COMMONWEALTH of VIRGINIA

DEPARTMENT OF TRANSPORTATION
1401 EAST BROAD STREET
RICHMOND, VIRGINIA 23219 2000

Charles A. Kilpatrick, P.E.
Commissioner

October 30, 2015

MEMORANDUM

To: All Holders of the Virginia Department of Transportation's 2008 Road and Bridge Standards

The following is a list of sheets contained in the 2008 Road and Bridge Standards that have been revised. Please add this page to your copy of the standards. An interim standard sheet will not be required in plan assemblies for the following sheet only. Changes to this sheet will not affect the basis of payment or estimates.

PAGE	REVISION
100.04	Revised index to reflect revised standard sheets.

The following is a list of revised standards to the 2008 Road and Bridge Standards that ***require*** an interim standard sheet to be in included in your plan assembly until the next edition of the standards is published. Please add these pages to your copy of the standards. The respective interim standard sheet number has been placed with the revised standard. The interim standard sheets are available on VDOT's web site, on the FTP server, and in Falcon DMS for VDOT personnel. Note that the revised Interim Standard Sheets dated 11/15 will be applicable to Tier 1 projects going to Advertisement on February 23, 2016 (Non Federally Eligible), March 8, 2016 (Federally Eligible) and Tier 2 projects going to Advertisement on June 14, 2016.

PAGE	INTERIM	STANDARD	REVISION
107.05	IIS01_107_05	PC-1	VALIDATED COVER HEIGHTS FOR HL-93 LOADING. REVISED NOTES.
107.06	IIS01_107_06	PC-1	VALIDATED COVER HEIGHTS FOR HL-93 LOADING. REVISED NOTES.

PAGE	INTERIM	STANDARD	REVISION
107.07	IIS01_107_07	PC-1	REVISED COVER HEIGHTS FOR HL-93 LOADING. ADDED CHART FOR 5”x1” CORRUGATIONS. REVISED NOTES.
107.08	IIS01_107_08	PC-1	REVISED COVER HEIGHTS FOR HL-93 LOADING. REVISED NOTES.
107.09	IIS01_107_09	PC-1	DELETED ALUMINUM ALLOY PIPE. REVIEWED COVER HEIGHTS FOR HL-93 LOADING. REVISED NOTES.
107.10	IIS01_107_10	PC-1	REVIEWED COVER HEIGHTS FOR HL-93 LOADING. REVISED NOTES.
107.11	IIS01_107_11	PC-1	REVIEWED COVER HEIGHTS FOR HL-93 LOADING. REVISED NOTES.
107.12	IIS01_107_12	PC-1	REVISED COVER HEIGHTS FOR HL-93 LOADING. REVISED NOTES.
107.13	IIS01_107_13	PC-1	REVIEWED COVER HEIGHTS FOR HL-93 LOADING. REVISED NOTES.
107.14	IIS01_107_14	PC-1	REVIEWED COVER HEIGHTS FOR HL-93 LOADING. REVISED NOTES.
107.15	IIS01_107_15	PC-1	REVIEWED COVER HEIGHTS FOR HL-93 LOADING. REVISED NOTES.
107.16	IIS01_107_16	PC-1	REVISED COVER HEIGHTS FOR HL-93 LOADING. REVISED NOTES.
107.17	IIS01_107_17	PC-1	REVISED COVER HEIGHTS FOR HL-93 LOADING. REVISED NOTES.
107.18	IIS01_107_18	PC-1	REVIEWED COVER HEIGHTS FOR HL-93 LOADING. REVISED NOTES.
107.19	IIS01_107_19	PC-1	REVISED COVER HEIGHTS FOR HL-93 LOADING. REVISED NOTES.

PAGE	INTERIM	STANDARD	REVISION
107.20	IIS01_107_20	PC-1	REVISED TABLE A TO REFLECT UPDATED PIPE DESCRIPTIONS AND TO REQUIRE A 75 YEAR DESIGN LIFE FOR HFC ROADWAYS AND 50 YEAR DESIGN LIFE FOR LFC ROADWAYS. REVISED NOTES.
107.21	IIS01_107_21	PC-1	REVISED TABLE A1 TO REFLECT UPDATED PIPE DESCRIPTIONS AND TO REQUIRE A 75 YEAR DESIGN LIFE FOR HFC ROADWAYS AND 50 YEAR DESIGN LIFE FOR LFC ROADWAYS. REVISED TABLE C TO REFLECT UPDATED PIPE DESCRIPTIONS. REVISED NOTES.
107.22	IIS01_107_22	PC-1	NEW SHEET FOR TABLE D FOR REQUIRED METAL GAUGE THICKNESS.

If you have any questions or comments regarding this revision, please contact Chuck Patterson P.E., at (804) 786-1805, of the Standards and Special Design Section.

Sincerely,

Signature on File Date: October 30, 2015

B. A. Thrasher, P.E.
State Location & Design Engineer

PC-1

DIAMETER INCHES	AREA SQ. FT.	MAXIMUM HEIGHT OF COVER IN FEET				DIAMETER INCHES
		NONREINFORCED CONCRETE (STRENGTH) (SEE NOTE 4)	REINFORCED CONCRETE CLASS			
			III	IV	V	
12	0.8	14' (1800)	14'	19'	29'	12
15	1.2	14' (2125)	14'	19'	29'	15
18	1.8	14' (2400)	14'	20'	29'	18
21	2.4	13' (2700)	14'	20'	29'	21
24	3.1	13' (3000)	14'	20'	29'	24
27	4.0		14'	20'	29'	27
30	4.9		14'	20'	29'	30
33	5.9		14'	20'	29'	33
36	7.1		14'	20'	30'	36
42	9.6		14'	21'	30'	42
48	12.6		14'	21'	30'	48
54	15.9		14'	21'	30'	54
60	19.6		14'	21'	30'	60
66	23.8		14'	21'	30'	66
72	28.3		14'	21'	30'	72
78	33.2		14'	21'	30'	78
84	38.5		14'	21'	30'	84
90	44.4		14'	21'	30'	90
96	50.3		14'	21'	30'	96
102	56.7		14'	21'	30'	102
108	63.6		14'	21'	30'	108

NOTES:

1. COVER HEIGHTS INDICATED IN TABLES ARE FOR FINISHED CONSTRUCTION. THE COVER HEIGHTS WERE RETAINED TO MATCH FORMER COVER HEIGHTS BASED ON ALLOWABLE STRESS DESIGN. COVER HEIGHTS WERE NOT RE-CALCULATED USING LRFD.
2. TO PROTECT PIPE DURING CONSTRUCTION, MINIMUM HEIGHTS OF COVER PRIOR TO ALLOWING CONSTRUCTION TRAFFIC TO CROSS INSTALLATION ARE TO BE 1/2 DIAMETER OR 3'0", WHICHEVER IS GREATER. THE COVER SHALL EXTEND THE FULL LENGTH OF THE PIPE. THE APPROACH FILL RAMP IS TO EXTEND A MINIMUM OF 10(DIAMETER + 36") ON EACH SIDE OF THE PIPE, OR TO THE INTERSECTION WITH A CUT.
3. STANDARD MINIMUM FINISHED HEIGHT OF COVER FOR ALL PIPES, EXCEPT THOSE UNDER ENTRANCES, SHALL BE 2.0' OR 1/2 DIAMETER, WHICHEVER IS GREATER. IN CASES IN WHICH THESE COVER HEIGHTS CANNOT BE ACHIEVED, AN ABSOLUTE MINIMUM FINISHED COVER HEIGHT OF 1.0' WILL BE ALLOWED ONLY IF ALL POSSIBLE MEANS TO OBTAIN THE STANDARD VALUE HAVE BEEN EXHAUSTED. THE MINIMUM FINISHED HEIGHT OF COVER FOR PIPES UNDER ENTRANCES IS 9".
4. CRUSHING STRENGTH (POUNDS PER LINEAR FOOT ULTIMATE STRENGTH) PER ASTM C76:
   2000 LBS FOR CLASS III PIPE
   3000 LBS FOR CLASS IV PIPE
   3750 LBS FOR CLASS V PIPE
5. FOR HEIGHT OF COVER GREATER THAN THAT SHOWN FOR CLASS V, A SPECIAL DESIGN CONCRETE PIPE IS REQUIRED.
6. NONREINFORCED PIPE TO BE USED ONLY UNDER ENTRANCES AND LOWER FUNCTIONAL CLASSIFICATION (LFC) ROADWAYS (SEE SHEET 17 OF 18).
7. SEE STANDARD PB-1 FOR PIPE BEDDING AND BACKFILL REQUIREMENTS.
8. PIPE WITH LESS THAN THE STANDARD MINIMUM COVER IS TO BE MINIMUM CLASS III REINFORCED.

VDOT
ROAD AND BRIDGE STANDARDS

SHEET 1 OF 18 | REVISION DATE 11/15

107.05

CONCRETE PIPE
HEIGHT OF COVER TABLE FOR HL-93 LIVE LOAD

VIRGINIA DEPARTMENT OF TRANSPORTATION

SPECIFICATION REFERENCE

302
232

HORIZONTAL INSTALLATION

EQUIVALENT ROUND SIZE INCHES	SPAN X RISE INCHES	MAX. HEIGHT OF COVER IN FEET CLASS HE - III	MAX. HEIGHT OF COVER IN FEET CLASS HE - IV
18	23 x 14	13'	21'
24	30 x 19	13'	21'
27	34 x 22	13'	21'
30	38 x 24	13'	21'
33	42 x 27	13'	21'
36	45 x 29	13'	21'
39	49 x 32	13'	21'
42	53 x 34	13'	21'
48	60 x 38	13'	21'
54	68 x 43	13'	21'
60	76 x 48	13'	21'
66	83 x 53	13'	21'
72	91 x 58	13'	21'
78	98 x 63	13'	21'
84	106 x 68	13'	21'

VERTICAL INSTALLATION

SPAN X RISE INCHES	MAX. HEIGHT OF COVER IN FEET CLASS VE - III	MAX. HEIGHT OF COVER IN FEET CLASS VE - IV	MAX. HEIGHT OF COVER IN FEET CLASS VE - V
29 x 45	13	21	29
32 x 49	13	21	29
34 x 53	13	21	29
38 x 60	13	21	29
43 x 68	13	21	29
48 x 76	13	21	29
53 x 83	13	21	29
58 x 91	13	21	29
63 x 98	13	21	29
68 x 106	13	21	29

NOTES:

1. COVER HEIGHTS INDICATED IN TABLES ARE FOR FINISHED CONSTRUCTION. THE COVER HEIGHTS WERE RETAINED TO MATCH FORMER COVER HEIGHTS BASED ON ALLOWABLE STRESS DESIGN. COVER HEIGHTS WERE NOT RE-CALCULATED USING LRFD.
2. TO PROTECT PIPE DURING CONSTRUCTION, MINIMUM HEIGHTS OF COVER PRIOR TO ALLOWING CONSTRUCTION TRAFFIC TO CROSS INSTALLATION ARE TO BE ½ SPAN OR 3', WHICHEVER IS GREATER. THE COVER SHALL EXTEND THE FULL LENGTH OF THE PIPE. THE APPROACH FILL RAMP IS TO EXTEND A MINIMUM OF 10(SPAN + 36") ON EACH SIDE OF THE PIPE OR TO THE INTERSECTION WITH A CUT.
3. STANDARD MINIMUM FINISHED HEIGHT OF COVER FOR ALL PIPES SHALL BE 2.0' OR ½ SPAN, WHICHEVER IS GREATER. IN CASES IN WHICH THESE COVER HEIGHTS CANNOT BE ACHIEVED, AN ABSOLUTE MINIMUM FINSHED COVER HEIGHT OF 1.0' WILL BE ALLOWED ONLY IF ALL POSSIBLE MEANS TO OBTAIN THE STANDARD VALUE HAVE BEEN EXHAUSTED. MINIMUM FINISHED HEIGHT OF COVER FOR PIPE UNDER ENTRANCES IS 9".
4. SEE STANDARD PB-1 FOR PIPE BEDDING AND BACKFILL REQUIREMENTS.

