

Section 520 Pipe Culverts

520.1 Description

- (1) This section describes providing culvert pipe, cattle pass, and apron endwalls where the material used is a contractor option; providing and removing temporary culvert pipe; and cleaning existing culvert pipes.

520.2 Materials

520.2.1 Culvert Pipe

- (1) Furnish culvert pipe consistent with the diameter the bid item indicates. Furnish materials for the various classes of pipe as follows:

TABLE 520-1 ALLOWABLE MATERIALS FOR CULVERT PIPE

CLASS	ALLOWABLE MATERIALS
III	Class III reinforced concrete, corrugated steel pipe of the thickness contract designates
III-A	Class II and Class III reinforced concrete, corrugated steel of the thickness the contract designates, corrugated polyethylene, corrugated polypropylene
III-A Non-metal	Class II and Class III reinforced concrete, corrugated polyethylene, corrugated polypropylene
III-B	Class III reinforced concrete, corrugated steel of the thickness the contract designates, corrugated polypropylene
III-B Non-metal	Class III reinforced concrete, corrugated polypropylene
IV	Class IV reinforced concrete, corrugated steel pipe of the thickness contract designates
V	Class V reinforced concrete, corrugated steel pipe of the thickness contract designates

- (2) For the given materials, conform to the following:

Corrugated steel pipe	521.2
Reinforced concrete pipe.....	522.2.2
Corrugated polyethylene pipe.....	530.2
Corrugated polypropylene pipe.....	530.2.2

- (3) Under the Culvert Pipe Temporary bid items, use either new or used culvert pipe in a condition suitable for the purpose intended.

520.2.2 Pipe Cattle Pass

- (1) Under the Pipe Cattle Pass bid item, if the plans do not designate a specific material, the contractor may use either corrugated steel or reinforced concrete. For the given materials, conform to the following:

Corrugated steel pipe cattle pass	521.2
Reinforced concrete pipe cattle pass.....	522.2.3

520.2.3 Apron Endwalls for Culvert Pipe

- (1) Under the Apron Endwalls for Culvert Pipe bid items, use steel apron endwalls for corrugated steel, corrugated polyethylene, and corrugated polypropylene pipe culvert installations, and use concrete apron endwalls with concrete pipe culvert installations. For the given materials, conform to the following:

Steel apron endwalls	521.2
Concrete apron endwalls.....	522.2.4

520.2.4 Concrete Collars for Pipe

- (1) For concrete collars, furnish grade A, A-FA, A-S, A-T, A-IS, A-IP, or A-IT concrete conforming to [501](#) as modified in [716](#). Provide QMP for class III ancillary concrete as specified in [716](#).

Add 520.2.5 to specify foundation backfill and trench backfill materials for backfilling culvert pipe.

520.2.5 Backfill

520.2.5.1 General

- (1) **Submit daily quantities for material requiring department testing to the engineer as follows:**
- For foundation backfill.
 - For trench backfill not obtained from the excavation.
- (2) Determine quantities at the point of placement by collecting truck tickets as the material is placed or by another engineer-approved method.

- (3) Ensure there is adequate moisture in backfill during placing, shaping, and compacting to prevent segregation and achieve adequate compaction.

520.2.5.2 Foundation Backfill

520.2.5.2.1 General

- (1) Furnish virgin materials consisting of either sand-sized particles or sand-sized particles mixed with gravel, crushed gravel, or crushed stone. Do not use materials classified under [301.2.4.3](#) as crushed concrete, reclaimed asphalt, reprocessed material, or blended material. The contractor may use material from the work site.
- (2) Ensure that material provided has a liquid limit less than or equal to 25 and a plasticity index less than or equal to 6.

