



CORRUGATED METALLIC-COATED STEEL CULVERT PIPE, PIPE-ARCHES AND END SECTIONS FIELD SECTION 1020 APPENDIX A CORRUGATED METAL PIPE (CMP) INSPECTION GUIDE

This guide will assist in the inspection of all types and configurations of corrugated metal pipe, couplings and ends. Answer each question and take the action indicated for the answer given. If no condition is provided for a particular answer, move on to the next question. **IT IS THE RESPONSIBILITY OF THE INSPECTOR TO CONFIRM THAT THIS INSPECTION GUIDE IS IN ACCORDANCE WITH CURRENT SPECIFICATION.**

Every lot should be visually inspected. The lot that appears to have the most defects, or a lot selected at random if all lots appear to be of equal quality, shall be inspected in greater detail to generally establish the Quality Control practices of the manufacturer. And at least one pipe per size offered in the lot shall be inspected in detail using this inspection guide. A lot shall be considered that quantity of material offered for inspection at one time that is of the same thickness and bears the same heat number and coating lot designation.

If this inspection guide is used to inspect a rejected pipe, it shall be submitted with the notification to the manufacturer of the failure to meet specification.

Has any of the material or pipe included in this lot been rejected during a previous inspection visit?

If Yes, the entire lot is unacceptable. Yes No

Is this manufacturer approved for production of this type of pipe?
(Refer to FS-1020, Table 1 for galvanized sheet, Table 2 for aluminized sheet)

If No, stop, the pipe is unacceptable. Yes No

Is the pipe accompanied by a bill of lading or delivery receipt at this location?

If No, stop, the pipe is unacceptable. Yes No

Does the bill of lading or delivery receipt contain an itemized list of the sizes and lengths of pipe?

If No, stop, the pipe is unacceptable. Yes No

Does the bill of lading or delivery receipt contain a MoDOT sample ID or is it accompanied by a Material Shipping Report Form?

If No, stop, the pipe is unacceptable. Yes No

Does the bill of lading or delivery receipt contain the certified statement, "This certifies that the pipe, bands, and end sections in this shipment are in accordance with MoDOT specifications and were fabricated at an approved plant."

If No, stop, the pipe is unacceptable. Yes No



Is the certified statement signed by an authorized representative of the manufacturer?

If No, stop, the pipe is unacceptable.

Yes No

Is the pipe marked (in accordance with the specification) with the following: the sheet manufacturer's name, tradename, or trademark?

If No, stop, the pipe is unacceptable.

Yes No

the brand name?

If No, stop, the pipe is unacceptable.

Yes No

the type of coating or AASHTO designation number of the coated steel?

If No, stop, the pipe is unacceptable.

Yes No

the specified sheet thickness?

If No, stop, the pipe is unacceptable.

Yes No

the specified weight (mass) of coating?

If No, stop, the pipe is unacceptable.

Yes No

identification symbols relating to a specific heat number and coating lot designation? (If unsure, contact the manufacturer.)

If No, stop, the pipe is unacceptable.

Yes No

Do the markings repeat on the pipe on intervals not exceeding 5 feet?

If No, stop, the pipe is unacceptable.

Yes No

Is the steel sheet used to make this pipe free from injurious defects such as blisters, flux, and uncoated spots?

If No, stop, the pipe is unacceptable.

Yes No

Has the steel sheet used in this pipe been sampled in the last 12 months?

If No, sample the sheet following the instructions in FS-1020.

Yes No

If any pipe is "shop elongated", is the vertical axis is 4 - 6% greater than the nominal diameter?

If No, the shop elongated pipe in the shipment is unacceptable.

Yes No

If any pipe is "shop elongated", does it have a paint mark indicating the top of pipe, and is the mark in the correct position?

If No, the shop elongated pipe is unacceptable.

Yes No

If any pipe is "shop elongated" and the end has been left round to accommodate connections, does it have a mark indicating "Outside End-Round" at that end of the pipe?

