

REVISED ON 7/05

CONCRETE PIPE CULVERT CRUSHING STRENGTH (LBS. PER LIN. FT. ULTIMATE STRENGTH, OR CLASS)							PC - 1
DIAMETER (IN.)	AREA (SQ. FT.)	METHOD A BEDDING MAXIMUM HEIGHT OF COVER IN FEET				DIAMETER (IN.)	
		STRENGTH OR CLASS					
		NON REINF.	III	IV	V		
12	0.8	1800 (14')	14'	19'	29'	12	
15	1.2	2125 (14')	14'	19'	29'	15	
18	1.8	2400 (14')	14'	20'	29'	18	
21	2.4	2700 (13')	14'	20'	29'	21	
24	3.1	3000 (13')	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	

Heights of cover shown in table are for finished construction.

To protect pipe during construction, minimum heights of cover prior to allowing construction traffic to cross installation are to be 2' or 3.0' whichever is greater. This cover shall extend the full length of the pipe culvert. The approach fill ramp is to extend a minimum of 10(Dia.+3') on each side of the culvert, or to the intersection with a cut.

Minimum finished height of cover to be $\frac{Dia}{2}$ or 2.0' whichever is greater, except pipe under entrances and median crossovers where a 9" min. will be permitted.

Sheet 1 of 17

SPECIFICATION
REFERENCE

302
232

CONCRETE PIPE
CLASS TABLE FOR H-20 LIVE LOAD
VIRGINIA DEPARTMENT OF TRANSPORTATION

107.05

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PC-1		HORIZONTAL INSTALLATION		VERTICAL INSTALLATION		
EQUIVALENT ROUND SIZE (IN.)	SPAN X RISE (IN.)	MAX. HEIGHT OF COVER IN FEET		MAX. HEIGHT OF COVER IN FEET		
		1 - 13	14 - 21	1 - 13	14 - 21	22 - 29
		HE - III	HE - IV	VE - III	VE - IV	VE - V
18	23 x 14					
24	30 x 19					
27	34 x 22					
30	38 x 24					
33	42 x 27					
36	45 x 29					
39	49 x 32					
42	53 x 34					
48	60 x 38					
54	68 x 43					
60	76 x 48					
66	83 x 53					
72	91 x 58					
78	98 x 63					
84	106 x 68					

Heights of cover shown in table are for finished construction. To protect pipe during construction, minimum heights of cover prior to allowing construction traffic to cross installation are to be $\frac{\text{Span}}{2}$ or 3.0' whichever is greater. This cover shall extend the full length of the pipe culvert. The approach fill ramp is to extend a minimum of 10(Span + 3') on each side of the culvert or to the intersection with a cut. Minimum finished height of cover to be $\frac{\text{Span}}{2}$ or 2.0' whichever is greater, except pipe under entrances and median crossovers where a 9" minimum will be permitted.

ELLIPTICAL CONCRETE PIPE
TABLE FOR H-20 LIVE LOAD
VIRGINIA DEPARTMENT OF TRANSPORTATION

SPECIFICATION REFERENCE
302
232

REVISED ON 7/05

PIPE DIAMETER (IN.)	AREA (SQ. FT.)	CORRUGATED STEEL PIPE - 2 2/3" x 1/2" CORRUGATIONS										MINIMUM SHEET THICKNESS FOR ENTRANCES WITH LESS THAN 1 FOOT COVER.	Notes:	PC-1
		MAXIMUM HEIGHT OF COVER LIMITS IN FEET												
		SHEET THICKNESS IN INCHES (GAUGE)												
		.064 (16)		.079 (14)		.109 (12)		.138 (10)		.168 (8)				
		CIRCULAR	ELONGATED	CIRCULAR	ELONGATED	CIRCULAR	ELONGATED	CIRCULAR	ELONGATED	CIRCULAR	ELONGATED			
12	.79	92		101								16		
15	1.23	69	74	80		104		108				16		
18	1.77	47	61	55	67	71	86	89	90	94		16		
21	2.40	36	53	41	57	51	74	62	77	74	81	14		
24	3.14	29	46	33	50	40	65	47	68	55	71	12		
27	3.98	26	41	28	44	33	57	38	60	44	63			
30	4.91	23	37	25	40	28	52	32	54	36	56			
33	5.94	21	33	23	36	25	47	28	49	31	51			
36	7.1	20	30	21	33	23	43	26	45	28	47			
42	9.6	19	34	20	40	21	42	22	45	24	48			
48	12.6	18	30	19	38	19	39	20	41	21	43			
54	16.0			18	32	19	38	19	39	20	40			
60	19.6					18	34	19	38	19	39			
66	23.8							18	34	18	37			
72	28.3							18	26	18	33			
78	33.2									18	26			
84	38.5									17	20			
PIPE DIAMETER (IN.)	AREA (SQ. FT.)	CORRUGATED STEEL PIPE - 3" x 1" and 5" x 1" CORRUGATIONS										MINIMUM SHEET THICKNESS FOR ENTRANCES WITH LESS THAN 1 FOOT COVER.	Notes:	
		MAXIMUM HEIGHT OF COVER LIMITS IN FEET												
		SHEET THICKNESS IN INCHES (GAUGE)												
		.064 (16)		.079 (14)		.109 (12)		.138 (10)		.168 (8)				
		CIRCULAR	ELONGATED	CIRCULAR	ELONGATED	CIRCULAR	ELONGATED	CIRCULAR	ELONGATED	CIRCULAR	ELONGATED			
36	7.1	34	53	38	66	47	95	57	114	66	130			
42	9.6	27	45	30	56	36	72	42	84	48	97			
48	12.6	24	39	26	49	30	60	34	68	38	76			
54	16.0	22	35	23	44	26	52	28	57	31	63			
60	19.6	20	31	21	39	23	47	25	51	27	55			
66	23.8	19	28	20	36	22	44	23	47	25	50			
72	28.3	19	26	19	33	20	41	22	44	23	46			
78	33.2	18	24	19	30	20	40	21	42	21	43			
84	38.5	18	22	18	28	19	39	20	40	21	42			
90	44.2	18	21	18	26	19	38	19	39	20	40			
96	50.3			18	24	18	36	19	38	19	39			
102	56.7			18	22	18	31	18	37	19	38			
108	63.6					18	26	18	34	18	37			
114	70.9					18	22	18	29	18	36			
120	78.5					17	19	18	25	18	31			
132	95.0							17	18	18	23			
144	113.0									17	18			
SPECIFICATION REFERENCE	CORRUGATED STEEL PIPE												Sheet 3 of 17	
	302 232	HEIGHT OF COVER TABLE FOR H-20 LIVE LOAD												
	VIRGINIA DEPARTMENT OF TRANSPORTATION												107.07	

