

**WEST VIRGINIA DEPARTMENT OF TRANSPORTATION  
DIVISION OF HIGHWAYS  
DESIGN DIRECTIVE**

**DD-502  
MAXIMUM FILL HEIGHT TABLES  
FOR VARIOUS TYPES PIPE**  
*October 1, 2003*

The following fill height tables for various type pipe materials are for use in pipe design.

Attachment

## REINFORCED CONCRETE PIPE

The following tables are to be used to determine the required strength and installation method for reinforced concrete pipe to adequately carry the design load.

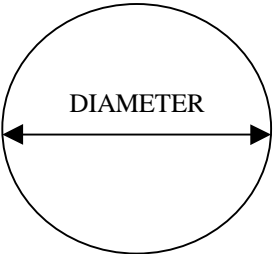
### MINIMUM COVER:

Values for minimum cover for highway loading are measured from top of pipe to the subgrade. Minimum cover for railroad loading is measured from top of pipe to the bottom of ties. Requirements by certain railroad companies, if more stringent, will govern over those listed herein.

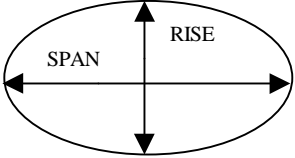
The following table is applicable to circular or elliptical pipes:

<b>MINIMUM FILL HEIGHTS (FEET)</b>				
	<b>CLASS II</b>	<b>CLASS III</b>	<b>CLASS IV</b>	<b>CLASS V</b>
Highway Loading	1	1	1	1
Railroad, 18" Through 24" D	5	2	2	2
Railroad, 36" Through 108" D	4	2	2	2

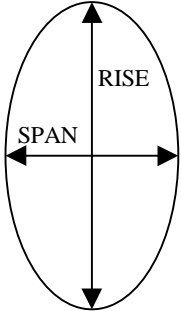
**MAXIMUM COVER FOR EMBANKMENT OR TRENCH INSTALLATION:**

<b>CIRCULAR RCP</b>					
 <p>Circular pipes are also available in diameters of 21, 27, 30, 33, 42, 54, 66, 78, 90 and 102.</p>	<b>Diameter (Inches)</b>	<b>Maximum Fill Heights (Feet)</b>			
		<b>Class II</b>	<b>Class III</b>	<b>Class IV</b>	<b>Class V</b>
	18	10	14	20	30
	24	11	14	21	31
	36	11	14	21	32
	48	11	14	22	32
	60	11	14	22	33
	72	11	15	22	34
	84	11	15	22	34
	96	12	15	22	35
108	13	16	22	37	

**MAXIMUM COVER FOR EMBANKMENT OR TRENCH INSTALLATION:**

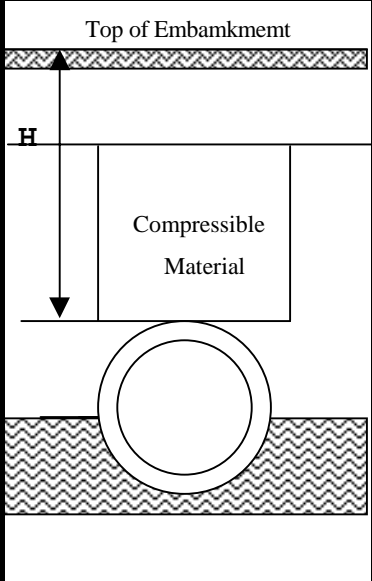
<b>HORIZONTAL ELLIPTICAL RCP</b>					
	<b>Rise x Span (Inches)</b>	<b>Equiv. Diameter (Inches)</b>	<b>Maximum Fill Heights (Feet)</b>		
			<b>Class HE-II</b>	<b>Class HE-III</b>	<b>Class HE-IV</b>
<p>This shape suitable for embankment or trench installation only.</p> <p>Minimum wall thicknesses vary from 2 3/4" to 8 1/2".</p> <p>"HE-" is required as part of the class when specifying this shape.</p>	14 x 23	18	10	14	20
	19 x 30	24	11	14	21
	22 x 34	27	11	14	21
	24 x 38	30	11	14	21
	27 x 42	33	11	14	21
	29 x 45	36	11	14	21
	32 x 49	39	11	14	21
	34 x 53	42	11	14	21
	38 x 60	48	11	14	--
	43 x 68	54	11	14	--
	48 x 76	60	11	14	--
	53 x 83	66	11	14	--
	58 x 91	72	11	15	--
	63 x 98	78	11	15	--
	68 x 106	84	11	15	--