SPECIFICATION REFERENCE	REINFORCED ELLIPTICAL CONCRETE PIPE HEIGHT OF COVER TABLES FOR HL-93 LIVE LOAD	VDOT ROAD AND BRIDGE STANDARDS
302 232	VIRGINIA DEPARTMENT OF TRANSPORTATION	REVISION DATE 11/15 · SHEET 2 OF 18 · 107.06

PC-1

CORRUGATED STEEL PIPE
2 2/3" x 1/2" CORRUGATIONS

PIPE DIAMETER INCHES	AREA SQ. FT.	MAXIMUM HEIGHT OF COVER IN FEET — SHEET THICKNESS IN INCHES (GAUGE)					MINIMUM SHEET THICKNESS FOR ENTRANCE PIPES WITH LESS THAN 1 FT COVER INCHES (GAUGE)
		0.064 (16)	0.079 (14)	0.109 (12)	0.138 (10)	0.168 (8)	
12	0.79	233	291				0.064 (16)
15	1.23	186	233				0.064 (16)
18	1.77	155	194	272			0.064 (16)
21	2.40	132	166	233			0.064 (16)
24	3.14	116	145	203			0.064 (16)
27	3.98	102	128	180			0.064 (16)
30	4.91	92	115	162			0.064 (16)
33	5.94	83	105	147	190		0.064 (16)
36	7.1	76	96	135	174		0.064 (16)
42	9.6	65	81	115	149	182	0.064 (16)
48	12.6	56	71	100	130	159	0.064 (16)
54	16.0		63	89	115	141	0.079 (14)
60	19.6			79	103	126	0.109 (12)
66	23.8				93	114	0.138 (10)
72	28.3				85	105	0.138 (10)
78	33.2					96	0.168 (8)
84	38.5					89	0.168 (8)

NOTES:

1. COVER HEIGHTS INDICATED IN TABLES ARE FOR FINISHED CONSTRUCTION, USING AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS AND ASSUMING 25% METAL LOSS AT END OF DESIGN LIFE.
2. TO PROTECT PIPE DURING CONSTRUCTION, MINIMUM HEIGHT OF COVER TO BE IN ACCORDANCE WITH TABLE A PRIOR TO ALLOWING CONSTRUCTION TRAFFIC TO CROSS INSTALLATION. THE COVER SHALL EXTEND THE FULL LENGTH OF THE PIPE. THE APPROACH FILL RAMP IS TO EXTEND A MINIMUM OF 15 DIAMETERS ON EACH SIDE OF THE PIPE OR THE INTERSECTION WITH A CUT.
3. STANDARD MINIMUM FINISHED HEIGHT OF COVER FOR ALL PIPES, EXCEPT UNDER ENTRANCES, SHALL BE 2.0' OR 1/2 DIAMETER, WHICHEVER IS GREATER. IN CASES IN WHICH THESE COVER HEIGHTS CANNOT BE ACHIEVED, AN ABSOLUTE MINIMUM FINISHED COVER HEIGHT OF 1.0' OR 1/8 DIAMETER, WHICHEVER IS GREATER, WILL BE ALLOWED ONLY IF ALL POSSIBLE MEANS TO OBTAIN THE STANDARD VALUE HAVE BEEN EXHAUSTED. THE MINIMUM FINISHED HEIGHT OF COVER FOR PIPES UNDER ENTRANCES IS 9" FOR PIPE DIAMETERS LESS THAN OR EQUAL TO 24" AND 12" OR 1/8 DIAMETER, WHICHEVER IS GREATER, FOR PIPE DIAMETERS GREATER THAN 24". WHERE A POLYMER COATED PIPE WILL BE USED AND THE SURFACE OVER THE TOP OF THE PIPE WILL BE ASPHALT, CLASS I BACKFILL MATERIAL IS TO BE PLACED UP TO A MINIMUM OF 6" ABOVE THE TOP OF THE PIPE.
4. SEE STANDARD PB-1 FOR PIPE BEDDING AND BACKFILL REQUIREMENTS.

TABLE A	
PIPE DIAMETER	MINIMUM COVER HEIGHT DURING CONSTRUCTION (SEE NOTE 2)
12" TO 33"	18"
36" AND ABOVE	1/2 DIAMETER

CONCRETE- LINED CORRUGATED STEEL PIPE
MAXIMUM HEIGHT OF COVER TO BE IN ACCORDANCE WITH THE TABLES BUT SHALL NOT EXCEED 30'.

CORRUGATED STEEL PIPE
3" x 1" CORRUGATIONS

PIPE DIAMETER INCHES	AREA SQ. FT.	MAXIMUM HEIGHT OF COVER IN FEET — SHEET THICKNESS IN INCHES (GAUGE)				
		0.064 (16)	0.079 (14)	0.109 (12)	0.138 (10)	0.168 (8)
36	7.1	88	110	155	200	246
42	9.6	75	94	133	171	210
48	12.6	65	82	116	149	183
54	16.0	57	72	102	132	163
60	19.6	51	65	92	119	146
66	23.8	46	58	83	108	132
72	28.3	42	53	76	98	121
78	33.2	38	49	69	90	111
84	38.5	35	45	64	83	103
90	44.2	32	41	59	77	96
96	50.3		38	55	72	89
102	56.7		36	52	68	84
108	63.6			49	64	80
114	70.9			45	60	74
120	78.5			43	56	70
132	95.0				51	63
144	113.0					57

CORRUGATED STEEL PIPE
5" x 1" CORRUGATIONS

PIPE DIAMETER INCHES	AREA SQ. FT.	MAXIMUM HEIGHT OF COVER IN FEET — SHEET THICKNESS IN INCHES (GAUGE)				
		0.064 (16)	0.079 (14)	0.109 (12)	0.138 (10)	0.168 (8)
36	7.1	78	98	138	178	218
42	9.6	66	84	118	152	187
48	12.6	58	73	103	133	163
54	16.0	51	64	91	118	144
60	19.6	45	57	81	105	130
66	23.8	41	52	74	95	117
72	28.3	37	47	67	87	107
78	33.2	34	43	61	80	99
84	38.5	31	39	57	74	91
90	44.2	28	36	53	69	85
96	50.3		34	49	64	79
102	56.7		31	46	60	74
108	63.6			43	56	69
114	70.9			40	53	65
120	78.5			38	50	62
132	95.0				44	55
144	113.0					50

VDOT
ROAD AND BRIDGE STANDARDS

CORRUGATED STEEL PIPE
HEIGHT OF COVER TABLES FOR HL-93 LIVE LOAD

VIRGINIA DEPARTMENT OF TRANSPORTATION

SPECIFICATION REFERENCE
302
232

SHEET 3 OF 18
107.07

REVISION DATE
11/15

CORRUGATED ALUMINUM ALLOY PIPE- 2 2/3" x 1/2" CORRUGATIONS

PIPE DIAMETER INCHES	AREA SQ. FT.	MAXIMUM HEIGHT OF COVER IN FEET — SHEET THICKNESS IN INCHES (GAUGE)					MINIMUM SHEET THICKNESS FOR ENTRANCE PIPES WITH LESS THAN 1 FT. COVER (GAUGE)
		0.060 (16)	0.075 (14)	0.105 (12)	0.135 (10)	0.164 (8)	
12	0.8	141	176	247	318	389	16
15	1.2	112	141	197	254	311	16
18	1.8	93	117	164	212	259	16
21	2.4	80	100	140	181	221	16
24	3.1	69	87	123	158	193	16
27	4.0		77	109	140	172	14
30	4.9		69	98	126	154	14
33	5.9		63	88	114	140	14
36	7.1		57	81	105	128	14
42	9.6			69	89	109	12
48	12.6			60	78	95	12
54	15.9			53	69	84	12
60	19.6				61	75	10
66	23.8					68	8
72	28.3					62	8

CORRUGATED ALUMINUM ALLOY PIPE- 3" x 1" CORRUGATIONS

PIPE DIAMETER INCHES	AREA SQ. FT.	MAXIMUM HEIGHT OF COVER IN FEET — SHEET THICKNESS IN INCHES (GAUGE)				
		0.060 (16)	0.075 (14)	0.105 (12)	0.135 (10)	0.164 (8)
36	7.1	52	66	93	126	148
42	9.6	44	56	80	107	127
48	12.6	38	49	69	93	110
54	16.0	34	43	61	83	98
60	19.6	30	38	54	74	87
66	23.8	26	34	49	67	79
72	28.3	24	31	45	61	72
78	33.2		28	41	56	66
84	38.5			37	51	61
90	44.2			34	47	57
96	50.3			32	44	53
102	56.7				41	49
108	63.6				38	46
114	70.9					43
120	78.5					41

NOTES:

1. COVER HEIGHTS INDICATED IN TABLES ARE FOR FINISHED CONSTRUCTION, USING AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS AND ASSUMING 25% METAL LOSS AT END OF DESIGN LIFE.
2. TO PROTECT PIPE DURING CONSTRUCTION, MINIMUM HEIGHT OF COVER TO BE IN ACCORDANCE WITH TABLE A PRIOR TO ALLOWING CONSTRUCTION TRAFFIC TO CROSS INSTALLATION. THE COVER SHALL EXTEND THE FULL LENGTH OF THE PIPE. THE APPROACH FILL RAMP IS TO EXTEND A MINIMUM OF 20 DIAMETERS ON EACH SIDE OF THE PIPE OR THE INTERSECTION WITH A CUT.
3. STANDARD MINIMUM FINISHED HEIGHT OF COVER FOR ALL PIPES, EXCEPT THOSE UNDER ENTRANCES, SHALL BE 2.0' OR 1/2 DIAMETER, WHICHEVER IS GREATER. IN CASES IN WHICH THESE COVER HEIGHTS CANNOT BE ACHIEVED, AN ABSOLUTE MINIMUM FINISHED COVER HEIGHT OF 1.0' OR 1/8 DIAMETER, WHICHEVER IS GREATER, WILL BE ALLOWED ONLY IF ALL POSSIBLE MEANS TO OBTAIN THE STANDARD VALUE HAVE BEEN EXHAUSTED. THE MINIMUM FINISHED HEIGHT OF COVER FOR PIPES UNDER ENTRANCES IS 9" FOR PIPE DIAMETERS EQUAL TO OR LESS THAN 18" AND 12" OR 1/8 DIAMETER, WHICHEVER IS GREATER, FOR PIPE DIAMETERS GREATER THAN 18".
4. SEE STANDARD PB-1 FOR PIPE BEDDING AND BACKFILL REQUIREMENTS.