If No, the shop elongated pipe with round end is unacceptable.

Yes No

If any pipe has "beveled ends", is the beveled end smooth and have the cut edges apparently been covered with two coats of the specified paint?

If No, the beveled ends pipe is unacceptable.

Yes No

Are the "end sections" in accordance with the shape, dimensions, and sheet thickness shown on the plans?

If No, the end section is unacceptable.

Yes No



Are the "end sections" integral units or made in sections that may be assembled in place?
If No, the end section is unacceptable. Yes No

Are "coupling bands" or "bell and spigot joint system" in accordance with section 1020.4.6 of the specification?
If No, the coupling band or pipe with a bell and spigot joint system is unacceptable. Yes No

Are "special fittings" in accordance with section 1020.4.7?
If No, the special fitting is unacceptable. Yes No

A single-spot test by magnetic or electronic gauge shall be performed, (in accordance with Section 1020.3.4.1.1 of the Materials Manual and ASTM E376) on at least one pipe per lot inspected, to determine the average coating mass (weight). The rate of testing may be reduced at the discretion of the engineer once the Quality Control practices of the manufacturer have been established. This testing may also be performed as one of the last procedures in the inspection process if the engineer chooses.

Is the mass (weight) of the coating (as determined by measuring the thickness of coating) equal to or greater than the specified minimum?
(refer to Section 1020.3.4.2 of the Materials Manual)
If No, stop, the pipe is unacceptable. Yes No

Is the pipe Riveted?
If Yes, go to the Riveted Pipe section. Yes No

Is the pipe Helical Lock Seam?
If Yes, go to the Helical Lock Seam section. Yes No

If you encounter welded pipe, please contact Central Office – Construction and Materials for guidance.



Riveted Pipe

The pipe inspected in detail should be the one that appears to have the most instances of poor workmanship and/or materials.

If the pipe is "pipe arch," does it have a longitudinal seam on the corner radius or invert?

If Yes, stop, the pipe is unacceptable. Yes No

If the pipe is "pipe arch," does it have any wrinkles or kinks in the arch?
(This is an indication that the steel has yielded.)

If Yes, stop, the pipe is unacceptable. Yes No

Are there any missing rivets?

If Yes, stop, the pipe is unacceptable. Yes No

Are there any rivets that are too small and not supplemented by an adjacent correct size rivet or bolt?

If Yes, stop, the pipe is unacceptable. Yes No

Are there any rivets that have not been placed in the valley of the corrugation?

If Yes, stop, the pipe is unacceptable. Yes No

Are there any lap joints which a 1/16" wire can be pushed through completely?

If Yes, stop, the pipe is unacceptable. Yes No

Are there two or more lap joints with gaps greater than 1/4", regardless of the overall length of pipe?

If Yes, stop, the pipe is unacceptable. Yes No

Are there more than 2 consecutive rivets, 3 rivets in one can, or 9 rivets in the pipe, regardless of overall length, that are less than twice its diameter from the edge of the sheet?
(This applies to the inside and outside of the pipe.)

If Yes, stop, the pipe is unacceptable. Yes No

For a pipe with a 12" diameter, are there less than 6 circumferential rivets?

If Yes, stop, the pipe is unacceptable. Yes No

For pipe with a diameter greater than 12", are there more than two instances of rivet spacing in the circumferential seam greater than 6"?

If Yes, stop, the pipe is unacceptable. Yes No

For pipe with a diameter greater than 12", are there any instances of rivet spacing in the circumferential seam greater than 8"?

If Yes, stop, the pipe is unacceptable. Yes No



Are there any deformations from typical shape that are greater than 1/2" from the specified position?

(Recommended apparatus: Stiff wire to lay on circumference of pipe over deformation. 1/2" marble or ball bearing to pass under wire.)

If Yes, stop, the pipe is unacceptable.

