

1 **SECTION 603 - CULVERTS AND STORM DRAINS**
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4 **603.01 Description.** This section describes fabricating, furnishing, installing and
 5 cleaning culverts and structural plate culverts, and constructing reinforced concrete
 6 jackets and collars. Circular corrugated metal, reinforced concrete, spiral rib metal,
 7 and high-density polyethylene pipes; corrugated metal and concrete pipe arches;
 8 and structural metal plate pipes; hereinafter referred to as culvert unless otherwise
 9 noted.

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 11 **603.02 Materials.**

12	Bed Course Material for Crushed Rock Cradle	703.16
13	Structure Backfill Material	703.20
14	Trench Backfill Material	703.21
15	Joint Filler	705.01
16	Joint Mortar for Pipe	705.02
17	Flexible Watertight Gasket	705.03
18	Reinforced Concrete Pipe (RCP)	706.02
19	High Density Polyethylene Pipe	706.10
20	Corrugated Metal Pipe and Pipe Arch	707.02
21	Bituminous Coated Corrugated Metal Pipe and Pipe Arch	707.03
22	Structural Aluminum Plate for Pipe, Pipe Arch	707.06
23	Structural Steel Plate for Pipe, Pipe Arch and Arch	707.08
24	Spiral Rib Metal Pipe	707.12
25	Spiral Rib Metal Coupling Band	707.13
26	Asphalt Paint	708.05
27	Reinforcing Steel	709.01
28	Curing Materials	711.01
29	Cullet Materials for Utility Structures	717.03

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49 Cullet Materials for Drainage Systems 717.04

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51 Class A concrete, used for installing culverts and concrete jackets and
52 collars, shall conform to Section 601 – Structural Concrete.

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54 Corrugated Metal Pipe Coupling Bands shall conform to Subsection 707.02 –
55 Corrugated Metal Pipe and Pipe Arch.

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57 If indicated in contract documents, consider option of furnishing and installing
58 corrugated metal pipe, spiral rib metal pipe, reinforced concrete pipe, or high-
59 density polyethylene pipe. Do not mix pipe material within inlet and outlet points of
60 installation.

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62 **603.03 Construction.** Provide temporary diversion of water to install culvert on
63 dry bed.

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65 **(A) Excavation.** Excavate trenches in accordance with requirements of
66 Section 206 - Excavation and Backfill for Drainage Facilities and this section.

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68 **(B) Laying Bed Course Material.** Unless otherwise indicated in contract
69 documents, construct bed course material as specified in this section.

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71 Backfill excavation required for solid rock and unsuitable material
72 removal, as specified in Subsection 206.03(A)(1) - General, with bed course
73 material and compact to relative compaction of not less than 95 percent, in
74 maximum 6-inch lifts. Determine maximum densities and relative
75 compaction in accordance with Subsection 203.03(C)(2) - Relative
76 Compaction Test.

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78 Bed course material width under culvert shall be equal to trench width;
79 and thickness shall be equal to 1/2 inch for each foot of fill over culvert, or 15
80 percent of culvert's height, or 12 inches, whichever is greater. Bed course
81 material thickness shall not exceed 3/4 of nominal culvert diameter or rise.

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83 Place bed course material in maximum 8-inch lifts. Compact bed
84 course material to remove voids, with one pass of vibratory equipment or
85 other equipment acceptable to Engineer. Shape bed course material to
86 accommodate culvert, including bells or collars.

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88 **(C) Laying Culvert.** Remove and replace culverts that are broken, bent,
89 or damaged during construction.

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91 **(1) Culverts.** Except for structural plate culverts, begin laying
92 culverts from downstream end of alignment. Construct culvert such
93 that bottom is in contact with shaped bedding throughout full length.
94 Place bell and groove ends of rigid culverts and outside laps of

flexible culverts facing upgrade. Place flexible culverts with longitudinal laps or seams at sides.

If rigid culverts are connected to drainage structures, construct bell and groove end flush with inside wall face on the downgrade side of drainage structures.