520.2.5.2.2 Gradation

- (1) Furnish foundation backfill with a gradation conforming to the following:

- For the entire sample, conform to the following gradation limits:

SIEVE	PERCENT PASSING BY WEIGHT
1 1/4-inch	100
No. 4	25 - 100

- For the portion of the sample passing the No. 4 sieve, conform to the following gradation limits:

SIEVE	PERCENT PASSING BY WEIGHT
No. 4	100
No. 40	—
No. 100	0 - 30
No. 200	0 - 15.0

- (2) The contractor may substitute material with a gradation conforming to the following:

3/4-inch dense-graded base course	305.2.2.1
1 1/4-inch dense-graded base course	305.2.2.1

520.2.5.2.3 Sampling and Testing

- (1) The department will sample and test material according to the following:

Sampling ^[1]	AASHTO T2
Percent passing the 200 sieve	AASHTO T11
Gradation ^[1]	AASHTO T27
Liquid limit	AASHTO T89
Plasticity index and plastic limit	AASHTO T90

^[1] As modified in [CMM 8-60](#).

- (2) Submit contractor test results for gradation, liquid limit, and plasticity index testing to the engineer for approval before placing backfill. The engineer may waive contractor testing for known sources.

520.2.5.3 Trench Backfill

- (1) Furnish trench backfill consisting of material from the typical roadway section. Use material from the excavation that is free of large lumps, clods, rocks and other perishable and deleterious matter. If the engineer determines that material from the excavation is not suitable, backfill the trench with an engineer-approved material.

520.2.6 Joint Connections

- (1) Wrap or seal joints with material conforming to:

Geotextile Type DF, Schedule A	645.2.2.4
Bituminous Mastic Joint Sealer	608.2

520.3 Construction

520.3.1 General

- (1) Unless the engineer authorizes otherwise in writing, do not order or deliver pipe culverts for the project until the engineer furnishes a corrected list of sizes and lengths.
- (2) Provide temporary drainage facilities necessary to protect the work and adjacent property. Maintain temporary drainage in effective operating condition, as the engineer approves, until the permanent culvert pipe installations are operational. Remove and dispose of temporary culverts after the permanent culvert pipe installations are operational.
- (3) Place foundation and trench backfill in a way that does not damage the pipe.

- (4) Construct concrete collars where and as the plans show.

520.3.2 Excavating and Constructing Foundations for Pipe Culverts

520.3.2.1 Public Highway Culvert

- (1) If placing pipe culverts under any public highway in open trenches, either place them in an excavation in the existing ground, or in previously placed embankment compacted as specified for embankment in [207](#). Place and compact the embankment to at least the elevation of the top of the culvert before excavating the trench. Avoid placing embankment to an elevation exceeding 2 feet above the top of the culvert before placing the culvert.

Revise 520.3.2.1(2)&(3) to add requirements for trench dimensions that are the same as specified for storm sewer.

- (2) Perform trenching, **shoring**, and excavating according to 29 CFR part 1926, OSHA subpart P. **If utilities and other restraints make sloping or benching of the excavation impracticable, employ a shoring system.**
http://www.dol.gov/dol/cfr/title_29/
- (3) **Make trenches wide enough to provide free working space on each side of the pipe. This space shall not exceed 1/2 the nominal diameter of the pipe, and never be less than 6 inches. The required working space shall depend upon the size of the pipe and the character of the material in the excavation; however, always provide sufficient space between the pipe and the sides of the trench to allow for preparing the foundation, laying the pipe, and placing and compacting the backfill.** If the height of the proposed embankment or earth cover above the top of the pipe exceeds 6 feet, excavate the trench below the top of the pipe as vertical as possible.
- (4) For steel or concrete pipe, make the trench wide enough to allow for preparing the foundation, laying the pipe, and placing and compacting backfill, except that the trench width shall not exceed the pipe's outside diameter by more than 36 inches. For polyethylene and polypropylene pipe, conform to [ASTM D2321](#) and ensure that the trench is as wide or wider than the pipe outside diameter plus 16 inches or the pipe outside diameter times 1.25 plus 12 inches whichever is wider.

Revise 520.3.2.1(5)-(8) to require foundation backfill below the pipe and prohibit flooding when using dense-graded base.