Cover heights indicated in tables are for finished construction.
To protect pipe during construction, minimum height of cover to be as follows prior to allowing construction traffic to cross installation.

Pipe Diameter	Min. Cover Height* During Construction
12" to 30"	1'-6"
36" and above	Diameter 2

Minimum finished height of cover is to be 1/8 Dia. or 1'-0", whichever is greater, except pipe underentrances and medians crossovers where a 9" minimum will be permitted for pipe up to 24" diameter in which case the tabulated Min. sheet thickness for entrances with less than 1 foot cover shall be used.

* The cover shall extend the full length of the pipe. The approach fill is to approach fill is to extend a Min. of (10) (Dia. 1/2 Dia.) on each side of the structure, or to the intersection with a cut.

Allowable cover height, as indicated in the tables to the left, in excess of 100' are to be considered as special design installations and will require detailed foundation determination.

For details of elongated pipe see sheet 17 of 17.

The allowable cover tables shown are 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.

CONCRETE-LINED CORRUGATED STEEL PIPE
Maximum height of cover to be in accordance with the tables but shall not exceed 30'.
Method "A" bedding is to be used
No elongated pipe allowed

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CORRUGATED ALUMINUM ALLOY PIPE - 2 2/3" x 1/2" CORRUGATIONS												MINIMUM SHEET THICKNESS FOR ENTRANCES WITH LESS THAN 1 FOOT COVER
PIPE DIAMETER (IN.)	AREA (SQ. FT.)	MAXIMUM HEIGHT OF COVER LIMITS IN FEET										
		SHEET THICKNESS IN INCHES										
		.060 (16)		.075 (14)		.105 (12)		.135 (10)		.164 (8)		
		CIRCULAR	ELONGATED	CIRCULAR	ELONGATED	CIRCULAR	ELONGATED	CIRCULAR	ELONGATED	CIRCULAR	ELONGATED	
12	0.8	50		50		80	86	90		93		.060
15	1.2	35	40	39	40	49	69	60	72	71	74	.105
18	1.8	27	33	30	33	35	57	41	60	48	62	.135
21	2.4	23	28	25	28	28	49	32	51	36	53	
24	3.1	21	25	22	25	25	43	27	45	30	46	
27	4.0	20	22	20	22	22	38	24	40	26	41	
30	4.9	19	20	19	20	21	34	22	36	23	37	
33	5.9	18		18		20	31	21	32	22	33	
36	7.1	16		16		19	28	20	30	21	31	
42	9.6	17	18	18	24	18	34	19	38	19	39	
48	12.6					18	23	18	30	18	37	
54	15.9					16		18	21	18	27	
60	19.6							15		17	19	
66	23.8									14		
72	28.3									11		

CORRUGATED ALUMINUM ALLOY PIPE - 3" X 1" CORRUGATIONS											
PIPE DIAMETER (IN.)	AREA (SQ. FT.)	MAXIMUM HEIGHT OF COVER LIMITS IN FEET									
		SHEET THICKNESS IN INCHES (GAUGE)									
		.060 (16)		.075 (14)		.105 (12)		.135 (10)		.164 (8)	
		CIRCULAR	ELONGATED	CIRCULAR	ELONGATED	CIRCULAR	ELONGATED	CIRCULAR	ELONGATED	CIRCULAR	ELONGATED
36	7.1	23	30	24	37	27	51	30	61	34	68
42	9.6	20	26	21	32	23	44	25	51	27	55
48	12.6	19	22	20	28	21	38	22	45	24	48
54	16.0	18	20	19	25	20	34	21	42	22	44
60	19.6	18		18	22	19	31	20	40	20	41
66	23.8			18	20	18	28	19	38	19	39
72	28.3			18		18	25	18	37	19	38
78	33.2			17		18	23	18	31	18	37
84	38.5					17	19	18	25	18	31
90	44.2					15		17	20	18	25
96	50.3					12		16		17	21
102	56.7							14		17	
108	63.6							11		14	
114	70.9									12	
120	78.5									10	

Notes:

Cover heights indicated in tables are for finished construction.