**MAXIMUM COVER FOR EMBANKMENT OR TRENCH INSTALLATION:**

<b>VERTICAL ELLIPTICAL RCP</b>						
 <p>This shape for embankment or trench installation only.</p> <p>Minimum wall thicknesses vary from 4½" to 8½".</p> <p>"VE-" is required as part of class when specifying this shape.</p>	<b>Rise x Span (Inches)</b>	<b>Equiv. Diameter (Inches)</b>	<b>Maximum Fill Heights (Feet)</b>			
			<b>Class VE-II</b>	<b>Class VE-III</b>	<b>Class VE-IV</b>	<b>Class VE-V</b>
	45 x 29	36	11	14	21	32
	53 x 34	42	11	14	21	32
	60 x 38	48	11	14	22	32
	68 x 43	54	11	14	22	32
	76 x 48	60	11	14	22	33
	83 x 53	66	11	14	22	33
	91 x 58	72	11	15	22	--
	98 x 63	78	11	15	22	--
106 x 68	84	11	15	22	--	

**MAXIMUM COVER FOR INDUCED TRENCH INSTALLATION:**

If the induced trench installation is required for the higher fills, the designer must specify that requirement clearly in the pipe summary and pipe profile and must include special details in the plans to outline the construction procedure. Induced trenches are for circular pipes only and should generally be specified only where other methods are not suitable.

Induced Trench Installation	Diameter (Inches)	Maximum Fill Heights (Feet)			
		Class II	Class III	Class IV	Class V
					
	18	32	44	67	100
	24	32	45	68	100
	36	32	45	68	100
	48	32	44	68	100
	60	32	44	67	100
	72	30	43	67	100
	84	29	42	67	100
	96	28	42	66	100
	108	27	42	64	100

**DESIGN METHODS:**

The fill heights herein were calculated by using methods outlined in publications by the American Concrete Pipe Association. Class B bedding was assumed for the calculations; and a safety factor of 1.0 for a 0.01" crack D-load was used.

For diameters or spans exceeding 108", the designer must furnish calculations considering live and earth loads, pH, backfill and trench conditions. Written approval of such designs must be obtained from the Engineering Division prior to preparing plan details.

## METAL PIPE

The following tables for diameters up through 108" are to be used to determine, for a given fill height in feet and pipe diameter in inches, what corrugations and what metal thicknesses would be required to adequately carry the design load. Tables for diameters over 108" are for information only. The designer must furnish calculations considering live load, maximum and minimum fill heights, pH and resistivity, backfill, and trench conditions for pipes over 108" diameter and for pipes not included in these tables. Written approval of such designs must be obtained from Engineering Division prior to preparing plan details. The format of the tables has been revised from those in previous editions to better compare alternative materials which are available at this time.

### MINIMUM COVER:

All values of minimum cover for HS-20 loading indicated in the tables are measured to the top of rigid pavement or to the bottom of flexible pavement.

### MATERIALS:

Names of various metal pipes in these tables have been shortened. Actual materials and descriptions for plans are to be in accordance with the Standard Specifications.

### CORROSION AND ABRASION:

The fill heights contained in these tables do not consider detrimental effects of metal thickness lost by corrosion and abrasion. Those conditions are discussed in more detail in another Departmental publication.

### DESIGN PARAMETERS:

The allowable fill heights in the tables were calculated by the service load design method in Section 9 of the 1981 AASHTO Interim Bridge Specifications with the exception of using  $k=0.33$  (soil stiffness factor) for pipes up through 54" diameter. The higher  $k$  value, relating to  $E'$  of 1050 instead of 1400, was used because backfill requirements for those pipes are not as stringent as for the larger pipes.

In some instances, the maximum allowable fill height for aluminum pipe as recommended by the manufacturer is lower than the value calculated according to AASHTO; therefore, the lower value appears in the table.

Allowable fill heights for fiber bonded steel pipe are considerable less than for steel pipe because the fiber bonded is fabricated with annular corrugations and riveted longitudinal seams which generally results in a lower strength structure than the helical fabrication of steel pipe. Steel and aluminum pipe with corrugations of  $\frac{1}{2}$ " and 1" depths are required to be helically fabricated.

MAXIMUM ALLOWABLE FILL HEIGHTS (FEET)								18" DIAMETER			
STEEL						FIBER BONDED STEEL		ALUMINUM			
		CORRUGATIONS				CORRUGATIONS				CORRUGATIONS	
GAGE	T (")	2 2/3 x 1/2	5 x 1	3 x 1	7 1/2 x 3/4 x 3/4	2 2/3 x 1/2	3 x 1	T (")	2 2/3 x 1/2	3 x 1	7 1/2 x 3/4 x 3/4
16	0.064	142*	--	--	68	62	--	0.060	59	--	55
14	0.079	178*	--	--	96	67	--	0.075	75	--	76
12	0.109	248*	--	--	--	86	--	0.105	107	--	--
10	0.138	--	--	--	--	91	--	0.135	--	--	--
8	0.168	--	--	--	--	95	--	0.164	--	--	--
7	0.188	--	--	--	--	--	--	--	--	--	--
5	0.218	--	--	--	--	--	--	--	--	--	--
3	0.249	--	--	--	--	--	--	--	--	--	--
1	0.280	--	--	--	--	--	--	--	--	--	--
<p style="text-align: center;">NOTES</p> <p>1. Minimum Fill Heights for this Diameter are:  HS-20 Loading            12 Inches</p> <p>2. -- Indicates thickness or corrugations not available or not suitable for this diameter.</p> <p>3. * Precoated galvanized steel available.</p>								0.100	--	--	--
								0.125	--	--	--
								0.150	--	--	--
								0.175	--	--	--
								0.200	--	--	--
								0.225	--	--	--
								0.250	--	--	--