TABLE A

PIPE DIAMETER	MINIMUM COVER HEIGHT DURING CONSTRUCTION (SEE NOTE 2)
12" TO 27"	18"
30" AND OVER	EQUAL TO DIAMETER

SPECIFICATION REFERENCE

232
302

CORRUGATED ALUMINUM ALLOY PIPE HEIGHT OF COVER TABLE FOR HL-93 LIVE LOAD

VIRGINIA DEPARTMENT OF TRANSPORTATION

VDOT
ROAD AND BRIDGE STANDARDS

REVISION DATE 11/15

PC-1

MINIMUM SHEET THICKNESS AND DESIGN DATA

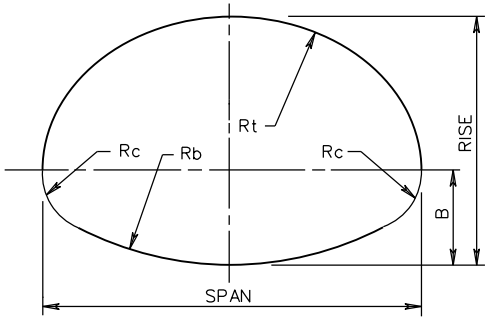
PIPE ARCH DIMENSION					MINIMUM SHEET THICKNESS REQUIRED	MAXIMUM COVER HEIGHT IN FEET	
						MAXIMUM CORNER PRESSURE	
NOMINAL SIZE SPAN - RISE INCHES	EQUIVALENT PIPE DIAMETER INCHES	AREA SQ. FT.	MAXIMUM "B" INCHES (SEE NOTE 7)	Rc INCHES	INCHES (GAUGE)	4000 LBS./SQ. FT. (SEE NOTE 4)	6000 LBS./SQ. FT. (SEE NOTE 6)
2 2/3" x 1/2" CORRUGATIONS							
17 x 13	15	1.1	5¼"	3	0.064 (16)	11	17
21 x 15	18	1.6	6"	3	0.064 (16)	9	14
24 x 18	21	2.2	7¼"	3	0.064 (16)	8	12
28 x 20	24	2.8	8"	3	0.064 (16)	7	10
35 x 24	30	4.4	9½"	3	0.064 (16)	5	8
42 x 29 ⊛	36	6.4	10½"	3½	0.064 (16)	5	8
49 x 33 ⊛	42	8.7	11½"	4	0.079 (14)	5	8
57 x 38 ⊛	48	11.4	13½"	5	0.109 (12)	5	8
64 x 43 ⊛	54	14.3	15"	6	0.109 (12)	6	9
71 x 47 ⊛	60	17.6	16½"	7	0.138 (10)	6	9
77 x 52 ⊛	66	21.3	18"	8	0.168 (8)	6	10
83 x 57 ⊛	72	25.3	20"	9	0.168 (8)	7	10
3" x 1" AND 5" x 1" CORRUGATIONS							
40 x 31 ⊛	36	6.4	9¾"	5	0.109 (12)	8	12
46 x 36 ⊛	42	8.7	11½"	6	0.109 (12)	8	12
53 x 41 ⊛	48	11.4	13"	7	0.109 (12)	8	13
60 x 46 ⊛	54	14.3	14¾"	8	0.109 (12)	8	13
66 x 51 ⊛	60	17.6	16½"	9	0.109 (12)	9	13
73 x 55 ⊛	66	22.0	21½"	12	0.109 (12)	11	16
81 x 59 ⊛	72	26.0	23"	14	0.109 (12)	11	17
87 x 63	78	31.0	24½"	14	0.109 (12)	10	16
95 x 67	84	35.0	26½"	16	0.109 (12)	11	16
103 x 71	90	40.0	27"	16	0.109 (12)	10	15
112 x 75	96	46.0	29"	18	0.109 (12)	10	16
117 x 79	102	52.0	30¾"	18	0.109 (12)	10	15
128 x 83	108	58.0	29½"	18	0.138 (10)	9	14
137 x 87	114	64.0	30¾"	18	0.138 (10)	8	13
142 x 91	120	71.0	32½"	18	0.168 (8)	8	12

⊛ INDICATES PIPE ARCHES FOR WHICH DIMENSIONS FOR EITHER CORRUGATION MAY BE USED WITHIN HEIGHT OF COVER LIMITATIONS.

NOTES:

1. COVER HEIGHTS INDICATED IN TABLES ARE FOR FINISHED CONSTRUCTION WHICH MATCH FORMER VDOT ALLOWABLE STRESS DESIGN TABLES. COVER HEIGHTS WERE NOT RE-CALCULATED USING LRFD
2. TO PROTECT PIPE DURING CONSTRUCTION, MINIMUM HEIGHT OF COVER TO BE IN ACCORDANCE WITH TABLE A PRIOR TO ALLOWING CONSTRUCTION TRAFFIC TO CROSS INSTALLATION. THE COVER SHALL EXTEND THE FULL LENGTH OF THE PIPE ARCH. THE APPROACH FILL RAMP IS TO EXTEND A MINIMUM OF 10(HEIGHT + ½ SPAN) ON EACH SIDE OF THE PIPE, OR TO THE INTERSECTION WITH A CUT.
3. STANDARD MINIMUM FINISHED HEIGHT OF COVER FOR ALL PIPES SHALL BE 2'0" OR ½ SPAN, WHICHEVER IS GREATER. IN CASES IN WHICH THESE COVER HEIGHTS CANNOT BE ACHIEVED, AN ABSOLUTE MINIMUM FINSHED COVER HEIGHT OF 1.0' OR ⅛ SPAN, WHICHEVER IS GREATER, WILL BE ALLOWED ONLY IF ALL POSSIBLE MEANS TO OBTAIN THE STANDARD VALUE HAVE BEEN EXHAUSTED. WHERE POLYMER COATED PIPE WILL BE USED AND THE SURFACE OVER THE TOP OF THE PIPE WILL BE ASPHALT, CLASS I BACKFILL MATERIAL IS TO BE PLACED UP TO A MINIMUM OF 6" ABOVE THE TOP OF THE PIPE.
4. SEE STANDARD PB-1 FOR PIPE BEDDING AND BACKFILL REQUIREMENTS.
5. THE MAXIMUM HEIGHT OF COVER SHOWN IN THE TABLES IS BASED ON A SOIL MODULUS OF 700 PSI. ALL OTHER DESIGN CRITERIA ARE IN ACCORDANCE WITH THE AASHTO SPECIFICATIONS AND VDOT MODIFICATIONS FOR SOIL CORRUGATED METAL STRUCTURE INTERACTION SYSTEMS.
6. WHEN DESIGN HEIGHT OF COVER REQUIRES THE USE OF THIS CATEGORY OF PIPE, FOUNDATION AND BACKFILL MUST BE APPROVED BY THE ENGINEER.
7. SPAN OF PIPE ARCHES IS MEASURED "B" INCHES ABOVE THE INVERT. SEE DIAGRAM BELOW FOR ILLUSTRATION OF "B" DIMENSION.

TABLE A	
PIPE ARCH SPAN	MINIMUM COVER HEIGHT DURING CONSTRUCTION (SEE NOTE 2)
17" TO 35"	18"
42" AND ABOVE	½ SPAN



VDOT
ROAD AND BRIDGE STANDARDS

CORRUGATED STEEL PIPE ARCH
HEIGHT OF COVER TABLE FOR HL-93 LIVE LOAD

VIRGINIA DEPARTMENT OF TRANSPORTATION

SHEET 5 OF 18 | REVISION DATE 11/15
107.09

SPECIFICATION REFERENCE
232
302

MINIMUM SHEET THICKNESS AND DESIGN DATA

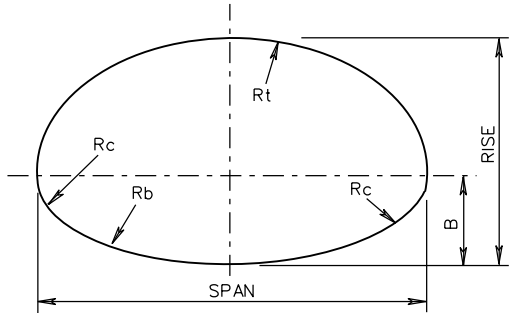
PIPE ARCH DIMENSION				MINIMUM SHEET THICKNESS REQUIRED	MAXIMUM COVER HEIGHT IN FEET	
					MAXIMUM CORNER PRESSURE	
NOMINAL SIZE SPAN-RISE INCHES	EQUIVALENT PIPE DIAMETER INCHES	AREA SQ. FT.	Rc INCHES	INCHES (GAUGE)	4000 LBS./SQ. FT. (SEE NOTE 4)	6000 LBS./SQ. FT. (SEE NOTE 6)
2 2/3" x ½" CORRUGATIONS						
17 x 13	15	1.1	3"	0.060 (16)	11	17
21 x 15	18	1.6	3"	0.060 (16)	9	14
24 x 18	21	2.2	3"	0.060 (16)	8	12
28 x 20	24	2.8	3"	0.075 (14)	7	10
35 x 24	30	4.4	3"	0.075 (14)	5	8
42 x 29 ⊛	36	6.4	3½"	0.105 (12)	5	8
49 x 33 ⊛	42	8.7	4"	0.105 (12)	5	8
57 x 38 ⊛	48	11.4	5"	0.135 (10)	5	8
64 x 43 ⊛	54	14.3	6"	0.135 (10)	6	9
71 x 47 ⊛	60	17.6	7"	0.164 (8)	6	9
3" x 1" CORRUGATIONS						
40 x 31 ⊛	36	6.4	5"	0.060 (16)	8	12
46 x 36 ⊛	42	8.7	6"	0.060 (16)	8	12
53 x 41 ⊛	48	11.4	7"	0.060 (16)	8	13
60 x 46 ⊛	54	14.3	8"	0.075 (14)	8	13
66 x 51 ⊛	60	17.6	9"	0.075 (14)	9	13
73 x 55	66	22.0	12"	0.105 (12)	11	16
81 x 59	72	26.0	14"	0.105 (12)	11	17
87 x 63	78	31.0	14"	0.135 (10)	10	16
95 x 67	84	35.0	16"	0.135 (10)	11	16
103 x 71	90	40.0	16"	0.164 (8)	10	15
112 x 75	96	46.0	18"	0.164 (8)	10	13
117 x 79	102	52.0	18"	0.164 (8)	10	11

⊛ INDICATES PIPE ARCHES FOR WHICH DIMENSIONS FOR EITHER CORRUGATION MAY BE USED WITHIN HEIGHT OF COVER LIMITATIONS.

NOTES:

1. COVER HEIGHTS INDICATED IN TABLES ARE FOR FINISHED CONSTRUCTION WHICH MATCH FORMER VDOT ALLOWABLE STRESS DESIGN TABLES. COVER HEIGHTS WERE NOT RE-CALCULATED USING LRFD
2. TO PROTECT PIPE DURING CONSTRUCTION, MINIMUM HEIGHT OF COVER TO BE IN ACCORDANCE WITH TABLE A PRIOR TO ALLOWING CONSTRUCTION TRAFFIC TO CROSS INSTALLATION. THE COVER SHALL EXTEND THE FULL LENGTH OF THE PIPE ARCH. THE APPROACH FILL RAMP IS TO EXTEND A MINIMUM OF 10(HEIGHT + ½ SPAN) ON EACH SIDE OF THE STRUCTURE OR TO THE INTERSECTION WITH A CUT.
3. STANDARD MINIMUM FINISHED HEIGHT OF COVER FOR ALL PIPES SHALL BE 2'0" OR ⅛ SPAN, WHICHEVER IS GREATER. IN CASES IN WHICH THESE COVER HEIGHTS CANNOT BE ACHIEVED, AN ABSOLUTE MINIMUM FINISHED COVER HEIGHT OF 1.0' OR ⅛ SPAN, WHICHEVER IS GREATER, WILL BE ALLOWED ONLY IF ALL POSSIBLE MEANS TO OBTAIN THE STANDARD VALUE HAVE BEEN EXHAUSTED.
4. SEE STANDARD PB-1 FOR PIPE BEDDING AND BACKFILL REQUIREMENTS.
5. THE MAXIMUM HEIGHT OF COVER SHOWN IN THE TABLES IS BASED ON A SOIL MODULUS OF 700 PSI. ALL OTHER DESIGN CRITERIA ARE IN ACCORDANCE WITH THE AASHTO SPECIFICATIONS AND VDOT MODIFICATIONS FOR SOIL CORRUGATED METAL STRUCTURE INTERACTION SYSTEMS.
6. WHEN DESIGN HEIGHT OF COVER REQUIRES THE USE OF THIS CATEGORY OF PIPE BEDDING FOUNDATION AND BACKFILL MUST BE APPROVED BY THE ENGINEER.
7. LAPPED LONGITUDINAL SEAMS SHALL BE STAGGERED SO AS TO ALTERNATE ON EACH SIDE OF THE CENTER OF ARCH TOP BY APPROXIMATELY 15 PERCENT OF THE PERIPHERY.
8. A TOLERANCE OF PLUS, OR MINUS, 1" IS PERMISSIBLE FOR DIMENSIONS OF SPAN, RISE, AND CORNER RADIUS.