Yes No

Are there any scrapes or other injuries to the coating that exposes the base metal on the bottom third of the perimeter as installed (or will be installed)?

If Yes, stop, the pipe is unacceptable.

Yes No

Are there any scrapes or other injuries to the coating that exposes the base metal and are longer than 1" on the top two thirds of the perimeter as installed (or will be installed)?

If Yes, stop, the pipe is unacceptable.

Yes No

Are there any instances where the expanded head of a rivet is between the two sheets, not holding the inside sheet (this is treated as a missing rivet), and the resulting space between acceptable rivets is greater than 8"?

If Yes, stop, the pipe is unacceptable.

Yes No

Is the diameter within the specified tolerances?
(refer to Table 1 or 2, attached)

If No, stop, the pipe is unacceptable.

Yes No

Is the lap of the longitudinal seam less than specified?
(refer to Table 3, attached)

If Yes, stop, the pipe is unacceptable.

Yes No

Do the corrugations of the pipe have the proper width and height as specified?
(refer to Tables 3 and 4)

If No, stop, the pipe is unacceptable.

Yes No

Are there more than 6 rusty rivets in the pipe?
(This indicates that the rivet is not galvanized.)

If Yes, stop, the pipe is unacceptable.

Yes No

Are there any loose rivets resulting in unacceptable rivet spacing?

If Yes, stop, the pipe is unacceptable.

Yes No

Are there more than 2 defective rivets in a can or more than 1% of the total rivets in the pipe that are defective?

(Defective rivets are those that are severely bent or struck off-center or are too small.)

If Yes, stop, the pipe is unacceptable.

Yes No

Prior to the QA inspection, the fabricator may make the following corrections:

1. Defective rivets may be re-struck or replaced with a correct size rivet or bolt
2. In the case of rivet spacing being too great, additional rivets or bolts may be added
3. A small dent may be hammered out as long as any scrape or other injury created by the hammering is properly re-coated in accordance with the specification



4. A missing rivet may be replaced with a correct size rivet or bolt
5. A small rivet may be replaced with a correct size rivet or bolt
6. A correct rivet or bolt may be placed directly adjacent to a rivet that is too small, or defective, in lieu of replacement

Have you rejected more than 25% of the shipment on the basis of the preceding sections?

If Yes, the entire shipment is to be rejected. Yes No

Helical Lock Seam

The pipe inspected in detail should be the one that appears to have the most instances of poor workmanship and/or materials. This inspection also includes inspection of a coupon containing the lock seam.

Are there any visible cracks in the metal of the finished lock seams?

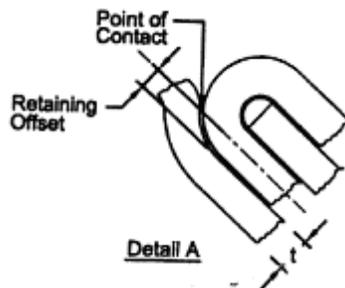
If Yes, stop the pipe is unacceptable. Yes No

Are there any roller indentations (usually indicative of a seam with excessive interior angularity)?

If Yes, stop, the pipe is unacceptable. Yes No

Does the lock seam include the proper retaining offset according to specification? (Refer to Detail A – Retaining offset measured from Point of Contact to parallel surfaces)

If No, stop the pipe is unacceptable. Yes No



Is there excessive interior angularity?

If Yes, stop the pipe is unacceptable. Yes No



Is there at least 5/16" of lap in the cross section of the lock seam?