MAXIMUM ALLOWABLE FILL HEIGHTS (FEET) 24" DIAMETER											
	STEEL					FIBER BONDED STEEL		ALUMINUM			
		CORRUGATIONS				CORRUGATIONS			CORRUGATIONS		
GAGE	T (")	2 2/3 x 1/2	5 x 1	3 x 1	7 1/2 x 3/4 x 3/4	2 2/3 x 1/2	3 x 1	T (")	2 2/3 x 1/2	3 x 1	7 1/2 x 3/4 x 3/4
16	0.064	106*	--	--	51	46	--	0.060	44	--	41
14	0.079	133*	--	--	72	50	--	0.075	56	--	57
12	0.109	186*	--	--	121	65	--	0.105	79	--	92
10	0.138	240	--	--	--	68	--	0.135	102	--	--
8	0.168	--	--	--	--	71	--	0.164	--	--	--
7	0.188	--	--	--	--	--	--	--	--	--	--
5	0.218	--	--	--	--	--	--	--	--	--	--
3	0.249	--	--	--	--	--	--	--	--	--	--
1	0.280	--	--	--	--	--	--	--	--	--	--
<p style="text-align: center;">NOTES</p> <p>1. Minimum Fill Heights for this Diameter are:  HS-20 Loading          12 Inches</p> <p>2. -- Indicates thickness or corrugations not available or not suitable for this diameter.</p> <p>3. * Precoated galvanized steel available.</p>								0.100	--	--	--
								0.125	--	--	--
								0.150	--	--	--
								0.175	--	--	--
								0.200	--	--	--
								0.225	--	--	--
								0.250	--	--	--

MAXIMUM ALLOWABLE FILL HEIGHTS (FEET)      30" DIAMETER												
	STEEL					FIBER BONDED STEEL		ALUMINUM				
		CORRUGATIONS				CORRUGATIONS			CORRUGATIONS			
GAGE	T (")	2 2/3 x 1/2	5 x 1	3 x 1	7 1/2 x 3/4 x 3/4	2 2/3 x 1/2	3 x 1	T (")	2 2/3 x 1/2	3 x 1	7 1/2 x 3/4 x 3/4	
16	0.064	85*	--	--	41	37	--	0.060	--	40	33	
14	0.079	106*	--	--	57	40	--	0.075	44	51	45	
12	0.109	149*	--	--	97	52	--	0.105	63	74	73	
10	0.138	192	--	--	--	54	--	0.135	81	95	--	
8	0.168	--	--	--	--	57	--	0.164	--	--	--	
7	0.188	--	--	--	--	--	--	--	--	--	--	
5	0.218	--	--	--	--	--	--	--	--	--	--	
3	0.249	--	--	--	--	--	--	--	--	--	--	
1	0.280	--	--	--	--	--	--	--	--	--	--	
<p style="text-align: center;">NOTES</p> <p>1. Minimum Fill Heights for this Diameter are:  HS-20 Loading      12 Inches</p> <p>2. -- Indicates thickness or corrugations not available or not suitable for this diameter.</p> <p>3. * Precoated galvanized steel available.</p>								0.100	--	--	--	
								0.125	--	--	--	
								0.150	--	--	--	
								0.175	--	--	--	
								0.200	--	--	--	
								0.225	--	--	--	
								0.250	--	--	--	

MAXIMUM ALLOWABLE FILL HEIGHTS (FEET) 36" DIAMETER											
	STEEL					FIBER BONDED STEEL		ALUMINUM			
		CORRUGATIONS				CORRUGATIONS			CORRUGATIONS		
GAGE	T (")	2 2/3 x 1/2	5 x 1	3 x 1	7 1/2 x 3/4 x 3/4	2 2/3 x 1/2	3 x 1	T (")	2 2/3 x 1/2	3 x 1	7 1/2 x 3/4 x 3/4
16	0.064	71*	--	81*	34	31	53	0.060	--	33	27
14	0.079	89*	--	102*	48	34	66	0.075	36	42	38
12	0.109	124*	--	143*	80	43	98	0.105	52	60	61
10	0.138	160	--	184	--	45	118	0.135	68	78	86
8	0.168	195	--	225	--	47	131	0.164	--	--	--
7	0.188	--	--	--	--	--	--	--	--	--	--
5	0.218	--	--	--	--	--	--	--	--	--	--
3	0.249	--	--	--	--	--	--	--	--	--	--
1	0.280	--	--	--	--	--	--	--	--	--	--
<p style="text-align: center;">NOTES</p> <p>1. Minimum Fill Heights for this Diameter are:  HS-20 Loading          12 Inches</p> <p>2. -- Indicates thickness or corrugations not available or not suitable for this diameter.</p> <p>3. * Precoated galvanized steel available.</p>								0.100	--	--	--
								0.125	--	--	--
								0.150	--	--	--
								0.175	--	--	--
								0.200	--	--	--
								0.225	--	--	--
								0.250	--	--	--