TABLE A	
PIPE DIAMETER	MINIMUM COVER HEIGHT DURING CONSTRUCTION (SEE NOTE 2)
17" TO 35"	18"
42" AND ABOVE	½ SPAN



SPECIFICATION REFERENCE

232

302

CORRUGATED ALUMINUM ALLOY PIPE ARCH HEIGHT OF COVER TABLE FOR HL-93 LIVE LOAD

VIRGINIA DEPARTMENT OF TRANSPORTATION

VDOT ROAD AND BRIDGE STANDARDS

REVISION DATE 11/15

SHEET 6 OF 18

107.10

PC-1

STRUCTURAL PLATE STEEL PIPE- 6" x 2" CORRUGATIONS

PIPE DIAMETER INCHES	AREA SQ. FT.	MINIMUM HEIGHT OF COVER IN FEET — SHEET THICKNESS IN INCHES (GAUGE)						
		0.11 (12)	0.14 (10)	0.17 (8)	0.188 (7)	0.218 (5)	0.249 (3)	0.280 (1)
60	20	91	118	145	163	191	218	246
66	24	83	107	132	148	173	198	224
72	28	75	98	120	135	158	181	205
78	33	69	90	111	124	146	167	188
84	38	64	83	103	115	135	154	175
90	44	59	77	95	107	126	144	163
96	50	55	72	89	100	117	134	152
102	57	51	67	83	94	110	126	143
108	64	48	63	78	88	104	119	134
114	71	45	60	74	83	98	112	127
120	78	43	56	70	79	92	106	120
132	95	38	50	63	71	83	96	109
144	113	34	45	57	64	76	87	99
156	133	31	41	52	58	69	80	91
168	154	28	38	47	54	63	73	83
180	177	25	34	43	49	59	68	77
192	201		31	40	45	54	63	72
204	227		29	37	42	50	58	67
216	254			34	39	47	54	62
228	284			31	36	44	51	58
240	314				34	41	48	55

NOTES:

1. COVER HEIGHTS INDICATED IN TABLE ARE FOR FINISHED CONSTRUCTION, USING AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS AND ASSUMING 25% METAL LOSS AT END OF DESIGN LIFE.
2. TO PROTECT PIPE DURING CONSTRUCTION MINIMUM HEIGHT OF COVER PRIOR TO ALLOWING CONSTRUCTION TRAFFIC TO CROSS INSTALLATION IS TO BE 1*2 DIAMETER. THIS COVER SHALL EXTEND THE FULL LENGTH OF THE PIPE. THE APPROACH FILL RAMP IS TO EXTEND A MINIMUM OF 10(DIAMETER + 36") ON EACH SIDE OF THE PIPE OR TO THE INTERSECTION WITH A CUT.
3. STANDARD MINIMUM FINISHED HEIGHT OF COVER FOR ALL PIPES SHALL BE 2.0' OR 1*2 DIAMETER, WHICHEVER IS GREATER. IN CASES IN WHICH THESE COVER HEIGHTS CANNOT BE ACHIEVED, AN ABSOLUTE MINIMUM FINISHED COVER HEIGHT OF 1.0' OR 1*8 DIAMETER WILL BE ALLOWED ONLY IF ALL POSSIBLE MEANS TO OBTAIN THE STANDARD VALUE HAVE BEEN EXHAUSTED.
4. STRUCTURAL PLATE PIPE DIMENSIONS ARE TO INSIDE CREST AND ARE SUBJECT TO MANUFACTURING TOLERANCES.
5. SEE STANDARD PB-1 FOR BEDDING AND BACKFILL REQUIREMENTS.

STRUCTURAL PLATE ALUMINUM ALLOY PIPE
9" x 2½" CORRUGATIONS

PIPE DIAMETER INCHES	AREA SQ. FT.	MAXIMUM HEIGHT OF COVER IN FEET — SHEET THICKNESS IN INCHES						
		0.10	0.125	0.15	0.175	0.20	0.225	0.25
60	20	59	74	90	105	120	136	151
66	24	53	67	81	95	109	123	137
72	28	48	61	74	87	100	112	125
78	33	44	56	68	80	92	103	115
84	38	41	52	63	74	85	96	107
90	44	38	48	58	68	79	89	99
96	50	35	44	54	64	73	83	93
102	57	32	41	50	60	69	78	88
108	64	30	39	47	56	64	73	82
114	71	28	36	44	53	61	69	77
120	78	26	34	42	49	57	65	73
132	95	23	30	37	44	51	58	65
144	113	20	27	33	40	46	53	59
156	133		24	30	36	42	48	54
168	154			27	33	38	44	49
180	177				30	35	40	45
192	201					32	37	42
204	227					29	34	39
216	254						31	36
228	284							33

NOTES:

1. COVER HEIGHTS INDICATED IN TABLE ARE FOR FINISHED CONSTRUCTION, USING AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS AND ASSUMING 25% METAL LOSS AT END OF DESIGN LIFE.
2. TO PROTECT PIPE DURING CONSTRUCTION, MINIMUM HEIGHT OF COVER PRIOR TO ALLOWING CONSTRUCTION TRAFFIC TO CROSS INSTALLATION SHALL BE ½ DIAMETER. THIS COVER SHALL EXTEND THE FULL LENGTH OF THE PIPE. THE APPROACH FILL RAMP IS TO EXTEND A MINIMUM OF 10(DIAMETER + 36") ON EACH SIDE OF THE PIPE OR TO THE INTERSECTION WITH A CUT.
3. STANDARD MINIMUM FINISHED HEIGHT OF COVER FOR ALL PIPES SHALL BE 2.0' OR ½ DIAMETER, WHICHEVER IS GREATER. IN CASES IN WHICH THESE COVER HEIGHTS CANNOT BE ACHIEVED, AND ABSOLUTE MINIMUM FINISHED COVER HEIGHT OF 1.0' OR ⅛ DIAMETER, WHICHEVER IS GREATER, WILL BE ALLOWED ONLY IF ALL POSSIBLE MEANS TO OBTAIN THE STANDARD VALUE HAVE BEEN EXHAUSTED.
4. SEE STANDARD PB-1 FOR PIPE BEDDING AND BACKFILL REQUIREMENTS.
5. STEEL BOLTS ONLY TO BE USED. BOLTS ARE ¾" DIAMETER HIGH STRENGTH TO MEET CURRENT AASHTO DESIGNATION M-164 AND GALVANIZED TO MEET CURRENT ASTM DESIGNATION A-394. BOLTS ARE TO BE LOCATED IN THE VALLEY AND CREST OF EACH CORRUGATION IN DOUBLE ROWS SPACED 1¾" APART.

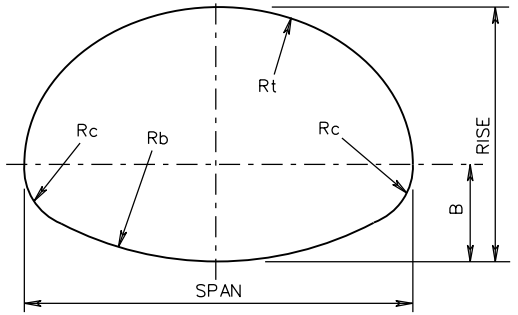
PC-1

MINIMUM THICKNESS-STRUCTURAL PLATE STEEL PIPE ARCHES 6" x 2" CORRUGATIONS

PIPE ARCH DIMENSION				MINIMUM SHEET THICKNESS REQUIRED	MAXIMUM ALLLOWABLE COVER HEIGHT IN FEET	
NOMINAL SIZE		AREA	Rc		MAXIMUM CORNER PRESSURE	
SPAN	RISE	SQ. FT.	INCHES	GAUGE	4000 LBS./SQ.FT. (SEE NOTE 4)	6000 LBS./SQ.FT. (SEE NOTE 6)
6'-1"	4'-7"	22	18	12	16	24
6'-4"	4'-9"	24	18	12	15	23
6'-9"	4'-11"	26	18	12	14	22
7'-0"	5'-1"	28	18	12	14	21
7'-3"	5'-3'	31	18	12	13	20
7'-8"	5'-5"	33	18	12	12	19
7'-11"	5'-7"	35	18	12	12	18
8'-2"	5'-9"	38	18	12	12	18
8'-7"	5'-11"	40	18	12	11	17
8'-10"	6'-1"	43	18	12	11	16
9'-4"	6'-3"	46	18	12	10	16
9'-6"	6'-5"	49	18	12	10	15
9'-9"	6'-7"	52	18	12	10	15
10'-3"	6'-9"	55	18	12	9	14
10'-8"	6'-11"	58	18	12	9	14
10'-11"	7'-1"	61	18	12	9	13
11'-5"	7'-3"	64	18	12	8	13
11-7"	7'-5"	67	18	12	8	12
11'-10"	7'-7"	71	18	12	8	12
12'-4"	7'-9"	74	18	12	8	12
12'-6"	7'-11"	78	18	12	8	12
12'-8"	8'-1"	81	18	12	7	11
12'-10"	8'-4"	85	18	12	7	11
13'-5"	8'-5"	89	18	12	7	11
13-11"	8'-7"	93	18	12	7	10
14'-1"	8'-9"	97	18	12	7	10
14'-3"	8'-11"	101	18	12	6	10
14'-10"	9'-1"	105	18	12	6	10
15'-4"	9'-3"	109	18	12	6	9
15'-6"	9'-5"	113	18	12	6	9
15'-8"	9'-7"	118	18	12	6	9
15'-10"	9'-10"	122	18	12	6	9
16'-5"	9'-11"	126	18	12	6	9
16'-7"	10'-1"	131	18	12	6	9

NOTES:

1. COVER HEIGHTS INDICATED IN TABLES ARE FOR FINISHED CONSTRUCTION WHICH MATCH FORMER VDOT ALLOWABLE STRESS DESIGN TABLES. COVER HEIGHTS WERE NOT RE-CALCULATED USING LRFD.
2. TO PROTECT PIPE DURING CONSTRUCTION, MINIMUM HEIGHT OF COVER PRIOR TO ALLOWING CONSTRUCTION TRAFFIC TO CROSS INSTALLATION SHALL BE 1/2 SPAN. THE COVER SHALL EXTEND THE FULL LENGTH OF THE PIPE ARCH. THE APPROACH FILL RAMP IS TO EXTEND A MINIMUM OF 10(HEIGHT + 1/2 SPAN) ON EACH SIDE OF THE STRUCTURE, OR TO THE INTERSECTION WITH A CUT.
3. STANDARD MINIMUM FINISHED HEIGHT OF COVER FOR ALL PIPES SHALL BE 2.0' OR 1/2 SPAN, WHICHEVER IS GREATER. IN CASES IN WHICH THESE COVER HEIGHTS CANNOT BE ACHIEVED, AN ABSOLUTE MINIMUM FINISHED COVER HEIGHT OF 1.0' OR 1/8 SPAN, WHICHEVER IS GREATER, WILL BE ALLOWED ONLY IF ALL POSSIBLE MEANS TO OBTAIN THE STANDARD VALUE HAVE BEEN EXHAUSTED.
4. SEE STANDARD PB-1 FOR PIPE BEDDING AND BACKFILL REQUIREMENTS.
5. THE MAXIMUM HEIGHT OF COVER SHOWN IN THE TABLES IS BASED ON A SOIL MODULUS OF 700 PSI. ALL OTHER DESIGN CRITERIA ARE IN ACCORDANCE WITH THE AASHTO SPECIFICATIONS AND VDOT MODIFICATIONS FOR SOIL CORRUGATED METAL STRUCTURE INTERACTION SYSTEMS.
6. WHEN DESIGN HEIGHT OF COVER REQUIRES THE USE OF THIS CATEGORY OF PIPE, BEDDING AND BACKFILL MUST BE APPROVED BY THE ENGINEER.
7. STRUCTURAL PLATE PIPE-ARCH DIMENSIONS ARE TO INSIDE OF CREST AND ARE SUBJECT TO MANUFACTURING TOLERANCES.



