243	Field Applied Coating of Corrugated Metal Structural Plate for Pipe, Pipe-Arches, and Arches	404 405 406
	AASHTO M 252	Corrugated Polyethylene Drainage Tubing	408

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