MAXIMUM ALLOWABLE FILL HEIGHTS (FEET)      42" DIAMETER											
		STEEL				FIBER BONDED STEEL		ALUMINUM			
		CORRUGATIONS				CORRUGATIONS		CORRUGATIONS			
GAGE	T (")	2 2/3 x 1/2	5 x 1	3 x 1	7 1/2 x 3/4 x 3/4	2 2/3 x 1/2	3 x 1	T (")	2 2/3 x 1/2	3 x 1	7 1/2 x 3/4 x 3/4
16	0.064	61*	--	70*	29	34	45	0.060	--	28	--
14	0.079	76*	--	87*	41	47	56	0.075	--	36	32
12	0.109	106*	--	122*	69	74	84	0.105	44	51	52
10	0.138	137	--	157	--	78	101	0.135	58	68	74
8	0.168	167	--	193	--	81	112	0.164	--	--	--
7	0.188	--	--	--	--	--	--	--	--	--	--
5	0.218	--	--	--	--	--	--	--	--	--	--
3	0.249	--	--	--	--	--	--	--	--	--	--
1	0.280	--	--	--	--	--	--	--	--	--	--
<p style="text-align: center;">NOTES</p> <p>1. Minimum Fill Heights for this Diameter are:</p> <p style="padding-left: 40px;">HS-20 Loading      12 Inches</p> <p>2. -- Indicates thickness or corrugations not available or not suitable for this diameter.</p> <p>3. * Precoated galvanized steel available.</p>								0.100	--	--	--
								0.125	--	--	--
								0.150	--	--	--
								0.175	--	--	--
								0.200	--	--	--
								0.225	--	--	--
								0.250	--	--	--

MAXIMUM ALLOWABLE FILL HEIGHTS (FEET) 48" DIAMETER											
	STEEL					FIBER BONDED STEEL		ALUMINUM			
		CORRUGATIONS				CORRUGATIONS			CORRUGATIONS		
GAGE	T (")	2 2/3 x 1/2	5 x 1	3 x 1	7 1/2 x 3/4 x 3/4	2 2/3 x 1/2	3 x 1	T (")	2 2/3 x 1/2	3 x 1	7 1/2 x 3/4 x 3/4
16	0.064	52*	54*	61*	25	30	40	0.060	--	24	--
14	0.079	66*	68*	76*	36	41	49	0.075	--	31	--
12	0.109	93*	95*	107*	60	65	73	0.105	38	45	46
10	0.138	120	123	136	--	68	88	0.135	50	58	65
8	0.168	146	150	169	--	71	98	0.164	61	72	--
7	0.188	--	--	--	--	--	--	--	--	--	--
5	0.218	--	--	--	--	--	--	--	--	--	--
3	0.249	--	--	--	--	--	--	--	--	--	--
1	0.280	--	--	--	--	--	--	--	--	--	--
<p style="text-align: center;">NOTES</p> <p>1. Minimum Fill Heights for this Diameter are:</p> <p style="padding-left: 40px;">HS-20 Loading      12 Inches</p> <p>2. -- Indicates thickness or corrugations not available or not suitable for this diameter.</p> <p>3. * Precoated galvanized steel available.</p>								0.100	--	--	--
								0.125	--	--	--
								0.150	--	--	--
								0.175	--	--	--
								0.200	--	--	--
								0.225	--	--	--
								0.250	--	--	--