VDOT
ROAD AND BRIDGE STANDARDS

SHEET 9 OF 18 | REVISION DATE 11/15
107.13

STRUCTURAL PLATE STEEL PIPE ARCH HEIGHT OF COVER TABLE FOR HL-93 LIVE LOAD

VIRGINIA DEPARTMENT OF TRANSPORTATION

SPECIFICATION REFERENCE
232
302

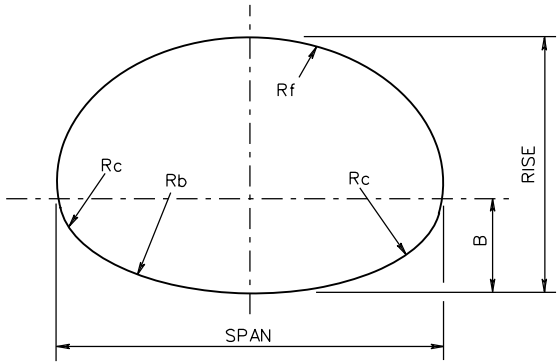
MINIMUM THICKNESS-STRUCTURAL PLATE STEEL PIPE ARCHES 6" x 2" CORRUGATIONS

PIPE ARCH DIMENSION				MINIIMUM SHEET THICKNESS REQUIRED	MAXIMUM ALLOWABLE COVER HEIGHT IN FEET	
					MAXIMUM CORNER PRESSURE	
SPAN	RISE	AREA SQ. FT.	Rc INCHES	GAUGE	4000 LBS./SQ. FT. (SEE NOTE 4)	6000 LBS./SQ. FT. (SEE NOTE 6)
13'-3"	9'-4"	97	31	12	12	18 ⊛
13'-6"	9'-6"	102	31	12	12	17 ⊛
14'-0"	9'-8"	105	31	12	12	17 ⊛
14'-2"	9'-10"	109	31	12	12	16 ⊛
14'-5"	10'-0"	114	31	12	11	16 ⊛
14'-11"	10'-2"	118	31	12	11	16 ⊛
15'-4"	10'-4"	123	31	12	11	15 ⊛
15'-7"	10'-6"	127	31	12	11	15 ⊛
15'-10"	10'-8"	132	31	12	10	14 ⊛
16'-3"	10'-10"	137	31	12	10	14 ⊛
16'-6"	11'-0"	142	31	12	10	14 ⊛
17'-0"	11'-2"	146	31	12	10	14 ⊛
17'-2"	11'-4"	151	31	12	10	13 ⊛
17'-5"	11'-6"	157	31	12	9	13 ⊛
17'-11"	11'-8"	161	31	12	9	13 ⊛
18'-1"	11'-10"	167	31	12	9	13 ⊛
18'-7"	12'-0"	172	31	12	9	12 ⊛
18'-9"	12'-2"	177	31	12	9	12 ⊛
19'-3"	12'-4"	182	31	10	8	13
19'-6"	12'-6"	188	31	10	8	13
19'-8"	12'-8"	194	31	10	8	13
19'-11"	12'-10"	200	31	10	8	12
20'-5"	13'-0"	205	31	10	8	12
20'-7"	13'-2"	211	31	10	8	12

⊛ MAXIMUM COVER HEIGHTS SHOWN MAY BE INCREASED BY A MAXIMUM OF 12" IF A SHEET THICKNESS GREATER THAN 12 GAUGE IS USED.

NOTES:

1. COVER HEIGHTS INDICATED IN TABLES ARE FOR FINISHED CONSTRUCTION WHICH MATCH FORMER VDOT ALLOWABLE STRESS DESIGN TABLES. COVER HEIGHTS WERE NOT RE-CALCULATED USING LRFD.
2. TO PROTECT PIPE DURING CONSTRUCTION, MINIMUM HEIGHT OF COVER PRIOR TO ALLOWING CONSTRUCTION TRAFFIC TO CROSS INSTALLATION SHALL BE 1/2 SPAN. THE COVER SHALL EXTEND THE FULL LENGTH OF THE PIPE ARCH. THE APPROACH FILL RAMP IS TO EXTEND A MINIMUM OF 10(HEIGHT + 1/2 SPAN) ON EACH SIDE OF THE STRUCTURE OR TO THE INTERSECTION WITH A CUT.
3. STANDARD MINIMUM FINISHED HEIGHT OF COVER FOR ALL PIPES SHALL BE 1/4 SPAN. IN CASES IN WHICH THIS COVER HEIGHT CANNOT BE ACHIEVED, AN ABSOLUTE MINIMUM FINSHED COVER HEIGHT OF 1/8 SPAN WILL BE ALLOWED ONLY IF ALL POSSIBLE MEANS TO OBTAIN THE STANDARD VALUE HAVE BEEN EXHAUSTED.
4. SEE STANDARD PB-1 FOR PIPE BEDDING AND BACKFILL REQUIREMENTS.
5. STRUCTURAL PLATE PIPE-ARCH DIMENSIONS ARE TO INSIDE OF CREST AND ARE SUBJECT TO MANUFACTURING TOLERANCES.
6. WHEN DESIGN HEIGHT OF COVER REQUIRES THE USE OF THIS CATEGORY OR PIPE, BEDDING AND BACKFILL MUST BE APPROVED BY THE ENGINEER.
7. THE MAXIMUM HEIGHT OF COVER SHOWN IN THE TABLES IS BASED ON A SOIL MODULUS OF 700 PSI. ALL OTHER DESIGN CRITERIA ARE IN ACCORDANCE WITH THE AASHTO SPECIFICATIONS AND VDOT MODIFICATIONS FOR SOIL CORRUGATED METAL STRUCTURE INTERACTION SYSTEMS.



SPECIFICATION REFERENCE	STRUCTURAL PLATE STEEL PIPE ARCH HEIGHT OF COVER TABLE FOR HL-93 LIVE LOAD	VDOT ROAD AND BRIDGE STANDARDS
232 302	VIRGINIA DEPARTMENT OF TRANSPORTATION	REVISION DATE 11/15 · SHEET 10 OF 5 · 107.14

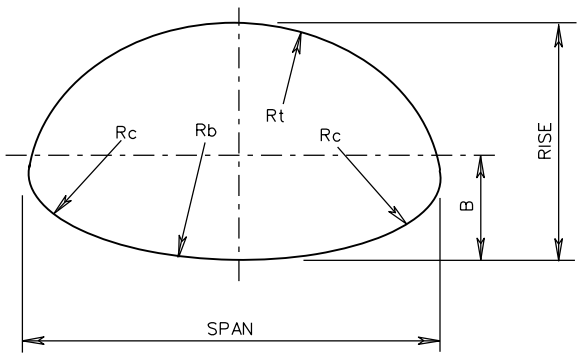
PC-1

STRUCTURAL PLATE ALUMINUM ALLOY PIPE ARCHES
9' x 2½" CORRUGATIONS

SPAN	RISE	CORNER RADIUS	MAXIMUM COVER HEIGHT IN FEET — MINIMUM SHEET THICKNESS IN INCHES — MAXIMUM CORNER PRESSURE IN LBS./SQ. FT.							AREA SQ.FT.
			0.100"	0.125"		0.150"		0.175"		
			4000 (SEE NOTE 4)	4000 (SEE NOTE 4)	6000 (SEE NOTE 6)	4000 (SEE NOTE 4)	6000 (SEE NOTE 6)	4000 (SEE NOTE 6)	6000 (SEE NOTE 6)	
6'-2"	5'-0"	31.8	25	28	36	28	42	28	42	24.7
6'-7"	4'-11"	31.8	23	26	34	26	40	26	40	26.6
6'-7"	5'-8"	31.8	23	26	34	26	40	26	40	29.6
6'-11"	5'-9"	31.8	22	25	32	25	38	25	38	31.9
7'-3"	5'-11"	31.8	21	24	31	24	36	24	36	34.3
7'-9"	6'-0"	31.8	20	22	29	22	34	22	34	36.8
8'-1"	6'-1"	31.8	19	21	28	21	32	21	32	39.3
8'-5"	6'-3"	31.8	18	20	27	20	31	20	31	41.9
8'-10"	6'-4"	31.8	17	20	25	20	30	20	30	44.5
9'-3"	6'-5"	31.8	16	19	24	19	28	19	28	45.1
9'-7"	6'-6"	31.8	16	18	23	18	27	18	27	49.9
9'-11"	6'-8"	31.8	15	17	22	17	26	17	26	52.7
10'-3"	6'-9"	31.8	15	17	22	17	25	17	25	55.5
10'-9"	6'-10"	31.8	14	16	21	16	24	16	24	58.4
11'-1"	7'-0"	31.8	14	15	20	15	23	15	23	61.4
11'-5"	7'-1"	31.8	13	15	19	15	23	15	23	64.4
11'-9"	7'-2"	31.8	13	15	19	15	22	15	22	67.5
12'-3"	7'-3"	31.8	12	14	18	14	21	14	21	70.5
12'-7"	7'-5"	31.8	12	14	18	14	21	14	21	73.7
12'-11"	7'-6"	31.8	12	13	17	13	20	13	20	77.0
13'-1"	8'-2"	31.8	11	13	17	13	20	13	20	83.0
13'-1"	8'-4"	31.8	11	13	17	13	20	13	20	86.8
13'-11"	8'-5"	31.8	11	12	16	12	19	12	19	90.3
14'-0"	8'-7"	31.8	11	12	16	12	18	12	18	94.2
13'-11"	9'-5"	31.8	11	12	16	12	19	12	19	101.5
14'-3"	9'-7"	31.8	10	12	15	12	18	12	18	105.7
14'-8"	9'-8"	31.8		12	14	12	17	12	18	109.9
14'-11"	9'-10"	31.8		11	13	11	16	11	17	114.2
15'-4"	10'-0"	31.8		11	12	11	14	11	17	118.6
15'-7"	10'-2"	31.8		11	11	11	14	11	16	123.1
16'-1"	10'-4"	31.8		10		10	12	10	15	127.6
16'-4"	10'-6"	31.8				10	12	10	14	132.3
16'-9"	10'-8"	31.8				10	11	10	13	136.9
17'-0"	10'-10"	31.8				10		10	12	141.8
17'-3"	11'-0"	31.8				10		10	12	
18'-0"	11'-4"	31.8						9	10	