To protect pipe during construction, minimum height of cover to be as follows prior to allowing construction traffic to cross installation.

Pipe Diameter	Min. Cover Height * During Construction
12" to 24"	1'-6"
30" and over	Equal to Diameter

* Minimum finished height of cover to be Dia./8 or 1'-0", whichever is greater except pipe under entrances and median crossovers where a 9" minimum will be permitted for pipe up to 18" diameter in which case the tabulated minimum thickness for entrances with less than 1 ft. cover shall be used.

* The cover shall extend the full length of the pipe culvert. The minimum of 20 Diameters on each approach fill ramp is to extend a side of the culvert, or to the intersection with a cut.

For details of elongated pipe see sheet 17 of 17.

The allowable cover tables shown are 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.

Sheet 4 of 17

CORRUGATED ALUMINUM ALLOY PIPE
HEIGHT OF COVER TABLE FOR H-20 LIVE LOAD

VIRGINIA DEPARTMENT OF TRANSPORTATION

SPECIFICATION
REFERENCE

302
232

107.08

REVISED ON 7/05

PC-1

CORRUGATED ALUMINUM ALLOY PIPE - 6" x 1" CORRUGATIONS											
PIPE DIAMETER (IN.)	AREA (SQ. FT.)	MAXIMUM HEIGHT OF COVER LIMITS IN FEET									
		SHEET THICKNESS IN INCHES (GAUGE)									
		.060 (16)		.075 (14)		.105 (12)		.135 (10)		.164 (8)	
		CIRCULAR	ELONGATED	CIRCULAR	ELONGATED	CIRCULAR	ELONGATED	CIRCULAR	ELONGATED	CIRCULAR	ELONGATED
36	7.1	22	29	24	36	26	51	30	60	33	66
42	9.6	20	25	21	31	23	44	25	50	27	54
48	12.6	19	22	20	27	21	38	22	45	23	47
54	16.0	18	19	19	24	20	34	21	42	21	43
60	19.6	17		18	22	19	31	19	39	20	41
66	23.8	16		18	20	18	28	19	36	19	39
72	28.3			18		18	25	18	33	19	38
78	33.2			16		18	23	18	30	18	37
84	38.5					17	18	18	24	18	29
90	44.2					15		17	19	18	24
96	50.3							16		17	19
102	56.7							13		16	
108	63.6									14	
114	70.9									11	
120	78.5										

Notes:

Cover heights indicated in tables are for finished construction.

To protect pipe during construction, minimum height of cover to be as follows prior to allowing construction traffic to cross installation.

Pipe Diameter	Min. Cover Height * During Construction
30" and over	Equal to Diameter

Minimum finished height of cover to be 1/8 Dia. or 1'-0", whichever is greater.

* The cover shall extend the full length of the pipe culvert. The approach fill ramp is to extend a minimum of (10)(2 Diameters) on each side of the culvert, or to the intersection with a cut.

For details of elongated pipe see sheet 17 of 17.

The allowable cover tables shown are 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
302 232

CORRUGATED ALUMINUM ALLOY PIPE
HEIGHT OF COVER TABLE FOR H-20 LIVE LOAD

VIRGINIA DEPARTMENT OF TRANSPORTATION

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PC-1							
MINIMUM SHEET THICKNESS AND DESIGN DATA							
NOMINAL SIZE SPAN - RISE (INCHES)	PIPE ARCH DIMENSION				MINIMUM SHEET THICKNESS REQUIRED (INCHES)	MAXIMUM COVER HEIGHT (FEET)	
	EQUIVALENT PIPE DIAMETER (INCHES)	AREA (SQ. FT.)	MAXIMUM "B" (INCHES)	Rc (INCHES)		MAXIMUM CORNER PRESSURE	
						4000 LBS./SQ. FT.	* 6000 LBS./SQ. FT.
2 2/3" X 1/2" CORRUGATIONS							
17 x 13	15	1.1	5 1/4"	3	.064 (16)	11	17
21 x 15	18	1.6	6"	3	.064 (16)	9	14
24 x 18	21	2.2	7 1/4"	3	.064 (16)	8	12
28 x 20	24	2.8	8"	3	.064 (16)	7	10
35 x 24	30	4.4	9 1/2"	3	.064 (16)	5	8
42 x 29 †	36	6.4	10 1/2"	3 1/2	.064 (16)	5	8
49 x 33 †	42	8.7	11 1/2"	4	.079 (14)	5	8
57 x 38 †	48	11.4	13 1/2"	5	.109 (12)	5	8
64 x 43 †	54	14.3	15"	6	.109 (12)	6	9
71 x 47 †	60	17.6	16 1/2"	7	.138 (10)	6	9
77 x 52 †	66	21.3	18"	8	.168 (8)	6	10
83 x 57 †	72	25.3	20"	9	.168 (8)	7	10
3" X 1" AND 5" X 1" CORRUGATIONS							
40 x 31 †	36	6.4	9 3/4"	5	.109 (12)	8	12
46 x 36 †	42	8.7	11 1/2"	6	.109 (12)	8	12
53 x 41 †	48	11.4	13"	7	.109 (12)	8	13
60 x 46 †	54	14.3	14 3/4"	8	.109 (12)	8	13
66 x 51 †	60	17.6	16 1/2"	9	.109 (12)	9	13
73 x 55 †	66	22.0	21 1/2"	12	.109 (12)	11	16
81 x 59 †	72	26.0	23"	14	.109 (12)	11	17
87 x 63	78	31.0	24 1/2"	14	.109 (12)	10	16
95 x 67	84	35.0	26 1/2"	16	.109 (12)	11	16
103 x 71	90	40.0	27"	16	.109 (12)	10	15
112 x 75	96	46.0	29"	18	.109 (12)	10	16
117 x 79	102	52.0	30 3/4"	18	.109 (12)	10	15
128 x 83	108	58.0	29 1/2"	18	.138 (10)	9	14
137 x 87	114	64.0	30 3/4"	18	.138 (10)	8	13
142 x 91	120	71.0	32 1/2"	18	.168 (8)	8	12