MAXIMUM ALLOWABLE FILL HEIGHTS (FEET)      54" DIAMETER											
		STEEL				FIBER BONDED STEEL		ALUMINUM			
		CORRUGATIONS				CORRUGATIONS		CORRUGATIONS			
GAGE	T (")	2 2/3 x 1/2	5 x 1	3 x 1	7 1/2 x 3/4 x 3/4	2 2/3 x 1/2	3 x 1	T (")	2 2/3 x 1/2	3 x 1	7 1/2 x 3/4 x 3/4
16	0.064	--	48*	54*	22	--	35	0.060	--	21*	--
14	0.079	53*	60*	68*	32	37	44	0.075	--	28	--
12	0.109	75*	85*	95*	53	58	65	0.105	29*	39	40
10	0.138	97	109	123	--	60	78	0.135	38	51	57
8	0.168	121	133	150	--	63	87	0.164	41	63	--
7	0.188	--	--	--	--	--	--	--	--	--	--
5	0.218	--	--	--	--	--	--	--	--	--	--
3	0.249	--	--	--	--	--	--	--	--	--	--
1	0.280	--	--	--	--	--	--	--	--	--	--
<p style="text-align: center;">NOTES</p> <p>1. Minimum Fill Heights for this Diameter are:  HS-20 Loading      12 Inches</p> <p>2. -- Indicates thickness or corrugations not available or not suitable for this diameter.</p> <p>3. * Precoated galvanized steel available.</p>								0.100	--	--	--
								0.125	--	--	--
								0.150	--	--	--
								0.175	--	--	--
								0.200	--	--	--
								0.225	--	--	--
								0.250	--	--	--

MAXIMUM ALLOWABLE FILL HEIGHTS (FEET)								60" DIAMETER				
STEEL						FIBER BONDED STEEL		ALUMINUM				
	CORRUGATIONS					CORRUGATIONS			CORRUGATIONS			
T (")	2 2/3 x 1/2	5 x 1	3 x 1	6 x 2	7 1/2 x 3/4 x 3/4	2 2/3 x 1/2	3 x 1	T (")	2 2/3 x 1/2	3 x 1	7 1/2 x 3/4 x 3/4	9 x 2 1/2
0.064	--	43*	49*	--	--	--	32	0.060	--	19*	--	--
0.079	--	54*	61*	--	28	--	39	0.075	--	24	--	--
0.109	74*	76*	86*	47	48	52	59	0.105	--	35	--	--
0.138	95	98	110	69	--	54	71	0.135	26*	46	52	--
0.168	117	120	135	90	--	57	78	0.164	32	57	--	--
0.188	--	--	--	103	--	--	--	--	--	--	--	--
0.218	--	--	--	124	--	--	--	--	--	--	--	--
0.249	--	--	--	146	--	--	--	--	--	--	--	--
0.280	--	--	--	160	--	--	--	--	--	--	--	--
<p style="text-align: center;">NOTES</p> <p>1. Minimum Fill Heights for this Diameter are:</p> <p style="padding-left: 40px;">HS-20 Loading      12 Inches</p> <p>2. -- Indicates thickness or corrugations not available or not suitable for this diameter.</p> <p>3. * Precoated galvanized steel available.</p>								0.100	--	--	--	31
								0.125	--	--	--	45
								0.150	--	--	--	60
								0.175	--	--	--	71
								0.200	--	--	--	81
								0.225	--	--	--	92
								0.250	--	--	--	103

MAXIMUM ALLOWABLE FILL HEIGHTS (FEET)								72 " DIAMETER				
STEEL						FIBER BONDED STEEL		ALUMINUM				
	CORRUGATIONS					CORRUGATIONS			CORRUGATIONS			
T (")	2 2/3 x 1/2	5 x 1	3 x 1	6 x 2	7 1/2 x 3/4 x 3/4	2 2/3 x 1/2	3 x 1	T (")	2 2/3 x 1/2	3 x 1	7 1/2 x 3/4 x 3/4	9 x 2 1/2
0.064	--	36*	41*	--	--	--	26	0.060	--	--	--	--
0.079	--	45*	51*	--	--	--	33	0.075	--	20*	--	--
0.109	--	64*	71*	39	40	--	49	0.105	--	29	--	--
0.138	79	82	92	57	--	45	59	0.135	16*	38	43	--
0.168	97	100	112	75	--	47	65	0.164	20*	47	--	--
0.188	--	--	--	86	--	--	--	--	--	--	--	--
0.218	--	--	--	104	--	--	--	--	--	--	--	--
0.249	--	--	--	122	--	--	--	--	--	--	--	--
0.280	--	--	--	133	--	--	--	--	--	--	--	--
<p style="text-align: center;">NOTES</p> <p>1. Minimum Fill Heights for this Diameter are:</p> <p style="padding-left: 40px;">HS-20 Loading      12 Inches</p> <p>2. -- Indicates thickness or corrugations not available or not suitable for this diameter.</p> <p>3. * Precoated galvanized steel available.</p>								0.100	--	--	--	26
								0.125	--	--	--	38
								0.150	--	--	--	50
								0.175	--	--	--	59
								0.200	--	--	--	68
								0.225	--	--	--	77
								0.250	--	--	--	86