If No, stop, the pipe is unacceptable. Yes No



Is there any loss of metal to metal contact in the lock seam?
If Yes, stop, the pipe is unacceptable. Yes No

Is the diameter within the specified tolerances?
(refer to Table 1 or 2, attached)
If No, stop, the pipe is unacceptable. Yes No

Are there any deformations from typical shape that are greater than 1/2"
from the specified position?
(Recommended apparatus: Stiff wire to lay on circumference of pipe
over deformation. 1/2" marble or ball bearing to pass under wire."
If Yes, stop, the pipe is unacceptable. Yes No

Are there any scrapes or other injuries to the coating that exposes the
base metal?
If Yes, stop, the pipe is unacceptable. Yes No

Do the corrugations of the pipe have the proper width and
height as specified?
(refer to Tables 3 and 4)
If No, stop, the pipe is unacceptable. Yes No

Prior to the QA inspection, the fabricator may make the following corrections:

1. For scrapes or other injuries, paint may be applied to the exposed area in accordance with the specification
2. A dent may be hammered out as long as any scrape or other injury created by the hammering is properly re-coated in accordance with the specification. (refer to No. 1)

Have you rejected more than 25% of the shipment on the basis of the
preceding sections?
If Yes, the entire shipment is to be rejected. Yes No



TABLE 1				
Diameter Dimensional Tolerances (ENGLISH)				
Specified Inside Diameter, Inch	Lower Tolerance, Inch	Lower Tolerance, mm^a	Upper Tolerance, Inch	Upper Tolerance, mm^a
12	11 8/16	292	12 8/16	318
15	14 8/16	368	15 8/16	394
18	17 8/16	445	18 8/16	470
21	20 8/16	521	21 8/16	546
24	23 8/16	597	24 8/16	622
30	29 8/16	749	30 8/16	775
36	35 8/16	902	36 8/16	927
42	41 8/16	1054	42 8/16	1080
48	47 8/16	1207	48 8/16	1232
54	53 8/16	1358	54 9/16	1385
60	59 7/16	1509	60 10/16	1539
66	65 6/16	1660	66 11/16	1693
72	71 5/16	1811	72 12/16	1847
78	77 4/16	1961	78 13/16	2001
84	83 3/16	2112	84 14/16	2155
90	89 2/16	2264	90 14/16	2308
96	95 1/16	2414	97	2463
102	101	2565	103	2616
108	106 15/16	2716	109 1/16	2770
114	112 14/16	2867	115 2/16	2924
120	118 13/16	3018	121 3/16	3078

^a The metric dimensions have been hard converted from their English counterparts.



TABLE 2				
Diameter Dimensional Tolerances (METRIC)				
Specified Inside Diameter, mm	Lower Tolerance, mm	Lower Tolerance, Inch^a	Upper Tolerance, mm	Upper Tolerance, Inch^a
300	287	11 5/16	313	12 5/16
375	362	14 4/16	388	15 5/16
450	437	17 3/16	463	18 4/16
525	512	20 3/16	538	21 3/16
600	587	23 2/16	613	24 2/16
750	737	29 1/16	763	30 1/16
900	887	34 15/16	913	35 15/16
1050	1037	40 14/16	1063	41 14/16
1200	1187	46 12/16	1213	47 12/16
1350	1337	52 10/16	1364	53 11/16
1500	1485	58 8/16	1515	59 11/16
1650	1634	64 5/16	1667	65 10/16
1800	1782	70 3/16	1818	71 9/16
1950	1931	76	1970	77 9/16
2100	2079	81 14/16	2121	83 8/16
2250	2228	87 12/16	2273	89 8/16
2400	2376	93 9/16	2424	95 7/16
2550	2525	99 7/16	2576	101 7/16
2700	2673	105 4/16	2727	107 6/16
2850	2822	111 2/16	2879	113 6/16
3000	2970	116 15/16	3030	119 5/16

^a The English units have been hard converted from their metric counterparts.