Notes:

- * Figures in parenthesis denote corresponding gage to sheet thickness.
- Span of Pipe Arches is measured "B" inches above the invert.
- Cover heights indicated in tables are for finished construction.
- To protect pipe during construction, minimum height of cover to be as follows prior to allowing construction traffic to cross installation.

Pipe Arch Span	** Min. Cover Height During Construction
17" to 35"	1'-6"
42" and above	Span 2

- † Indicates pipe arches for which dimensions for either corrugation may be used within fill height limitations.

The allowable cover tables shown are 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.

Sheet 6 of 17	<p>CORRUGATED STEEL PIPE ARCH HEIGHT OF COVER TABLE FOR H-20 LIVE LOAD</p> <p>VIRGINIA DEPARTMENT OF TRANSPORTATION</p>	<p>SPECIFICATION REFERENCE</p> <p>232 302</p>
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MINIMUM SHEET THICKNESS AND DESIGN DATA							Notes:	PC-1
PIPE ARCH DIMENSION				MINIMUM SHEET THICKNESS REQUIRED (INCHES)	MAXIMUM COVER HEIGHT (FEET)			
NOMINAL SIZE SPAN - RISE (INCHES)	EQUIVALENT PIPE DIAMETER (INCHES)	AREA (SQ. FT.)	Rc (INCHES)		MAXIMUM CORNER PRESSURE			
					4000 LBS./SQ. FT.	* 6000 LBS./SQ. FT.		
2 2/3" X 1/2" CORRUGATIONS								
17 X 13	15	1.1	3"	.060 (16)	11	17		
21 X 15	18	1.6	3"	.060 (16)	9	14		
24 X 18	21	2.2	3"	.060 (16)	8	12		
28 X 20	24	2.8	3"	.075 (14)	7	10		
35 X 24	30	4.4	3"	.075 (14)	5	8		
42 X 29 †	36	6.4	3 1/2"	.105 (12)	5	8		
49 X 33 †	42	8.7	4"	.105 (12)	5	8		
57 X 38 †	48	11.4	5"	.135 (10)	5	8		
64 X 43 †	54	14.3	6"	.135 (10)	6	9		
71 X 47 †	60	17.6	7"	.164 (8)	6	9		
3" X 1" CORRUGATIONS								
40 X 31 †	36	6.4	5"	.060 (16)	8	12		
46 X 36 †	42	8.7	6"	.060 (16)	8	12		
53 X 41 †	48	11.4	7"	.060 (16)	8	13		
60 X 46 †	54	14.3	8"	.075 (14)	8	13		
66 X 51 †	60	17.6	9"	.075 (14)	9	13		
73 X 55	66	22.0	12"	.105 (12)	11	16		
81 X 59	72	26.0	14"	.105 (12)	11	17		
87 X 63	78	31.0	14"	.135 (10)	10	16		
95 X 67	84	35.0	16"	.135 (10)	11	16		
103 X 71	90	40.0	16"	.164 (8)	10	15		
112 X 75	96	46.0	18"	.164 (8)	10	13		
117 X 79	102	52.0	18"	.164 (8)	10	11		
† Indicates pipe arches for which demensions for either corrugation may be used within fill height limitations.								
Sheet 7 of 17								
SPECIFICATION REFERENCE	CORRUGATED ALUMINUM ALLOY PIPE ARCH HEIGHT OF COVER TABLE FOR H-20 LIVE LOAD							
232 302	VIRGINIA DEPARTMENT OF TRANSPORTATION							107.11

* Figures in parenthesis denote corresponding gage to sheet thickness.
 Cover heights indicated in tables are for finished construction.
 To protect pipe during construction, minimum height of cover to be as follows prior to allowing construction traffic to cross installation.

Pipe Arch Span	** Min. Cover Height During Construction
17" to 35"	1'-6"
42" and above	Span 2

Minimum finished height of cover to be 1/8 Span or 1'-0", whichever is greater.

** 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 the intersection with a cut.

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.

A tolerance of plus, or minus, 1 inch is permissible for dimensions of span, rise, and corner radius.

* When design height of cover falls within this category, foundation and backfill must be approved by the engineer.

The allowable cover tables shown are 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.