NOTES:

1. COVER HEIGHTS INDICATED IN TABLES ARE FOR FINISHED CONSTRUCTION WHICH MATCH FORMER VDOT ALLOWABLE STRESS DESIGN TABLES. COVER HEIGHTS WERE NOT RE-CALCULATED USING LRFD.
2. TO PROTECT PIPE DURING CONSTRUCTION, MINIMUM HEIGHT OF COVER PRIOR TO ALLOWING CONSTRUCTION TRAFFIC TO CROSS INSTALLATION TO BE ½ SPAN. THE COVER SHALL EXTEND THE FULL LENGTH OF THE PIPE ARCH. THE APPROACH FILL RAMP IS TO EXTEND A MINIMUM OF 10(RISE + ½ SPAN) ON EACH SIDE OF THE PIPE, OR TO THE INTERSECTION WITH A CUT.
3. STANDARD MINIMUM FINISHED HEIGHT OF COVER FOR ALL PIPES SHALL BE 2.0' OR ¼ SPAN, WHICHEVER IS GREATER. IN CASES IN WHICH THESE COVER HEIGHTS CANNOT BE ACHIEVED, AN ABSOLUTE MINIMUM FINISHED COVER HEIGHT OF 1.0' OR ⅛ SPAN, WHICHEVER IS GREATER, WILL BE ALLOWED ONLY IF ALL POSSIBLE MEANS TO OBTAIN THE STANDARD VALUE HAVE BEEN EXHAUSTED.
4. SEE STANDARD PB-1 FOR BEDDING AND BACKFILL REQUIREMENTS.
5. THE MAXIMUM HEIGHT OF COVER SHOWN IN THE TABLES IS BASED ON A SOIL MODULUS OF 700 PSI. ALL OTHER DESIGN CRITERIA ARE IN ACCORDANCE WITH THE AASHTO SPECIFICATIONS AND VDOT MODIFICATIONS FOR SOIL CORRUGATED METAL STRUCTURE INTERACTION SYSTEMS.
6. WHEN DESIGN HEIGHT OF COVER REQUIRES THE USE OF THIS CATEGORY OF PIPE, BEDDING AND BACKFILL MUST BE APPROVED BY THE ENGINEER.
7. BOLTS ARE ¾" DIAMETER, HIGH STRENGTH TO MEET CURRENT A.S.T.M. DESIGNATION M-164 AND GALVANIZED TO MEET CURRENT A.S.T.M. DESIGNATION A-394. BOLTS ARE TO BE LOCATED IN THE VALLEY AND CREST OF EACH CORRUGATION IN DOUBLE ROWS SPACED 1¾" APART.
8. STRUCTURAL PLATE PIPE-ARCH DIMENSIONS ARE TO INSIDE CREST AND ARE SUBJECT TO MANUFACTURING TOLERANCES.



VDOT
ROAD AND BRIDGE STANDARDS

SHEET 11 OF 18 | REVISION DATE 11/15
107.15

STRUCTURAL PLATE ALUMINUM ALLOY PIPE ARCH HEIGHT OF COVER TABLE FOR HL-93 LIVE LOAD

VIRGINIA DEPARTMENT OF TRANSPORTATION

SPECIFICATION REFERENCE
232
302

ALUMINUM SPIRAL RIB PIPE 3/4" WIDE x 3/4" DEEP RIBS SPACED @ 7 1/2"

PIPE DIAMETER INCHES	AREA SQ. FT.	MAXIMUM HEIGHT OF COVER IN FEET				MINIMUM SHEET THICKNESS FOR ENTRANCE PIPES WITH LESS THAN 1 FT. COVER INCHES (GUAGE)
		SHEET THICKNESS IN INCHES (GAUGE)				
		0.06 (16)	0.075 (14)	0.105 (12)	0.135 (10)	
12	0.8	75	103	166		0.064 (16)
15	1.2	59	82	133	188	0.075 (14)
18	1.8	49	68	110	156	0.075 (14)
21	2.4	42	58	94	134	0.105 (12)
24	3.1	36	50	82	117	0.105 (12)
27	4.0	32	44	73	103	0.105 (12)
30	4.9	28	40	65	93	0.105 (12)
36	7.1	23	33	54	77	0.105 (12)
42	9.6	19	27	46	65	0.105 (12)
48	12.6	16	23	39	57	0.105 (12)
54	16.0	13	20	35	50	0.105 (12)
60	19.6	11	17	31	45	0.105 (12)
66	23.8	9	15	27	40	0.105 (12)
72	28.3	7	13	25	36	0.105 (12)

NOTES:

1. COVER HEIGHTS INDICATED IN TABLE ARE FOR FINISHED CONSTRUCTION, USING AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS AND ASSUMING 25% METAL LOSS AT END OF DESIGN LIFE.
2. TO PROTECT PIPE DURING CONSTRUCTION, MINIMUM HEIGHT OF COVER TO BE IN ACCORDANCE WITH TABLE A PRIOR TO ALLOWING CONSTRUCTION TRAFFIC TO CROSS INSTALLATION. THE COVER SHALL EXTEND THE FULL LENGTH OF THE PIPE. THE APPROACH FILL RAMP IS TO EXTEND A MINIMUM OF 20 DIAMETERS ON EACH SIDE OF THE PIPE, OR TO THE INTERSECTION WITH A CUT.
3. STANDRD MINIMUM FINISHED HEIGHT OF COVER FOR ALL PIPES, EXCEPT THOSE UNDER ENTRANCES, SHALL BE 2'0" OR 1/2 DIAMETER, WHICHEVER IS GREATER. IN CASES IN WHICH THESE COVER HEIGHTS CANNOT BE ACHIEVED, AN ABSOLUTE MINIMUM FINISHED COVER HEIGHT OF 1.0' OR 1/4 DIAMETER, WHICHEVER IS GREATER, WILL BE ALLOWED ONLY IF ALL POSSIBLE MEANS TO OBTAIN THE STANDARD VALUE HAVE BEEN EXHAUSTED. THE MINIMUM FINISHED HEIGHT OF COVER FOR PIPES UNDER ENTRANCES IS 9" FOR PIPE DIAMETERS LESS THAN OR EQUAL TO 18" AND 12" OR 1/4 DIAMETER, WHICHEVER IS GREATER, FOR PIPE DIAMETERS GREATER THAN 18".
4. SEE STANDARD PB-1 FOR PIPE BEDDING AND BACKFILL REQUIREMENTS.

TABLE A	
PIPE DIAMETER	MINIMUM COVER HEIGHT DURING CONSTRUCTION (SEE NOTE 2)
12" TO 27"	18"
30" AND OVER	EQUAL TO DIAMETER

SPECIFICATION REFERENCE

232
302

ALUMINUM SPIRAL RIB PIPE HEIGHT OF COVER TABLE FOR HL-93 LIVE LOAD

VIRGINIA DEPARTMENT OF TRANSPORTATION

VDOT
ROAD AND BRIDGE STANDARDS

REVISION DATE 11/15

SHEET 12 OF 18

107.16

STEEL SPIRAL RIB PIPE 3/4" WIDE x 3/4" RIBS SPACED @ 7 1/2"

PIPE DIAMETER INCHES	AREA SQ. FT.	MAXIMUM HEIGHT OF COVER IN FEET — SHEET THICKNESS IN INCHES (GAUGE)				MINIMUM SHEET THICKNESS FOR ENTRANCE PIPES WITH LESS THAN 1 FT. COVER INCHES (GAUGE)
		0.064 (16)	0.079 (14)	0.109 (12)	0.138 (10)	
18	1.8	101	142			0.064 (16)
21	2.4	86	121	203		0.064 (16)
24	3.1	75	106	177		0.064 (16)
27	4.0	67	94	157		0.064 (16)
30	4.9	60	84	141		0.064 (16)
36	7.1	49	70	117		0.064 (16)
42	9.6	42	59	100		0.064 (16)
48	12.6	36	51	87	127	0.064 (16)
54	16.0		45	77	113	0.079 (14)
60	19.6		40	69	101	0.079 (14)
66	23.8			62	92	0.109 (12)
72	28.3			57	84	0.109 (12)
78	33.2			52	77	0.109 (12)
84	38.6				71	0.138 (10)
90	44.17				66	0.138 (10)

NOTES:

1. COVER HEIGHTS INDICATED IN TABLE ARE FOR FINISHED CONSTRUCTION, USING AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS AND ASSUMING 25% METAL LOSS AT END OF DESIGN LIFE.
2. TO PROTECT PIPE DURING CONSTRUCTION, MINIMUM HEIGHT OF COVER TO BE IN ACCORDANCE WITH TABLE A PRIOR TO ALLOWING CONSTRUCTION TRAFFIC TO CROSS INSTALLATION. THE COVER SHALL EXTEND THE FULL LENGTH OF THE PIPE. THE APPROACH FILL IS TO EXTEND A MINIMUM OF 15 DIAMETERS ON EACH SIDE OF THE PIPE OR TO THE INTERSECTION WITH THE CUT.
3. MINIMUM FINISHED HEIGHT OF COVER FOR ALL PIPES, EXCEPT THOSE UNDER ENTRANCES, SHALL BE 2.0' OR 1/2 DIAMETER, WHICHEVER IS GREATER. IN CASES IN WHICH THESE COVER HEIGHTS CANNOT BE ACHIEVED, AN ABSOLUTE MINIMUM FINISHED COVER HEIGHT OF 1.0' OR 1/4 DIAMETER, WHICHEVER IS GREATER, WILL BE ALLOWED ONLY IF ALL POSSIBLE MEANS TO OBTAIN THE STANDARD VALUE HAVE BEEN EXHAUSTED. THE MINIMUM FINISHED HEIGHT OF COVER FOR PIPES UNDER ENTRANCES IS 9" FOR PIPE DIAMETERS LESS THAN OR EQUAL TO 24" AND 12" OR 1/4 DIAMETER, WHICHEVER IS GREATER, FOR PIPE DIAMETERS GREATER THAN 24". WHERE POLYMER COATED PIPE WILL BE USED AND THE SURFACE OVER THE TOP OF THE PIPE WILL BE ASPHALT, CLASS I BACKFILL MATERIAL IS TO BE PLACED UP TO A MINIMUM OF 6" ABOVE THE TOP OF THE PIPE.
4. SEE STANDARD PB-1 FOR PIPE BEDDING AND BACKFILL REQUIREMENTS.
5. A MAXIMUM HEIGHT OF COVER TABLE FOR STEEL SPRIAL RIB WITH 3/4" WIDE x 1" DEEP RIPS SPACED AT 11 1/2" IS AVAILIBLE UPON REQUEST.

TABLE A	
PIPE DIAMETER	MINIMUM COVER HEIGHT DURING CONSTRUCTION (SEE NOTE 2)
12" TO 30"	18"
36" AND ABOVE	1/2 DIAMETER

STEEL SPIRAL RIB PIPE
HEIGHT OF COVER TABLE FOR HL-93 LIVE LOAD

VIRGINIA DEPARTMENT OF TRANSPORTATION

CAST IRON PIPE CULVERT DESIGNATION				
DIAMETER INCHES	AREA SQ. FT.	MAXIMUM HEIGHT OF COVER IN FEET		
		1-13	14-21	22-35 (2)
12 (2)	0.8	STANDARD PIPE	HEAVY PIPE	EXTRA HEAVY PIPE
15 (3)	1.2			
16 (2) (4)	1.4			
18 (1)	1.8			
24 (1)	3.1			
30 (1)	4.9			
36 (1)	7.1			
42 (2)	9.6			
48 (2)	12.6			

(1) PIPE MAY BE SMOOTH CAST IRON, CORRUGATED CAST IRON, OR RIBBED CAST IRON.