Orient vertical axis of elliptical and elliptically reinforced culverts to within 5 degrees of vertical plane through longitudinal axis of culvert. Orient elongated circular corrugated culverts with major axis vertical.

In multiple culvert installation, provide clearance between culverts of 0.5 diameter of culvert with maximum 4 feet and minimum 1 foot.

(2) Structural Plate Culverts. Assemble structural plate culverts in accordance with manufacturer's instructions.

(D) Joining Culverts. This section applies to joining culverts other than structural plate culverts.

Prior to placement of backfill, Engineer will inspect culvert. Re-lay or replace culverts out of alignment or unduly settled at no increase in contract price or contract time.

(1) Reinforced Concrete Culverts. Reinforced concrete culverts may be of bell and spigot, or tongue and groove design. Join culvert sections such that ends are inserted fully and inner surfaces are flush and even.

Make joints with joint mortar, or flexible watertight gaskets.

When using joint mortar to join culvert sections 30 inches or less in diameter, apply mortar to ends of each culvert section before joining. Make mortar joints with mortar forming bead around outside of culvert and finish smooth on inside.

When using joint mortar to join culvert sections greater than 30 inches in diameter, apply mortar within joint surface only. Mortar joints only after installing culvert sections and after placing sufficient backfill to ensure that culvert does not move. Finish interior joint surface smooth with inside culvert surface.

When using portland cement mixtures, protect completed joints against rapid drying by suitable covering material.

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Clean and dry joint surfaces when applying preformed plastic sealing compounds. Apply primer coat accepted by the Engineer to surface and allow to dry completely. Apply flat side of preformed plastic sealing adhesive strips to dry primed surface and leave outside wrapper for protection. In trench before jointing, remove outside wrapper. Join culverts by pushing or pulling force applied in straight line to bring opposing joint surface flush and even. Apply pressure to culverts that results in squeezing plastic gasket to solid pack. Only whole and single cut piece is acceptable to complete the circumference.

Table 603.03-1 - (Dry Trench Condition) Extruded Rope Size and Table 603.03-2 - (Wet Trench Condition) Extruded Rope Size (Double Head Application) list gasket sizes for dry and wet trench (double head application) conditions.

TABLE 603.03-1 - (DRY TRENCH CONDITION) EXTRUDED ROPE SIZE			
Pipe Size (Inches)	Rope Diameter (Inches)	Cross Sectional Area (Square Inches)	Minimum Delivery Length (Feet-Inches)
18 and below	1	0.80	2' – 5"
24 – 42	1-1/2	1.75	3' – 5"
48 – 66	1-3/4	2.50	3' – 5"
72 – 96	2	3.25	3' – 5"

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TABLE 603.03-2 - (WET TRENCH CONDITION) EXTRUDED ROPE SIZE (DOUBLE HEAD APPLICATION)			
Pipe Size (Inches)	Rope Diameter (Inches)	Cross Sectional Area (Square Inches)	Minimum Delivery Length (Feet-Inches)
30 and below	1	0.80	2' – 5"
36 – 48	1-1/2	1.75	3' – 5"
54 – 72	1-3/4	2.50	3' – 5"
78 – 96	2	3.25	3' – 5"

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Install rubber ring gaskets or plastic sealing compounds to form flexible watertight seal. Clean and dry surfaces to receive lubricants, cements, or adhesives. Affix gaskets and jointing materials to culvert not more than 24 hours before installation. Protect gaskets and jointing materials from sun, dust, and other deleterious agents. Engineer will inspect gaskets and jointing materials before installation of culvert. Remove and replace loose or improperly affixed gaskets and jointing materials. Remove culvert and remake joint when gasket or jointing material becomes loose and can be seen through exterior joint recess when pulling joint up to 1 inch of closure.

(2) Metal and High-Density Polyethylene Culverts. Join metal culverts firmly with coupling bands.

Join high-density polyethylene culverts with coupling bands in accordance with manufacturer's instructions.

Submit joint detail and joining method to Engineer for acceptance before joining culverts.

Watertight joints, unless specified, are not required.

(E) Elongation of Corrugated Metal Culverts. When using corrugated metal culverts and when elongation is specified, elongate vertical diameter 5 percent from full circular cross section before placing fills.