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PC-1		STRUCTURAL PLATE STEEL PIPE -6" X 2" CORRUGATIONS													
PIPE DIAMETER (IN.)	AREA (SQ. FT.)	MAXIMUM HEIGHT OF COVER LIMITS IN FEET													
		SHEET THICKNESS IN INCHES (GAUGE)													
		0.109 (12)		0.138 (10)		0.168 (8)		0.188 (7)		0.218 (5)		0.249 (3)		0.280 (1)	
		CIRCULAR	ELONGATED	CIRCULAR	ELONGATED	CIRCULAR	ELONGATED	CIRCULAR	ELONGATED	CIRCULAR	ELONGATED	CIRCULAR	ELONGATED	CIRCULAR	ELONGATED
60	20	43	47	50	68	58	90	63	103	71	124	79	146	88	160
66	24	36	43	42	62	48	81	51	93	58	113	64	128	70	141
72	28	32	39	36	57	40	75	43	86	48	97	53	106	58	116
78	33	28	36	32	52	35	69	38	76	41	83	45	91	49	99
84	38	26	34	29	49	32	64	33	67	36	73	39	79	43	86
90	44	24	31	27	45	29	58	30	61	33	66	35	71	38	76
96	50	23	29	25	43	27	54	28	56	30	60	32	64	34	68
102	57	22	28	23	40	25	50	26	53	28	56	29	59	31	63
108	64	21	26	22	38	24	48	25	50	26	52	27	55	29	58
114	71	20	25	21	36	23	46	23	47	25	50	26	52	27	54
120	78	20	23	21	34	22	44	22	45	23	47	24	49	25	51
132	95	19	21	20	31	20	40	21	42	22	44	22	45	23	47
144	113	18	19	19	28	20	37	20	40	21	42	21	43	22	44
156	133	18		18	26	19	34	19	39	20	40	20	41	21	42
168	154	17		18	24	18	32	19	36	19	39	19	39	20	40
180	177	15		18	22	18	30	18	34	19	38	19	38	19	39
192	201			18	21	18	28	18	32	18	37	19	37	19	38
204	227			17	19	18	24	18	27	18	32	18	37	18	37
216	254					17	20	18	23	18	27	18	31	18	35
228	284					17		17	19	18	23	18	26	18	30
240	314							16		17	19	18	22	18	25

Notes:

Cover heights indicated in the table are for finished construction.

To protect pipe during construction minimum height of cover prior to allowing construction traffic to cross installation is to be Dia./2

This cover shall extend the full length of the pipe.

Structural Plate Pipe dimensions are to inside crest and are subject to manufacturing tolerances.

The approach fill ramp is to extend a minimum of 10 (Dia.+3') on each side of the culvert, or to the intersection with a cut.

Minimum finished height of cover to be Dia./8 or 12" whichever is greater.

For details of elongated pipe see sheet 17 of 17.

The allowable cover tables shown are based on a soil modulus of 700 PSI.

All other design criteria are in accordance with AASHTO Specifications and VDOT Modifications for Soil Corrugated Metal Structure Interaction Systems.

Sheet 8 of 17

STRUCTURAL PLATE STEEL PIPE
HEIGHT OF COVER TABLE FOR H-20 LIVE LOAD

SPECIFICATION
REFERENCE

232
302

107.12

VIRGINIA DEPARTMENT OF TRANSPORTATION

REVISED ON 7/05

STRUCTURAL PLATE ALUMINUM PIPE - 9" X 2½" CORRUGATIONS															PC-1
PIPE DIAMETER (IN.)	AREA (SQ. FT.)	MAXIMUM HEIGHT OF COVER LIMITS IN FEET													
		SHEET THICKNESS IN INCHES													
		0.10		0.125		0.15		0.175		0.20		0.225		0.25	
		CIRCULAR	ELONGATED	CIRCULAR	ELONGATED	CIRCULAR	ELONGATED	CIRCULAR	ELONGATED	CIRCULAR	ELONGATED	CIRCULAR	ELONGATED	CIRCULAR	ELONGATED
60	20	29	31	32	45	35	60	38	70	41	81	45	89	48	96
66	24	26	28	28	41	31	54	33	64	35	71	38	76	40	80
72	28	24	25	25	37	27	50	29	59	31	62	33	66	35	70
78	33	22	23	24	34	25	46	26	53	28	56	29	59	31	62
84	38	21	22	22	32	23	42	25	49	26	52	27	54	28	56
90	44	20		21	30	22	40	23	46	24	48	25	50	26	52
96	50	19		20	28	21	37	22	44	23	46	23	47	24	49
102	57	18		20	26	20	35	21	41	22	44	22	45	23	46
108	64	17		19	25	20	33	20	39	21	42	21	43	22	44
114	71	16		19	24	19	31	20	37	20	41	21	42	21	43
120	78	15		18	22	19	30	19	35	20	40	20	41	20	41
132	95	14		18	20	18	27	19	32	19	37	19	39	19	39
144	113	12		18	19	18	25	18	29	18	33	19	38	19	38
156	133			17		18	23	18	27	18	31	18	35	18	37
168	154					17	19	18	22	18	26	18	29	18	32
180	177							17	18	18	21	18	23	18	26
192	201									17		17	19	17	21
204	227									14		16		17	18
216	254											13		15	
228	284													13	

Notes:

To protect pipe during construction minimum height of cover prior to allowing construction traffic to cross installation is to be Dia./2. This cover shall extend the full length of the pipe.

The approach fill ramp is to extend a minimum of 10(Dia. + 3') on each side of the structure, or to the intersection with a cut. Steelbolts only to be used.