(2) PIPE TO BE SMOOTH CAST IRON ONLY.

(3) PIPE TO BE CORRUGATED CAST IRON OR RIBBED CAST IRON.

(4) MAY BE SUBSTITUTED FOR 15" PIPE CULVERT AT NO INCREASE IN PRICE BID FOR 15" PIPE, WHERE APPROVED BY THE ENGINEER.

NOTES:

1. COVER HEIGHTS INDICATED IN TABLES ARE FOR FINISHED CONSTRUCTION WHICH MATCH FORMER VDOT ALLOWABLE STRESS DESIGN TABLES. COVER HEIGHTS WERE NOT RE-CALCULATED USING LRFD

2. TO PROTECT PIPE DURING CONSTRUCTION, MINIMUM HEIGHT OF COVER PRIOR TO ALLOWING CONSTRUCTION TRAFFIC TO CROSS INSTALLATION IS TO BE 24". THIS COVER IS TO EXTEND THE FULL LENGTH OF THE PIPE CULVERT. THE APPROACH FILL RAMP IS TO EXTEND A MINIMUM OF 10 (DIAMETER + 36") ON EACH SIDE OF THE CULVERT, OR TO THE INTERSECTION WITH A CUT.

3 MINIMUM FINISHED HEIGHT OF COVER TO BE 24", EXCEPT PIPE UNDER ENTRANCES AND MEDIAN CROSSOVERS WHERE A 9" MINIMUM WILL BE PERMITTED.

4. SEE STANDARD PB-1 FOR PIPE BEDDING AND BACKFILL REQUIREMENTS.

SPECIFICATION REFERENCE	CAST IRON PIPE HEIGHT OF COVER TABLE FOR HL-93 LIVE LOAD VIRGINIA DEPARTMENT OF TRANSPORTATION	VDOT ROAD AND BRIDGE STANDARDS
232 302		REVISION DATE 11/15
		SHEET 14 OF 18
		107.18

POLYETHYLENE CORRUGATED PIPE (PE) (SEE NOTE 5)		
DIAMETER INCHES	AREA SQ. FT.	MAXIMUM HEIGHT OF COVER FEET
12	0.8	24
15	1.2	24
18	1.8	20
24	3.1	20
30	4.9	19
36	7.1	18
42	9.6	18
48	12.6	17
54	15.9	16
60	19.6	16

POLYVINYLCHLORIDE PROFILE WALL PIPE (PVC)		
DIAMETER INCHES	AREA SQ. FT.	MAXIMUM HEIGHT OF COVER FEET
18	1.7	41
21	2.3	40
24	3.0	37
30	4.7	34
36	6.9	34

POLYPROPYLENE PIPE (PP) (SEE NOTE 6)		
DIAMETER INCHES	AREA SQ. FT.	MAXIMUM HEIGHT OF COVER FEET
12	0.8	25
15	1.2	25
18	1.8	21
24	3.1	20
30	4.9	19
36	7.1	18
42	9.6	18
48	12.6	17
60	19.6	17

NOTES:

1. COVER HEIGHTS INDICATED IN TABLES ARE FOR FINISHED CONSTRUCTION, USING AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS.
2. TO PROTECT PIPE DURING CONSTRUCTION, MINIMUM HEIGHT OF COVER TO BE IN ACCORDANCE WITH TABLE A PRIOR TO ALLOWING CONSTRUCTION TRAFFIC TO CROSS INSTALLATION. THE COVER SHALL EXTEND THE FULL LENGTH OF THE PIPE. THE APPROACH FILL IS TO EXTEND A MINIMUM OF 10(DIAMETER + ½ DIAMETER) ON EACH SIDE OF THE PIPE OR TO THE INTERSECTION WITH A CUT.
3. STANDARD MINIMUM FINISHED HEIGHT OF COVER FOR ALL PIPES, EXCEPT THOSE UNDER ENTRANCES, SHALL BE 2.0' OR ½ DIAMETER WHICHEVER IS GREATER. FOR 12" THROUGH 48" DIAMETER PIPE INSTALLATIONS WHERE THE COVER HEIGHTS CANNOT BE ACHIEVED, AN ABSOLUTE MINIMUM FINISHED COVER HEIGHT OF 1.0' WILL BE ALLOWED ONLY IF ALL POSSIBLE MEANS TO OBTAIN THE STANDARD VALUE HAVE BEEN EXHAUSTED. THE MINIMUM FINISHED HEIGHT OF COVER FOR PIPES UNDER ENTRANCES IS 9" FOR PIPE DIAMETERS LESS THAN OR EQUAL TO 24", AND 12" FOR PIPE DIAMETERS GREATER THAN 24". WHERE THE SURFACE OVER THE TOP OF THE PIPE WILL BE ASPHALT, A MINIMUM OF 6" OF CLASS I BACKFILL MATERIAL IS TO BE PLACED BETWEEN THE TOP OF THE PIPE AND THE BOTTOM OF THE ASPHALT.
4. SEE STANDARD PB-1 FOR PIPE BEDDING AND BACKFILL REQUIREMENTS.
5. HEIGHT OF COVER VALUES FOR 12" THROUGH 36" DIAMETER APPLY TO TYPE C OR S. HEIGHT OF COVER VALUES FOR 42" THROUGH 60" APPLY TO TYPE S ONLY.
6. HEIGHT OF COVER VALUES FOR 12" THROUGH 30" DIAMETER APPLY TO TYPE S. HEIGHT OF COVER VALUES FOR 36" THROUGH 60" APPLY TO TYPE D.
7. LARGE CULVERTS SHALL BE DESIGNED BY AN ENGINEER, REGISTERED IN THE COMMONWEALTH OF VIRGINIA, AND SHALL BE DESIGNED IN ACCORDANCE WITH THE REQUIREMENTS OF VOLUME V, PART 2 OF THE MANUAL OF THE STRUCTURE AND BRIDGE DIVISION. A LARGE CULVERT IS ANY CULVERT THAT WILL BECOME PART OF THE STRUCTURE AND BRIDGE INVENTORY. THE GEOMETRIC DEFINITION OF THESE STRUCTURES IS PROVIDED IN THE CURRENT VERSION OF VDOT'S IIM-S&B-27.

TABLE A	
PIPE DIAMETER	MINIMUM COVER HEIGHT DURING CONSTRUCTION (SEE NOTE 2)
12" TO 30"	18"
36" AND ABOVE	½ DIAMETER

PLASTIC PIPE
HEIGHT OF COVER TABLES FOR HL-93 LIVE LOAD
VIRGINIA DEPARTMENT OF TRANSPORTATION

SPECIFICATION REFERENCE
232
302

TABLE A - ALLOWABLE TYPE OF PIPE CULVERT

FOR ROADWAYS THAT ARE CONSTRUCTED, FUNDED OR WILL ULTIMATELY BE MAINTAINED BY VDOT

FUNCTIONAL CLASSIFICATION OF ROADS SYSTEM UNDER WHICH PIPE IS TO BE INSTALLED					
	HIGHER FUNCTIONAL CLASS - HFC 75 - YEAR DESIGN LIFE RURAL PRINCIPAL ARTERIAL, URBAN PRINCIPAL ARTERIAL, RURAL MINOR ARTERIAL, URBAN MINOR ARTERIAL, RURAL COLLECTOR ROADS, URBAN COLLECTOR STREETS, SUBDIVISION STREETS WITH AN ADT GREATER THAN 4000		LOWER FUNCTIONAL CLASS - LFC 50 - YEAR DESIGN LIFE RURAL LOCAL ROADS, URBAN LOCAL STREETS, SUBDIVISION STREETS WITH AN ADT LESS THAN OR EQUAL TO 4000		ENTRANCE PIPE
ALLOWABLE PIPE CULVERTS NOTES 1 & 2	STATEWIDE EXCEPT LOCATIONS SHOWN IN TABLE B	LOCATION SHOWN IN TABLE B	STATEWIDE EXCEPT LOCATIONS SHOWN IN TABLE B	LOCATION SHOWN IN TABLE B	STATEWIDE
CONCRETE	✓	✓	✓	✓	✓
ALUMINUM COATED TYPE 2 CORRUGATED STEEL NOTE 3	✓		✓		✓
POLYMER COATED (10/10) CORRUGATED STEEL NOTE 3	✓	✓	✓	✓	✓
UNCOATED GALVANIZED CORRUGATED STEEL NOTES 3 & 4					✓
GALVANIZED STEEL STRUCTURAL PLATE NOTE 3			✓		✓
GALVANIZED STEEL STRUCTURAL PLATE WITH THICKENED INVERT NOTE 3, 5	✓		✓	✓	✓
CORRUGATED ALUMINUM ALLOY NOTE 3	✓	✓	✓	✓	✓
CORRUGATED ALUMINUM ALLOY STRUCTUAL PLATE NOTE 3	✓	✓	✓	✓	✓
POLYVINYLCHLORIDE (PVC) PROFILE WALL PIPE (SMOOTH INTERIOR)	✓	✓	✓	✓	✓
POLYETHYLENE (PE) CORRUGATED TYPE C	✓	✓	✓	✓	
POLYETHYLENE (PE) CORRUGATED TYPE S	✓	✓	✓	✓	✓
POLYPROPYLENE (PP) TYPE D OR S	✓	✓	✓	✓	✓

NOTES:

1. ALLOWABLE TYPES OF PIPES FOR A SPECIFIC AREA ARE TO CONFORM TO THE CRITERIA SHOWN IN TABLES A, A1, B, AND C. ANY DEVIATION MUST BE APPROVED BY THE STATE LOCATION AND DESIGN ENGINEER AND THE DISTRICT MATERIALS ENGINEER.
2. SEE HEIGHT OF COVER TABLES FOR MINIMUM AND MAXIMUM COVER LIMITATIONS FOR EACH TYPE OF PIPE.
3. SEE TABLE C FOR MINIMUM AND MAXIMUM pH, RESISTIVITY, AND VELOCITY LIMITATIONS FOR METAL PIPES. SEE TABLE D FOR REQUIRED GAUGE OF METAL PIPE.
4. USE ONLY UNDER ENTRANCES WHERE THE PIPE SIZE IS LESS THAN OR EQUAL TO 30" DIAMETER (OR EQUIVALENT) AND THE HEIGHT OF COVER IS LESS THAN OR EQUAL TO 15' AND AS AN OUTLET PIPE FOR STANDARD DI-13 SHOULDER SLOT INLETS.
5. BOTTOM AND CORNER PLATES SHALL BE 2 GAUGE STEPS THICKER