Elongate culverts either at fabricating shop or in field.

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189 Elongate culverts at fabricating shop by following methods:

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191 (1) Fabricate plates so that elongation is achieved after assembly.

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193 (2) Employ mechanical pressure sufficient to introduce permanent
194 elongation in culvert.

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196 (3) Elongate assembled culvert and retain elongation by rods and
197 turnbuckles, wires, or struts.

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199 When elongating culverts in field, method of elongation shall be in
200 accordance with details indicated in contract documents.

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202 Keep in place rods and turnbuckles, wires, or struts used to maintain
203 culvert elongation, until embankment has been completed. Remove them
204 before installing headwalls or other structures at ends of culverts.

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206 (F) **Elongation of Structural Plate Culverts.** When using circular
207 structural plate culvert and when elongation is specified, elongate vertical
208 diameter in accordance with contract documents.

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210 Elongate culverts uniformly from end to end when not using
211 headwalls. When using headwalls with circular culverts, reduce percent of
212 elongation gradually under side slopes of embankment so that ends of
213 culvert at headwalls are circular.

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215 Elongate by using factory-elongated plates or by elongating circular
216 culvert by means of timber struts and sills placed in accordance with details
217 indicated in contract documents.

218

219 When using factory-elongated plates, elongate plates to provide
220 increase of 5 percent in vertical diameter of culvert after assembly.

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222 When elongating culverts in field, increase vertical diameters in
223 accordance with Table 603.03-3 - Culvert Elongation.

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TABLE 603.03-3 - CULVERT ELONGATION	
Culverts using No. 1 or 3 gage top and side plates	1 Percent
Culverts using No. 5 or 7 gage top and side plates	2 Percent
Culverts using No. 8, 10, 12 gage top and side plates	3 Percent

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226 Strut factory-elongated culverts for support. Upon completion of
227 embankment, remove strutting.

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(G) Strutting for Support. Place required timber struts and sills for full length of culvert before backfilling. Place strutting to retain original cross section of culvert.

(H) Repairing Damaged Zinc-Coated Surfaces. Repair damaged zinc-coated surfaces in accordance with Subsection 501.03(G)(2) - Repairing Damaged Zinc-Coated Surfaces.

(I) Backfilling. After installing culvert, backfill in accordance with Section 206 - Excavation and Backfill for Drainage Facilities.

Trench backfill material placed below horizontal plane 12 inches above top of culvert shall conform to Subsection 703.21(A) - Trench Backfill Material A or Section 314 - Controlled Low Strength Material (CLSM) for Utilities and Structures.

Except for structural plate culvert, backfill remainder of trench with structural backfill material B conforming to Subsection 703.20 - Structure Backfill Material, or with trench backfill material B conforming to Subsection 703.21(B) - Trench Backfill Material B, or with CLSM conforming to Section 314 - Controlled Low Strength Material (CLSM) for Utilities and Structures.

Place CLSM only for that portion of trench backfill below original ground, grading plane, or top of embankment placed before excavating for culvert. Where necessary, compact earth plugs at each end of culvert before placing backfill so that CLSM is completely contained in pipe trench.

When using CLSM, compaction of backfill is not required.

For structural plate culvert, backfill remainder of trench in accordance with Subsection 203.03(C) - Embankment Construction and Subsection 206.03(A)(3) - Structural Plate Culverts in Embankment Fill.

When operating earth-moving equipment over culverts, provide minimum compacted cushion of earth as follows:

(1) 4 feet above top of culvert.

(2) Extending 5 diameters on each side of culvert. Remove and replace culverts broken or damaged at no increase in contract price or contract time.

(J) Concrete Jackets and Collars. Construct concrete jackets and collars in accordance with requirements of contract documents. Perform

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273 concrete construction in accordance with Section 503 – Concrete Structures.
274 Perform reinforcing steel work in accordance with Section 602 – Reinforcing
275 Steel.