Bolts are ¾" diameter, high strength to meet current AASHTO 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.

Sheet 9 of 17

Cover heights indicated in table are for finished construction.

Minimum finished height of cover to be Dia./8 or 12" whichever is greater.

[For details of elongated pipe see sheet 17 of 17.](#)

The allowable cover tables shown are based on a soil modulus of 700 PSI. All other design criteria are in accordance with AASHTO Specifications and VDOT Modifications for Soil Corrugated Metal Structure Interaction Systems.

SPECIFICATION REFERENCE 232 302	STRUCTURAL PLATE ALUMINUM ALLOY PIPE HEIGHT OF COVER TABLE FOR H-20 LIVE LOAD VIRGINIA DEPARTMENT OF TRANSPORTATION	107.13
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REVISED ON 7/05

PC-1						
MINIMUM THICKNESS-STRUCTURAL PLATE STEEL PIPE ARCHES 6" X 2" CORRUGATIONS						
PIPE ARCH DIMENSION				MINIMUM SHEET THICKNESS REQUIRED	MAXIMUM ALLOWABLE COVER HEIGHT (FT.)	
NOMINAL SIZE		AREA (SQ. FT.)	Rc (INCHES)		MAXIMUM CORNER PRESSURE	
SPAN	RISE				4000 LBS./SQ. FT.	*6000 LBS./SQ. FT.
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

Sheet 10 of 17

NOTES

- * When design height of cover falls within this category, foundation and backfill must be approved by the Engineer.

Cover heights indicated in table are for finished construction.

The allowable cover tables shown are 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.

Structural Plate Pipe-Arch dimensions are to inside of crest and are subject to manufacturing tolerances.

Minimum finished height of cover shall be $\frac{1}{8}$ Span or 1'-0", whichever is greater.

To protect pipe during construction minimum height of cover prior to allowing construction traffic to cross installation shall be $\frac{\text{Span}}{2}$.

This cover shall extend the full length of the pipe arch. The approach fill ramp is to extend a minimum of $(10)(\frac{\text{Height} + \text{Span}}{2})$ on each side of the structure, or to the intersection with a cut.

STRUCTURAL PLATE STEEL PIPE ARCH
HEIGHT OF COVER TABLE FOR H-20 LIVE LOAD

SPECIFICATION REFERENCE

232
302

107.14

VIRGINIA DEPARTMENT OF TRANSPORTATION

REVISED ON 7/05

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

Notes:

Cover heights indicated in table are for finished construction. Structural Plate Pipe-Arch dimensions are to inside crest and are subject to manufacturing tolerances.

To protect pipe during construction, minimum height of cover prior to allowing construction traffic to cross installation to be 1/2 Span. This 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.

Steel bolts only to be used.

Minimum finished height of cover to be 1/8 Span or 1'-0" whichever is greater.

Bolts are 3/4" 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 1 3/4" apart.

★ When design height of cover falls within this category, foundation and backfill must be approved by the Engineer.

The allowable cover tables shown are 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.

Sheet 12 of 17

STRUCTURAL PLATE ALUMINUM ALLOY PIPE ARCH HEIGHT OF COVER TABLE FOR H-20 LIVE LOAD

SPECIFICATION REFERENCE

232
302

107.16

VIRGINIA DEPARTMENT OF TRANSPORTATION

REVISED ON 7/05

PC-1

ALUMINUM SPIRAL RIB PIPE 3/4" WIDE x 3/4" DEEP RIBS SPACED @ 7/2"										MINIMUM SHEET THICKNESS FOR ENTRANCES WITH LESS THAN 1 FOOT COVER
PIPE DIAMETER (IN.)	AREA (SQ. FT.)	MAXIMUM HEIGHT OF COVER LIMITS IN FEET								
		SHEET THICKNESS IN INCHES (GAUGE)								
		.064 (16)		.079 (14)		.109 (12)		.135 (10)		
		CIRCULAR	ELONGATED	CIRCULAR	ELONGATED	CIRCULAR	ELONGATED	CIRCULAR	ELONGATED	
12	0.8	76	152	95		136				.060
15	1.2	47	94	57	114	78		100		.105
18	1.8	34	69	40	80	52	105	65	130	.135
21	2.4	28	56	31	63	39	78	47	94	
24	3.1	24	49	26	53	32	64	37	74	
27	4.0	22	44	24	48	27	55	31	62	
30	4.9	20	41	22	44	24	49	27	54	
36	7.1	19	38	20	40	21	42	23	46	
42	9.6	18	36	18	37	19	39	20	41	
48	12.6			18	36	18	37	19	39	
54	16.0					18	36	18	37	
60	19.6					18	36	18	36	
66	23.8							18	36	
72	28.3							17		

Notes:
 Cover heights indicated in tables are for finished construction.
 To protect pipe during construction, minimum height of cover to be as follows prior to allowing construction traffic to cross installation.

Pipe Diameter	Min. Cover Height * During Construction
12" to 24"	1'-6"
30" and over	Equal to Diameter

Minimum finished height of cover to be $\frac{D_{ig}}{4}$ or 1'-0", whichever is greater, except pipe under entrances and median crossovers where a 9" minimum will be permitted for pipe up to 18" diameter in which case the tabulated minimum sheet thickness for entrances with less than 1 ft. cover shall be used.