MAXIMUM ALLOWABLE FILL HEIGHTS (FEET)								84 " DIAMETER				
STEEL						FIBER BONDED STEEL		ALUMINUM				
	CORRUGATIONS					CORRUGATIONS			CORRUGATIONS			
T (")	2 2/3 x 1/2	5 x 1	3 x 1	6 x 2	7 1/2 x 3/4 x 3/4	2 2/3 x 1/2	3 x 1	T (")	2 2/3 x 1/2	3 x 1	7 1/2 x 3/4 x 3/4	9 x 2 1/2
0.064	--	31*	35*	--	--	--	23	0.060	--	--	--	--
0.079	--	39*	44*	--	--	--	28	0.075	--	--	--	--
0.109	--	54*	61*	33	34	--	42	0.105	--	24*	--	--
0.138	--	70	79	49	--	--	50	0.135	--	32	--	--
0.168	75	86	96	64	--	41	56	0.164	12*	40	--	--
0.188	--	--	--	73	--	--	--	--	--	--	--	--
0.218	--	--	--	89	--	--	--	--	--	--	--	--
0.249	--	--	--	105	--	--	--	--	--	--	--	--
0.280	--	--	--	114	--	--	--	--	--	--	--	--
<p style="text-align: center;">NOTES</p> <p>1. Minimum Fill Heights for this Diameter are:</p> <p style="padding-left: 40px;">HS-20 Loading      12 Inches</p> <p>2. -- Indicates thickness or corrugations not available or not suitable for this diameter.</p> <p>3. * Precoated galvanized steel available.</p>								0.100	--	--	--	22
								0.125	--	--	--	32
								0.150	--	--	--	43
								0.175	--	--	--	50
								0.200	--	--	--	58
								0.225	--	--	--	66
								0.250	--	--	--	74

MAXIMUM ALLOWABLE FILL HEIGHTS (FEET)      96" DIAMETER											
		STEEL				FIBER BONDED STEEL		ALUMINUM			
		CORRUGATIONS				CORRUGATIONS		CORRUGATIONS			
GAGE	T (")	2 2/3 x 1/2	5 x 1	3 x 1	6 x 2	2 2/3 x 1/2	3 x 1	T (")	2 2/3 x 1/2	3 x 1	9 x 2 1/2
16	0.064	--	--	--	--	--	--	0.060	--	--	--
14	0.079	--	34*	38*	--	--	25	0.075	--	--	--
12	0.109	--	48*	53*	29	--	35	0.105	--	21*	--
10	0.138	--	61	69	43	--	45	0.135	--	28*	--
8	0.168	--	75	84	56	--	50	0.164	--	34	--
7	0.188	--	--	--	64	--	--	--	--	--	--
5	0.218	--	--	--	78	--	--	--	--	--	--
3	0.249	--	--	--	92	--	--	--	--	--	--
1	0.280	--	--	--	100	--	--	--	--	--	--
<p style="text-align: center;">NOTES</p> <p>1. Minimum Fill Heights for this Diameter are:  HS-20 Loading      12 Inches</p> <p>2. -- Indicates thickness or corrugations not available or not suitable for this diameter.</p> <p>3. * Precoated galvanized steel available.</p>								0.100	--	--	19
								0.125	--	--	28
								0.150	--	--	37
								0.175	--	--	44
								0.200	--	--	51
								0.225	--	--	58
								0.250	--	--	65

MAXIMUM ALLOWABLE FILL HEIGHTS (FEET)      108" DIAMETER											
	STEEL					FIBER BONDED STEEL		ALUMINUM			
		CORRUGATIONS				CORRUGATIONS			CORRUGATIONS		
GAGE	T (")	2 2/3 x 1/2	5 x 1	3 x 1	6 x 2	2 2/3 x 1/2	3 x 1	T (")	2 2/3 x 1/2	3 x 1	9 x 2 1/2
16	0.064	--	--	--	--	--	--	0.060	--	--	--
14	0.079	--	--	--	--	--	--	0.075	--	--	--
12	0.109	--	42*	47*	26	--	30	0.105	--	--	--
10	0.138	--	54	61	38	--	39	0.135	--	--	--
8	0.168	--	66	75	50	--	45	0.164	--	--	--
7	0.188	--	--	--	57	--	--	--	--	--	--
5	0.218	--	--	--	69	--	--	--	--	--	--
3	0.249	--	--	--	81	--	--	--	--	--	--
1	0.280	--	--	--	89	--	--	--	--	--	--
<p style="text-align: center;">NOTES</p> <p>1. Minimum Fill Heights for this Diameter are:</p> <p style="padding-left: 40px;">HS-20 Loading      12 Inches</p> <p>2. -- Indicates thickness or corrugations not available or not suitable for this diameter.</p> <p>3. * Precoated galvanized steel available.</p>								0.100	--	--	17
								0.125	--	--	25
								0.150	--	--	33
								0.175	--	--	39
								0.200	--	--	45
								0.225	--	--	51
								0.250	--	--	57