TABLE A1 - ALLOWABLE TYPE OF STORM SEWER PIPE

FOR ROADWAYS THAT ARE CONSTRUCTED, FUNDED OR WILL ULTIMATELY BE MAINTAINED BY VDOT

FUNCTIONAL CLASSIFICATION OF ROADS SYSTEM UNDER WHICH PIPE IS TO BE INSTALLED			
HIGHER FUNCTIONAL CLASS - HFC 75 - YEAR DESIGN LIFE RURAL PRINCIPAL ARTERIAL, URBAN PRINCIPAL ARTERIAL, RURAL MINOR ARTERIAL, URBAN MINOR ARTERIAL, RURAL COLLECTOR ROADS, URBAN COLLECTOR STREETS, SUBDIVISION STREETS WITH AN ADT GREATER THAN 4000		LOWER FUNCTIONAL CLASS - LFC 50 - YEAR DESIGN LIFE RURAL LOCAL ROADS, URBAN LOCAL STREETS, SUBDIVISION STREETS WITH AN ADT LESS THAN OR EQUAL TO 4000	
ALLOWABLE PIPE CULVERTS NOTES 1 & 2	STATEWIDE	STATEWIDE EXCEPT LOCATIONS SHOWN IN TABLE B	LOCATION SHOWN IN TABLE B
CONCRETE	✓	✓	✓
ALUMINUM COATED TYPE 2 STEEL SPIRAL RIB NOTE 3		✓	
POLYMER COATED (10/10) CORRUGATED STEEL SPIRAL RIB NOTE 3		✓	✓
POLYMER COATED (10/10) CORRUGATED STEEL DOUBLE WALL (SMOOTH INTERIOR) NOTE 3	✓	✓	✓
ALUMINUM SPIRAL RIB NOTE 3		✓	✓
POLYVINYLCHLORIDE (PVC) PROFILE WALL PIPE (SMOOTH INTERIOR)	✓	✓	✓
POLYETHYLENE (PE) CORRUGATED TYPE S	✓	✓	✓
POLYPROPYLENE (PP) TYPE D OR S	✓	✓	✓

TABLE B

EXCEPTIONS TO STATEWIDE APPLICATIONS

COUNTIES (INCLUDING TOWNS)				CITIES	
ARLINGTON - EAST OF AND INCLUDING RTES. 95 & 395		SURRY - EAST OF AND INCLUDING RTE. 10		SUFFOLK - EAST OF AND INCLUDING RTE. 32	
FAIRFAX - EAST OF AND INCLUDING RTES. 95 & 395		ISLE OF WIGHT - EAST OF AND INCLUDING RTE. 10		CHESAPEAKE	WILLIAMSBURG
PRINCE WILLIAM - EAST OF AND INCLUDING RTES. 95 & 395				VIRGINIA BEACH	POQUOSON
WESTMORELAND	JAMES CITY	ESSEX	NORTHAMPTON	HAMPTON	PORTSMOUTH
LANCASTER	ACCOMACK	MIDDLESEX	STAFFORD	NEWPORT NEWS	
MATTHEWS	SPOTSYLVANIA	YORK	KING GEORGE	NORFOLK	
GLOUCESTER	NORTHUMBERLAND	RICHMOND		ALEXANDRIA	
				FREDERICKSBURG	

TABLE C

PIPE TYPE	ALLOWABLE pH RANGE (SEE NOTE 6)		ALLOWABLE RESISTIVITY RANGE (Ohms-cm)		ALLOWABLE VELOCITY (FPS) (SEE NOTE 4)
	MIN.	MAX.	MIN.	MAX.	MAXIMUM
UNCOATED GALVANIZED CORRUGATED STEEL	6.0	10.0	2000	10000	5
GALVANIZED STEEL STRUCTURAL PLATE	6.0	9.0	2000	10000	5
GALVANIZED STEEL STRUCTURAL PLATE WITH THICKENED INVERT	6.0	9.0	2000	10000	15
ALUMINUM COATED TYPE 2 CORRUGATED STEEL	5.0	9.0	1500	-	5
ALUMINUM COATED TYPE 2 SPIRAL RIB	5.0	9.0	1500	-	5
CORRUGATED ALUMINUM ALLOY	4.0	9.0	1500	-	5
CORRUGATED ALUMINUM ALLOY STRUCTURAL PLATE	4.0	9.0	1500	-	5
ALUMINUM SPIRAL RIB	4.0	9.0	1500	-	5
POLYMER COATED (10/10) CORRUGATED STEEL	4.0	9.0	750	-	10
POLYMER COATED CORRUGATED STEEL SPIRAL RIB	4.0	9.0	750	-	10
POLYMER COATED CORRUGATED STEEL DOUBLE WALL	4.0	9.0	750	-	10

NOTES:

1. ALLOWABLE TYPES OF PIPES FOR A SPECIFIC AREA ARE TO CONFORM TO THE CRITERIA SHOWN IN TABLES A, A1, B, AND C. ANY DEVIATION MUST BE APPROVED BY THE STATE LOCATION AND DESIGN ENGINEER AND THE DISTRICT MATERIALS ENGINEER.
2. SEE HEIGHT OF COVER TABLES FOR MINIMUM AND MAXIMUM COVER LIMITATIONS FOR EACH TYPE OF PIPE.
3. SEE TABLE C FOR MINIMUM AND MAXIMUM pH, RESISTIVITY, AND VELOCITY LIMITATIONS FOR METAL PIPES. SEE TABLE D FOR REQUIRED GAUGE OF METAL PIPE.
4. ALLOWABLE WATER VELOCITY IN PIPE WHERE ABRASIVE BEDLOAD IS PRESENT OR ANTICIPATED. MAXIMUM VELOCITY BASED ON 10 YEAR DESIGN DISCHARGE (Q).
5. pH VALUES APPLY TO BOTH THE IN-SITU SOIL AND WATER. THE LESSER OF THE TWO VALUES SHALL APPLY.
6. ph OF SOIL - AASHTO T289.
   ph OF WATER - ASTM 1293-12 METHOD A
   RESISTIVITY (MINIMUM) OF SOIL - AASHTO T288
7. LARGE CULVERTS SHALL BE DESIGNED BY AN ENGINEER, REGISTERED IN THE COMMONWEALTH OF VIRGINIA, AND SHALL BE DESIGNED IN ACCORDANCE WITH THE REQUIREMENTS OF VOLUME V, PART 2 OF THE MANUAL OF THE STRUCTURE AND BRIDGE DIVISION. A LARGE CULVERT IS ANY CULVERT THAT WILL BECOME PART OF THE STRUCTURE AND BRIDGE INVENTORY. THE GEOMETRIC DEFINITION OF THESE STRUCTURES IS PROVIDED IN THE CURRENT VERSION OF VDOT'S IIM-S&B-27.

ALLOWABLE PIPE CRITERIA FOR CULVERT AND STORM SEWERS

VIRGINIA DEPARTMENT OF TRANSPORTATION

SPECIFICATION REFERENCE
232
302

TABLE D - REQUIRED METAL GAUGE THICKNESS (AFTER ABRASION CONSIDERATIONS)

TABLE D FOR GALVANIZED STEEL 50-YEAR DESIGN LIFE								
	MINIMUM IN -SITU SOIL RESISTIVITY							
pH *	2000	3000	4000	5000	6000	7000	8000	>9000
6	10	12	12	12	12	12	14	14
6.5	12	12	12	14	14	14	14	16
6.8	12	14	14	14	16	16	16	16
7	14	14	16	16	16	16	16	16
7.1	14	16	16	16	16	16	16	16
≥ 7.2	16	16	16	16	16	16	16	16

TABLE D FOR GALVANIZED STEEL 75-YEAR DESIGN LIFE					
	MINIMUM IN -SITU SOIL RESISTIVITY				
pH *	2000	3000	4000-5000	6000-8000	>9000
6	8	8	10	10	12
6.5	8	10	10	12	12
6.8	10	10	12	12	12
7	10	12	12	12	12
7.1	12	12	12	12	12
≥7.2	12	12	12	12	12

TABLE D FOR ALUMINUM COATED TYPE 2, ALUMINUM ALLOY, AND POLYMER -COATED STEEL 50-YEAR DESIGN LIFE											
	MINIMUM IN -SITU SOIL RESISTIVITY										
pH *	1500	2000	3000	4000	5000	6000	7000	8000	9000	10000	>20000
4	10	10	12	12	12	12	14	14	14	14	16
5	12	12	12	14	14	14	14	16	16	16	16
5.5	12	12	14	14	14	16	16	16	16	16	16
6	12	12	14	14	14	16	16	16	16	16	16
6.5	14	14	14	16	16	16	16	16	16	16	16
6.8	14	14	16	16	16	16	16	16	16	16	16
≥7	16	16	16	16	16	16	16	16	16	16	16

TABLE D FOR ALUMINUM COATED TYPE 2, ALUMINUM ALLOY, AND POLYMER -COATED STEEL 75-YEAR DESIGN LIFE															
	MINIMUM IN -SITU SOIL RESISTIVITY														
pH *	1500	2000	3000	4000	5000	6000	7000	8000	9000	10000	20000	30000	40000	50000	>50000
4	N/A	N/A	8	10	10	10	10	12	12	12	12	12	14	14	14
5	8	8	10	10	12	12	12	12	12	12	12	14	14	14	14
5.5	8	10	12	12	12	12	12	12	12	12	14	14	14	16	16
6	10	10	12	12	12	12	12	12	12	12	14	14	16	16	16
6.5	12	12	12	12	12	12	12	14	14	14	16	16	16	16	16
6.8	12	12	12	12	14	14	14	14	14	14	16	16	16	16	16
7	12	12	14	14	14	14	14	16	16	16	16	16	16	16	16
7.1	12	12	14	14	16	16	16	16	16	16	16	16	16	16	16
7.2	14	14	14	16	16	16	16	16	16	16	16	16	16	16	16
7.3	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16
> 7.3	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16

NOTES:

1. LEVEL 3 ABRASION IS MAXIMUM FOR POLYMER COATED STEEL PIPE AND GALVANIZED STEEL PLATE WITH THICKENED INVERT.
2. LEVEL 2 ABRASION IS MAXIMUM FOR REST OF METAL PIPES.
3. PIPES THAT MEET THE CRITERIA OF TABLES A, B, AND C MAY NOT MEET THE CONSIDERATION OF PARTICLE SIZE OF THE BEDLOAD AS DESCRIBED IN THE FHWA ABRASION REQUIREMENTS.
4. BASED ON pH AND RESISTIVITY REQUIREMENTS THE GAUGE OF PIPE MAY NEED TO BE INCREASED AS NOTED IN THESE TABLES TO ATTAIN THE REQUIRED DESIGN LIFE.

* MINIMUM AND MAXIMUM ph FOR EACH PIPE TYPE IS LISTED IN TABLE C

ABRASION LEVEL DEFINITIONS (FHWA)

LEVEL 1 - NONABRASIVE CONDITIONS, AREAS OF NO BEDLOAD AND VERY LOW VELOCITIES. THIS IS THE CONDITION ASSUMED FROM THE SOIL SIDE OF DRAINAGE PIPES

LEVEL 2 - LOW ABRASIVE CONDITIONS, AREAS OF MINOR BEDLOADS AND VELOCITIES OF 5 ft/s OR LESS.

LEVEL 3 - MODERATE ABRASIVE CONDITIONS, AREAS OF MODERATE BEDLOADS OF SAND AND GRAVEL AND VELOCITIES BETWEEN 5 ft/s AND 15 ft/s.

LEVEL 4 - SEVERE ABRASIVE CONDITIONS, AREAS OF HEAVY BEDLOADS OF SAND, GRAVEL, AND ROCK AND VELOCITIES EXCEEDING 15 ft/s.

SPECIFICATION REFERENCE

232
302

A COPY OF THE ORIGINAL SEALED AND SIGNED STANDARD DRAWING IS ON FILE IN THE CENTRAL OFFICE

ALLOWABLE PIPE CRITERIA FOR CULVERT AND STORM SEWERS

VIRGINIA DEPARTMENT OF TRANSPORTATION

VDOT
ROAD AND BRIDGE STANDARDS

REVISION DATE 11/15

SHEET 18 OF 18

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