* The cover shall extend the full length of the pipe culvert. The approach fill ramp is to extend a minimum of (20)Diam. on each side of the culvert, or to the intersection with a cut.

For details of elongated pipe see sheet 17 of 17.

The allowable cover tables shown are 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.

Sheet 13 of 17

SPECIFICATION REFERENCE
232 302

ALUMINUM SPIRAL RIB PIPE
 HEIGHT OF COVER TABLE FOR H-20 LIVE LOAD
 VIRGINIA DEPARTMENT OF TRANSPORTATION

107.17

REVISED ON 7/05

PC-1		STEEL SPIRAL RIB PIPE 3/4" WIDE X 3/4" DEEP RIBS SPACED @ 7/2"						MINIMUM SHEET THICKNESS FOR ENTRANCES WITH LESS THAN 1 FOOT COVER	<p>Notes:</p> <p>Cover heights indicated in tables are for finished construction.</p> <p>To protect pipe during construction, minimum height of cover to be as follows prior to allowing construction traffic to cross installation.</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <th>Pipe Diameter</th> <th>Min. Cover Height * During Construction</th> </tr> <tr> <td>12" to 30"</td> <td>1'-6"</td> </tr> <tr> <td>36" and above</td> <td>$\frac{\text{Dia.}}{2}$</td> </tr> </table> <p>Minimum finished height of cover to be $\frac{\text{Dia.}}{4}$ or 1'-0", whichever is greater except pipe under entrances and median crossovers where a 9" minimum will be permitted for pipe up to 24" diameter in which case the tabulated minimum sheet thickness for entrances with less than 1 ft. cover shall be used.</p> <p>* The cover shall extend the full length of the pipe. The approach fill is to extend a minimum of $(10)(\text{Dia.} + \frac{1}{2}\text{Dia.})$ on each side of the structure, or to the intersection with a cut.</p> <p>Allowable cover heights, as indicated in the table to the left, in excess of 100' are to be considered as special design installations and will require detailed foundation determination.</p> <p>For details of elongated pipe see sheet 17 of 17.</p> <p>The allowable cover tables shown are 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.</p>	Pipe Diameter	Min. Cover Height * During Construction	12" to 30"	1'-6"	36" and above	$\frac{\text{Dia.}}{2}$
Pipe Diameter	Min. Cover Height * During Construction														
12" to 30"	1'-6"														
36" and above	$\frac{\text{Dia.}}{2}$														
PIPE DIAMETER (IN.)	AREA (SQ. FT.)	MAXIMUM HEIGHT OF COVER LIMITS IN FEET													
		SHEET THICKNESS IN INCHES (GAUGE)													
		.064 (16)		.079 (14)		.109 (12)									
		CIRCULAR	ELONGATED	CIRCULAR	ELONGATED	CIRCULAR	ELONGATED								
12	0.8	159								.064					
15	1.2	115								.064					
18	1.8	74		92		130		.064							
21	2.4	53	106	64	129	88		.079							
24	3.1	41	82	48	97	65	130	.109							
27	4.0	34	68	39	78	50	101								
30	4.9	29	58	33	66	41	83								
36	7.1	24	48	26	52	31	62								
42	9.6	21	43	23	46	26	52								
48	12.6	20	40	21	42	23	46								
54	16.0	19	38	19	39	21	42								
60	19.6	18	37	19	38	20	40								
66	23.8			18	37	19	38								
72	28.3			18	36	18	37								
78	33.2					18	36								
84	38.6					18	36								

Note:
A Maximum Height of Cover Table for Steel Spiral Rib Pipe with 3/4" wide X 1" deep ribs spaced at 1 1/2" is available upon request.

Sheet 14 of 17

STEEL SPIRAL RIB PIPE
HEIGHT OF COVER TABLE FOR H-20 LIVE LOAD

SPECIFICATION
REFERENCE

232
302

107.18

VIRGINIA DEPARTMENT OF TRANSPORTATION

CAST IRON PIPE CULVERT DESIGNATION⁽⁵⁾

Diameter IN.	Area SQ. FT.	MAXIMUM HEIGHT OF COVER IN FEET		
		1 - 13	14 - 21	22 - 35 (2)
12 (2)	0.8	Standard Pipe Method "A" Bedding	Heavy Pipe Method "A" Bedding	Extra Heavy Pipe Method "A" Bedding
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			

Notes:

- (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.
- (5) Crushing strength (Lbs. per Lin. Ft.)
 - Standard pipe 2000 D
 - Heavy pipe 3000 D
 - Extra heavy pipe 4000 D

Maximum height of cover shown in table is for finished construction. To protect pipe during construction, minimum height of cover prior to allowing construction traffic to cross installation is to be 2.0'. This cover is to extend the full length of the pipe culvert. The approach fill ramp is to extend a minimum of 10 (Diameter + 3') on each side of the culvert, or to the intersection with a cut. Minimum finished height of cover to be 2.0', except pipe under entrances and median crossovers where a 9" minimum will be permitted.

SPECIFICATION REFERENCE
232 302

CAST IRON PIPE
STRENGTH TABLE FOR H-20 LIVE LOAD

PC-1

EXTRA STRENGTH CLAY PIPE		
Diameter (IN.)	Area (SQ. FT.)	Allowable Maximum Cover (FT.)
12	0.8	15
15	1.2	15
18	1.8	15
21	2.4	15
24	3.1	15
30	4.9	13
36	7.1	13

Notes:

All Vitrified Clay Pipe is to be Extra Strength.