MAXIMUM ALLOWABLE FILL HEIGHTS (FEET)      120" DIAMETER											
		STEEL				FIBER BONDED STEEL		ALUMINUM			
		CORRUGATIONS				CORRUGATIONS				CORRUGATIONS	
GAGE	T (")	2 2/3 x 1/2	5 x 1	3 x 1	6 x 2	2 2/3 x 1/2	3 x 1	T (")	2 2/3 x 1/2	3 x 1	9 x 2 1/2
16	0.064	--	--	--	--	--	--	0.060	--	--	--
14	0.079	--	--	--	--	--	--	0.075	--	--	--
12	0.109	--	38*	42*	23	--	33	0.105	--	--	--
10	0.138	--	49	55	34	--	40	0.135	--	--	--
8	0.168	--	60	67	45	--	--	0.164	--	--	--
7	0.188	--	--	--	51	--	--	--	--	--	--
5	0.218	--	--	--	62	--	--	--	--	--	--
3	0.249	--	--	--	73	--	--	--	--	--	--
1	0.280	--	--	--	80	--	--	--	--	--	--
<p style="text-align: center;">NOTES</p> <p>1. Minimum Fill Heights for this Diameter are:</p> <p style="padding-left: 40px;">HS-20 Loading      12 Inches</p> <p>2. -- Indicates thickness or corrugations not available or not suitable for this diameter.</p> <p>3. * Precoated galvanized steel available.</p>								0.100	--	--	15*
								0.125	--	--	23
								0.150	--	--	30
								0.175	--	--	35
								0.200	--	--	41
								0.225	--	--	46
								0.250	--	--	51

MAXIMUM ALLOWABLE FILL HEIGHTS (FEET) 132" DIAMETER											
	STEEL					FIBER BONDED STEEL		ALUMINUM			
		CORRUGATIONS				CORRUGATIONS			CORRUGATIONS		
GAGE	T (")	2 2/3 x 1/2	5 x 1	3 x 1	6 x 2	2 2/3 x 1/2	3 x 1	T (")	2 2/3 x 1/2	3 x 1	9 x 2 1/2
16	0.064	--	--	--	--	--	--	0.060	--	--	--
14	0.079	--	--	--	--	--	--	0.075	--	--	--
12	0.109	--	--	--	21	--	--	0.105	--	--	--
10	0.138	--	--	--	31	--	--	0.135	--	--	--
8	0.168	--	--	--	41	--	35	0.164	--	--	--
7	0.188	--	--	--	47	--	--	--	--	--	--
5	0.218	--	--	--	56	--	--	--	--	--	--
3	0.249	--	--	--	66	--	--	--	--	--	--
1	0.280	--	--	--	73	--	--	--	--	--	--
<p style="text-align: center;">NOTES</p> <p>1. Minimum Fill Heights for this Diameter are:  HS-20 Loading          12 Inches</p> <p>2. -- Indicates thickness or corrugations not available or not suitable for this diameter.</p> <p>3. * Precoated galvanized steel available.</p>								0.100	--	--	14*
								0.125	--	--	20
								0.150	--	--	27
								0.175	--	--	32
								0.200	--	--	37
								0.225	--	--	42
								0.250	--	--	46

MAXIMUM ALLOWABLE FILL HEIGHTS (FEET)      144" DIAMETER											
		STEEL				FIBER BONDED STEEL		ALUMINUM			
		CORRUGATIONS				CORRUGATIONS				CORRUGATIONS	
GAGE	T (")	2 2/3 x 1/2	5 x 1	3 x 1	6 x 2	2 2/3 x 1/2	3 x 1	T (")	2 2/3 x 1/2	3 x 1	9 x 2 1/2
16	0.064	--	--	--	--	--	--	0.060	--	--	--
14	0.079	--	--	--	--	--	--	0.075	--	--	--
12	0.109	--	--	--	19	--	--	0.105	--	--	--
10	0.138	--	--	--	29	--	--	0.135	--	--	--
8	0.168	--	--	--	37	--	--	0.164	--	--	--
7	0.188	--	--	--	43	--	--	--	--	--	--
5	0.218	--	--	--	52	--	--	--	--	--	--
3	0.249	--	--	--	61	--	--	--	--	--	--
1	0.280	--	--	--	67	--	--	--	--	--	--
<p style="text-align: center;">NOTES</p> <p>1. Minimum Fill Heights for this Diameter are:  HS-20 Loading      12 Inches</p> <p>2. -- Indicates thickness or corrugations not available or not suitable for this diameter.</p> <p>3. * Precoated galvanized steel available.</p>								0.100	--	--	13*
								0.125	--	--	19
								0.150	--	--	25
								0.175	--	--	29
								0.200	--	--	34
								0.225	--	--	38
								0.250	--	--	42