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277 **(K) Cleaning Culverts.** Clean, remove, and dispose of silt, trash,
278 vegetation growth from existing culverts and adjoining drainage structures
279 within project limits. Clean by manual or mechanical means. Discharge of
280 debris or wash water during culvert cleaning into stream, ocean, or State of
281 Hawaii waters will not be allowed.

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283 **603.04 Measurement.**

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285 **(A)** Bed course material for culverts, and reinforced concrete collar will be
286 paid on a lump sum basis. Measurement for payment will not apply.

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288 **(B)** Engineer will measure reinforced concrete jacket per linear foot in
289 accordance with contract documents.

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291 **(C)** Engineer will measure cleaning of existing culverts on a force account
292 basis in accordance with Subsection 109.06 - Force Account Provisions and
293 Compensation and as ordered by Engineer.

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295 **603.05 Payment.** Engineer will pay for accepted pay items listed below at
296 contract price per pay unit, as shown in proposal schedule. Payment will be full
297 compensation for work prescribed in this section and contract documents.

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299 Engineer will pay for each of the following pay items when included in
300 proposal schedule:

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302 Pay Item	303 Pay Unit
304 Bed Course Material for Culvert	Lump Sum
305 _____ - Inch Reinforced Concrete Pipe, Class _____	Lump Sum
306 _____ - Inch Spiral Rib Aluminum Pipe, Sheet Thickness, 307 _____ - Inch	Lump Sum
308 _____ - Inch High Density Polyethylene Pipe, Type _____	Lump Sum
309 _____ - Inch Corrugated _____, Sheet Thickness, 310 _____ - Inch	Lump Sum
311 _____ - Inch Reinforced Concrete Pipe, Class _____, or 312 _____ - Inch High Density Polyethylene Pipe, Type _____, or 313 _____ - Inch Corrugated Steel Pipe, Sheet Thickness 314 _____ - Inch, or	
315 _____ - Inch, or	
316 _____ - Inch, or	
317 _____ - Inch, or	
318 _____ - Inch, or	
319 _____ - Inch, or	

320	_____ - Inch Spiral Rib Aluminum Pipe, Sheet Thickness,	
321	_____ - Inch	Lump Sum
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323	_____ - Inch Reinforced Concrete Pipe, Class _____, or	
324	_____ - Inch High Density Polyethylene Pipe, Type _____, or	
325	_____ - Inch Spiral Rib Aluminum Pipe, Sheet Thickness,	
326	_____ - Inch,	Lump Sum
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328	_____ - Inch Reinforced Concrete Pipe, Class _____, or	
329	_____ - Inch High Density Polyethylene Pipe, Type _____	Lump Sum
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331	_____ - Inch Reinforced Concrete Pipe, Class _____, or	
332	_____ - Inch Spiral Rib Aluminum Pipe, Sheet Thickness,	
333	_____ - Inch	Lump Sum
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335	_____ - Corrugated _____ Pipe Arch, Sheet Thickness,	
336	_____ - Inch	Lump Sum
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338	_____ - Inch Structural _____ Plate _____, No. _____ Gage	Lump Sum
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340	_____ - Inch Structural Steel Plate _____, No. _____ Gage or	
341	_____ - Inch Structural Aluminum Plate _____, No. _____ Gage	Lump Sum
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343	Reinforced Concrete Collar _____	Lump Sum
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345	Reinforced Concrete Jacket _____	Linear Foot
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347	(1) 100 percent of contract bid price upon completion of constructing	
348	concrete jacket.	
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350	Clean Existing Culverts	Force Account
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352	An estimated amount for force account may be allocated in proposal	
353	schedule under "Clean Existing Culverts", but actual amount to be paid will be the	
354	sum shown on accepted force account records, whether this sum be more or less	
355	than estimated amount allocated in proposal schedule.	
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357	Lump sum monthly payment basis will be determined in accordance with	
358	Subsection 109.01 - Schedule of Agreed Prices for Lump Sum Price Items.	
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360	Engineer will pay for accepted excavation including excavation below flow	
361	line grade, bedding, and backfill for culverts and storm drains under Section 206-	
362	Excavation and Backfill for Drainage Facilities.	

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END OF SECTION 603