Maximum heights of cover shown in table are for finished construction.

To protect pipe during construction minimum height of cover prior to allowing construction traffic to cross installation is to be 3.0'. This cover is to extend the full length of the pipe culvert. The approach fill ramp is to extend a minimum of 10 (Dia. + 3') on each side of the culvert, or to the intersection with a cut.

Minimum finished height of cover to be 2.0', except pipe under entrances and median crossovers where a 9" minimum will be permitted.

Method "A" bedding is to be used for all installations unless otherwise designated on plans.

VITRIFIED CLAY

Sheet 16 of 17

POLYETHYLENE DOUBLE WALL CORRUGATED PIPE CULVERT		
Diameter (IN.)	Area (SQ. FT.)	Allowable Maximum Cover (FT.)
12	0.8	21
15	1.2	21
18	1.8	20
24	3.1	20
30	4.9	19
36	7.1	18

Note: For details of bedding for Polyethylene Pipe Culvert see Standard PB-1.

POLYVINYLCHLORIDE RIBBED PIPE CULVERT		
Diameter (IN.)	Area (SQ. FT.)	Allowable Maximum Cover (FT.)
18	1.7	20
21	2.3	19
24	3.0	19
30	4.7	18
36	6.9	18
48	12.3	18

Notes:

Cover heights indicated in tables are for finished construction.

To protect pipe during construction, minimum height of cover to be as follows prior to allowing construction traffic to cross installation.

Pipe Diameter	** Minimum cover Height During Construction
12" to 30"	1'-6"
36" and above	$\frac{\text{Diameter}}{2}$

Minimum finished height of cover to be $\frac{1}{8}$ Diameter or 1'-0" whichever is greater, except pipe under entrances and median crossovers where a 9" minimum will be permitted for pipe up to 24" diameter.

** The cover shall extend the full length of the pipe. The approach fill is to extend a minimum of $(10)(\text{Diameter} + \frac{1}{2} \text{ Diameter})$ on each side of the structure, or to the intersection with a cut.

The allowable cover tables shown are based on a soil modulus of 700 PSI. All other design criteria are in accordance with the AASHTO Specifications and VDOT Modifications for Soil Thermoplastic Pipe Interaction Systems.

PLASTIC PIPE

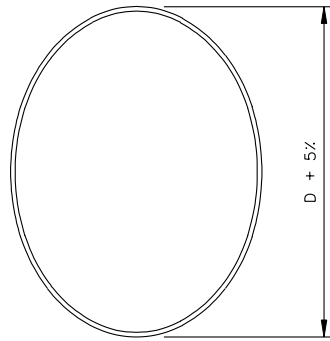
VITRIFIED CLAY AND PLASTIC PIPE
MAXIMUM COVER TABLE FOR H-20 LIVE LOAD

SPECIFICATION REFERENCE

232
302

107.20

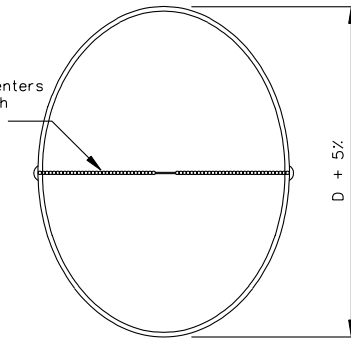
VIRGINIA DEPARTMENT OF TRANSPORTATION



ELLIPTICAL FACTORY SHAPE
(SHOP ELONGATED)

TYPE 1

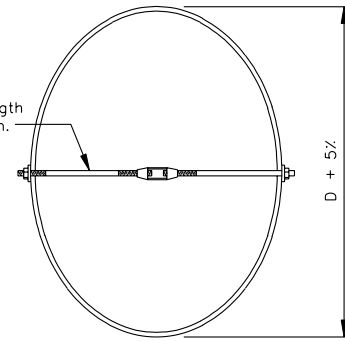
Double Line of Min.
8 ga. Wire on 2' Centers
Min. Tensile Strength
80,000 lbs./sq. in.



ELONGATED WITH WIRE

TYPE 2

Min. 4 ga. Rods
on 2' Centers.
Min. Tensile Strength
80,000 lbs./sq. in.



ELLIPTICAL WITH ROD
AND TURNBUCKLE

TYPE 3

D = Diameter of round pipe

Note:

Wire or rod to be removed when fill reaches height specified for allowing construction traffic.

Methods shown apply to corrugated steel or corrugated aluminum alloy pipe.

Pipe size and cover height combinations requiring elongation are to be as tabulated on the applicable PC-1 tables or as shown on plans.

Any of above types of elongation may be used, unless otherwise noted on plans, special provisions, or directed by the Engineer.

Field elongation will not be permitted without the approval of the Engineer, or unless indicated on plans.

Elongation is to be performed prior to any required bituminous coating and paving of the invert.

Wire and rods to be attached to side of pipe in accordance with manufacturer's standard methods, meeting the approval of the Engineer.

SPECIFICATION REFERENCE

SHOP ELONGATION OF CORRUGATED
METAL PIPE AND STRUCTURAL PLATE PIPE

VIRGINIA DEPARTMENT OF TRANSPORTATION