- (5) **Excavate the trench to at least 6 inches below the elevation established for the bottom of the pipe. Backfill to this depth with foundation backfill. Mechanically compact foundation backfill before laying the pipe. After laying the pipe, place and mechanically compact foundation backfill to an elevation of 12 inches above the pipe to provide full and continuous support. Do not place lifts more than 6 inches thick as measured after compaction. Compact the entire layer before placing the next layer. Do not compact by flooding if using foundation backfill with a dense-graded base gradation.**
- (6) Excavate and backfill pipe arches as specified above, except backfill and trim to a height that fully and continuously supports the pipe arch.
- (7) If the engineer determines that existing foundation material for at least 6 inches below the bottom of the pipe conforms to [520.2.5.1](#); the contractor need not excavate, backfill, or shape the bed under the pipe.
- (8) If rock, hardpan, or fragmented material exists, excavate the trench below the pipe to a depth equal to 1/2 inch per foot of proposed embankment above the top of the pipe, but not less than 6 inches. Construct the foundation and backfill to 12 inches above the pipe with foundation backfill as specified above.
- (9) Excavate recesses to receive bells if necessary.

520.3.2.2 Private Entrance and Temporary Culverts

- (1) Shape the earth foundation for the pipe culverts for private entrances, and temporary installations to fit the pipe exterior with reasonable closeness for a height of at least 10 percent of the pipe's overall diameter.
- (2) If rock, hard pan, boulders, or fragmented material exist, bed the pipe on an earth, or granular bedding, compacted and shaped similarly to the above, for no less than 6 inches below the pipe.

520.3.3 Laying Pipe

- (1) Do not place any pipe culvert until the engineer approves the foundation. Additionally, do not place pipe culverts in cuts until completing the rough grading.
- (2) Unless the plans show otherwise, if laying 2 or more pipes next to each other, separate them by a distance equal to at least 1/2 the pipe diameter, with a minimum distance of 18 inches. For pipes with attached apron endwalls, separate them by a distance that provides a minimum of 6 inches between the apron endwalls. For cast-in-place concrete or other alternate endwall installations, space pipes as the plans show.

- (3) Lay concrete pipe with bells or grooves up grade and with spigot or tongue ends fully inserted in the bells or grooves. Protect each joint against backfill infiltration by providing a full circumferential wrap of geotextile extending one foot or more on each side of each joint and securing the wrap in place.
- (4) The contractor may use sealers instead of the geotextile joint wrap. Construction methods for sealing joints with these sealers shall conform to [608.3.4](#).
- (5) Provide joint ties on the upstream and downstream ends of concrete culvert and concrete cattle pass installations. Tie the last 3 sections or, if using apron endwalls, the endwall and the last 2 sections. Ties are not required on culverts with masonry endwalls unless the plans show otherwise.
- (6) Lay riveted or spot-welded corrugated steel pipe so that flow is over the lap of the sheets, except for beveled end sections where the contractor may reverse the lap at the outlet end. Make field joints by joining the metal pipe sections together with a band bolted firmly in place. If elongation of the vertical diameter is specified, provide an appropriately modified prefabricated section.
- (7) Ensure that culvert pipe joints are soil-tight as follows:
 - For polyethylene according to AASHTO M294.
 - For polypropylene according to AASHTO M330.
- (8) Lay pipes true to the designated line, grade, and required camber. Fit and match them to form a smooth and uniform invert.
- (9) Carefully fit the sections of pipe together to keep the size of joint openings to a minimum.
- (10) Clean sockets carefully before lowering pipes into trenches. Lower the pipes in a way that avoids unnecessary handling in the trench.

520.3.4 Backfilling Trenches

520.3.4.1 Public Highway Culverts

Revise 520.3.4.1(1)-(3) to limit layer thickness for trench backfill to 8 inches after compaction.

- (1) Place trench backfill from 1 foot above the top of the pipe to the top of the subgrade in layers no more than 8 inches thick after compaction. Mechanically compact the entire length of each layer to the same degree as the material next to the trench before placing the next layer.
- (2) Immediately after backfilling the pipe in an embankment being constructed, cushion the installation as necessary by placing compacted earth embankment over the pipe for at least the trench width. Provide 2 feet or more cover, including backfill depth, above the pipe. Maintain this cushion during subsequent construction operations.
- (3) Place the remaining portion of the embankment, if any, above the top of the trench as specified for the adjacent embankment.

520.3.4.2 Private Entrance and Temporary Culverts

- (1) Carefully backfill private entrance and temporary culverts in layers no more than 8 inches deep after compaction, then ram and tamp material to completely fill spaces under and next to the pipe.