TABLE 3			
Pipe Requirements			
Specified Inside Diameter,	Specified Corrugation Pitch, Inch (mm)	Specified Corrugation Depth, Inch (mm)	Width of Lap
Inch (mm)			Inch (mm), Minimum
12 (300)	2 2/3 (68)	1/2 (13)	1 1/2 (38)
15 (375)	2 2/3 (68)	1/2 (13)	1 1/2 (38)
18 (450)	2 2/3 (68)	1/2 (13)	1 1/2 (38)
21 (525)	2 2/3 (68)	1/2 (13)	1 1/2 (38)
24 (600)	2 2/3 (68)	1/2 (13)	1 1/2 (38)
30 (750)	2 2/3 (68)	1/2 (13)	1 1/2 (38)
36 (900)	2 2/3 (68)	1/2 (13)	1 1/2 (38)
	3 (75)	1 (25)	3 (75)
42 (1050)	2 2/3 (68)	1/2 (13)	3 (75)
	3 (75)	1 (25)	
48 (1200)	2 2/3 (68)	1/2 (13)	3 (75)
	3 (75)	1 (25)	
54 (1350)	2 2/3 (68)	1/2 (13)	3 (75)
	3 (75)	1 (25)	
60 (1500)	2 2/3 (68)	1/2 (13)	3 (75)
	3 (75)	1 (25)	
66 (1650)	2 2/3 (68)	1/2 (13)	3 (75)
	3 (75)	1 (25)	
72 (1800)	2 2/3 (68)	1/2 (13)	3 (75)
	3 (75)	1 (25)	
78 (1950)	2 2/3 (68)	1/2 (13)	3 (75)
	3 (75)	1 (25)	
84 (2100)	2 2/3 (68)	1/2 (13)	3 (75)
	3 (75)	1 (25)	
90 (2250)	3 (75)	1 (25)	3 (75)
96 (2400)	3 (75)	1 (25)	3 (75)
102 (2550)	3 (75)	1 (25)	3 (75)
108 (2700)	3 (75)	1 (25)	3 (75)
114 (2850)	3 (75)	1 (25)	3 (75)
120 (3000)	3 (75)	1 (25)	3 (75)



TABLE 4											
Corrugated Metallic-Coated Steel Circular Pipe											
ENGLISH											
Maximum Allowable Overfill Heights (ft)											
Specified Diameter of Pipe (in.)	Minimum Cover (ft)	Specified Thickness of Coated Steel, in.									
		0.064		0.079		0.109		0.138		0.168	
		A*	B*	A*	B*	A*	B*	A*	B*	A*	B*
12	1	92	---	101	---	---	---	---	---	---	---
15	1	74	---	80	---	---	---	---	---	---	---
18	1	61	---	67	---	---	---	---	---	---	---
21	1	53	---	57	---	---	---	---	---	---	---
24	1	46	---	50	---	65	---	---	---	---	---
30	1	37	---	40	---	52	---	---	---	---	---
36	1	30	---	33	---	43	---	45	---	---	---
42	1	26	---	28	---	37	---	38	---	40	---
48	1	23	39	25	49	32	73	34	88	35	98
54	1	---	35	22	44	28	65	30	78	31	87
60	1	---	31	---	39	26	58	27	70	28	78
66	1	---	28	---	36	---	53	24	64	25	71
72	1	---	26	---	33	---	49	22	58	23	65
78	1	---	24	---	30	---	45	---	54	21	60
84	1	---	22	---	28	---	42	---	50	20	46
90	1	---	21	---	26	---	39	---	47	---	52
96	1	---	---	---	24	---	36	---	44	---	49
102	2	---	---	---	23	---	34	---	41	---	46
108	2	---	---	---	---	---	32	---	39	---	43
114	2	---	---	---	---	---	30	---	37	---	41
120	2	---	---	---	---	---	29	---	35	---	39
126	2	---	---	---	---	---	---	---	33	---	37
132	2	---	---	---	---	---	---	---	32	---	35
138	2	---	---	---	---	---	---	---	30	---	34
144	2	---	---	---	---	---	---	---	---	---	32

* A = 2 2/3 by 1/2-inch corrugations

B = 3 by 1-inch corrugations

Note: It is the responsibility of the inspector to confirm that this table is in accordance with the Standard Plans.