520.3.5 Placing Apron Endwalls

- (1) Excavate the foundation for the apron endwall to the required width and grade. For metal aprons with toe plates, excavate a trench to allow placing the toe plate against the inner face of the trench if the apron is in its final position. After securing the apron to the pipe, backfill and firmly compact the trench.
- (2) Place the concrete apron endwall with its tongue or groove fully entered in the groove or tongue of the pipe.
- (3) Use the same backfill for the apron as required for the culvert pipe unless the engineer directs otherwise.

520.3.6 Cleaning Culvert Pipes

- (1) Clean the existing culvert pipes of dirt and vegetation. Use all suitable materials removed from the culvert pipes in other areas requiring fill material within the project limits as the engineer directs. Dispose of surplus and unsuitable material as specified in [205.3.12](#).

520.3.7 Deflection Testing

- (1) The department accepts polyethylene and polypropylene pipe based on testing with a department-approved mandrel. Test pipe as the engineer directs after installation but before paving or finish grading.
- (2) Provide a mandrel with a diameter equal to 92.5 percent of the pipe's nominal diameter and having cable attachment points on each end of the core. Ensure that the mandrel has nine fins or legs permanently marked to designate the pipe size and the allowable percent deflection.

- (3) The engineer will designate at least 10 percent of the installed length of pipe for testing. The mandrel must pass through the entire section in one pass when pulled by hand without using excessive force. If the designated length of pipe fails, engineer may require additional testing.
- (4) Relay or replace pipe with deflection greater than 5 percent. Retest all relayed or replaced pipe.

520.4 Measurement

- (1) The department will measure the Culvert Pipe bid items and Pipe Cattle Pass by the linear foot acceptably completed, measured along the invert.
- (2) The department will measure the Apron Endwalls, Cleaning Culvert Pipes, and Concrete Collars bid items as each individual unit acceptably completed.
- (3) The department will measure Cleaning Culvert Pipes as each individual culvert acceptably completed.

520.5 Payment

Revise 520.5 to make backfilling incidental and to clarify payment for water used for compaction and dust control.

520.5.1 General

- (1) The department will pay for measured quantities at the contract unit price under the following bid items:

<u>ITEM NUMBER</u>	<u>DESCRIPTION</u>	<u>UNIT</u>
520.1000 - 1199	Apron Endwalls for Culvert Pipe (size)	EACH
520.2000 - 2099	Culvert Pipe Temporary (size)	LF
520.3100 - 3199	Culvert Pipe Class III (size)	LF
520.3300 - 3399	Culvert Pipe Class III-A (size)	LF
520.3400 - 3499	Culvert Pipe Class III-A Non-metal (size)	LF
520.3500 - 3599	Culvert Pipe Class III- B (size)	LF
520.3600 - 3699	Culvert Pipe Class III-B Non-metal (size)	LF
520.4100 - 4199	Culvert Pipe Class IV (size)	LF
520.5100 - 5199	Culvert Pipe Class V (size)	LF
520.8000	Concrete Collars for Pipe	EACH
520.8500	Pipe Cattle Pass	LF
520.8700	Cleaning Culvert Pipes	EACH

- (2) Payment for the Apron Endwalls for Culvert Pipe bid items is full compensation for providing apron endwalls; and for excavating, constructing the foundation, and backfilling. The department will pay separately for concrete endwalls under the Concrete Masonry Endwalls bid item.
- (3) Payment for Concrete Collars for Pipe is full compensation for providing concrete pipe collars.
- (4) Payment for Cleaning Culvert Pipes is full compensation for cleaning the culvert pipe and for disposing of excess material.
- (5) Payment for the 520 bid items also includes water for compaction and dust control, except if the contract contains the Water bid item, the department will pay separately for water under [624.5](#).

520.5.2 Culvert Pipe and Cattle Pass

- (1) Payment for the Culvert Pipe bid items and Pipe Cattle Pass is full compensation for providing pipe; for excavating, constructing the foundation, and backfilling; and for associated dewatering and maintaining drainage. If material from the typical roadway section is not suitable for trench backfill, the department will pay separately for trench backfill under other contract bid items.