MAXIMUM ALLOWABLE FILL HEIGHTS (FEET) 156" DIAMETER											
	STEEL					FIBER BONDED STEEL		ALUMINUM			
		CORRUGATIONS				CORRUGATIONS			CORRUGATIONS		
GAGE	T (")	2 2/3 x 1/2	5 x 1	3 x 1	6 x 2	2 2/3 x 1/2	3 x 1	T (")	2 2/3 x 1/2	3 x 1	9 x 2 1/2
16	0.064	--	--	--	--	--	--	0.060	--	--	--
14	0.079	--	--	--	--	--	--	0.075	--	--	--
12	0.109	--	--	--	17	--	--	0.105	--	--	--
10	0.138	--	--	--	26	--	--	0.135	--	--	--
8	0.168	--	--	--	34	--	--	0.164	--	--	--
7	0.188	--	--	--	39	--	--	--	--	--	--
5	0.218	--	--	--	47	--	--	--	--	--	--
3	0.249	--	--	--	56	--	--	--	--	--	--
1	0.280	--	--	--	61	--	--	--	--	--	--
<p style="text-align: center;">NOTES</p> <p>1. Minimum Fill Heights for this Diameter are:  HS-20 Loading      12 Inches</p> <p>2. -- Indicates thickness or corrugations not available or not suitable for this diameter.</p> <p>3. * Precoated galvanized steel available.</p>								0.100	--	--	--
								0.125	--	--	17*
								0.150	--	--	23*
								0.175	--	--	27
								0.200	--	--	31
								0.225	--	--	35
								0.250	--	--	38

MAXIMUM ALLOWABLE FILL HEIGHTS (FEET)      168" DIAMETER											
		STEEL				FIBER BONDED STEEL		ALUMINUM			
		CORRUGATIONS				CORRUGATIONS		CORRUGATIONS			
GAGE	T (")	2 2/3 x 1/2	5 x 1	3 x 1	6 x 2	2 2/3 x 1/2	3 x 1	T (")	2 2/3 x 1/2	3 x 1	9 x 2 1/2
16	0.064	--	--	--	--	--	--	0.060	--	--	--
14	0.079	--	--	--	--	--	--	0.075	--	--	--
12	0.109	--	--	--	16	--	--	0.105	--	--	--
10	0.138	--	--	--	24	--	--	0.135	--	--	--
8	0.168	--	--	--	32	--	--	0.164	--	--	--
7	0.188	--	--	--	36	--	--	--	--	--	--
5	0.218	--	--	--	44	--	--	--	--	--	--
3	0.249	--	--	--	52	--	--	--	--	--	--
1	0.280	--	--	--	57	--	--	--	--	--	--
<p style="text-align: center;">NOTES</p> <p>1. Minimum Fill Heights for this Diameter are:  HS-20 Loading      12 Inches</p> <p>2. -- Indicates thickness or corrugations not available or not suitable for this diameter.</p> <p>3. * Precoated galvanized steel available.</p>								0.100	--	--	--
								0.125	--	--	16*
								0.150	--	--	21*
								0.175	--	--	25
								0.200	--	--	29
								0.225	--	--	32
								0.250	--	--	35

MAXIMUM ALLOWABLE FILL HEIGHTS (FEET)      180" DIAMETER											
	STEEL					FIBER BONDED STEEL		ALUMINUM			
		CORRUGATIONS				CORRUGATIONS			CORRUGATIONS		
GAGE	T (")	2 2/3 x 1/2	5 x 1	3 x 1	6 x 2	2 2/3 x 1/2	3 x 1	T (")	2 2/3 x 1/2	3 x 1	9 x 2 1/2
16	0.064	--	--	--	--	--	--	0.060	--	--	--
14	0.079	--	--	--	--	--	--	0.075	--	--	--
12	0.109	--	--	--	15	--	--	0.105	--	--	--
10	0.138	--	--	--	23	--	--	0.135	--	--	--
8	0.168	--	--	--	30	--	--	0.164	--	--	--
7	0.188	--	--	--	34	--	--	--	--	--	--
5	0.218	--	--	--	41	--	--	--	--	--	--
3	0.249	--	--	--	48	--	--	--	--	--	--
1	0.280	--	--	--	53	--	--	--	--	--	--
<p style="text-align: center;">NOTES</p> <p>1. Minimum Fill Heights for this Diameter are:  HS-20 Loading      12 Inches</p> <p>2. -- Indicates thickness or corrugations not available or not suitable for this diameter.</p> <p>3. * Precoated galvanized steel available.</p>								0.100	--	--	--
								0.125	--	--	--
								0.150	--	--	19*
								0.175	--	--	23*
								0.200	--	--	27
								0.225	--	--	30
								0.250	--	--	33

### METAL PIPE ARCH

The following tables are to be used for selecting available pipe arch dimensions and minimum and maximum fill heights.

At any location where these low-head structures are required, aluminum and steel pipe arches and horizontal elliptical reinforced pipe should be included as alternatives. Corrosive or abrasive conditions may require paved inverts in the metal arches.

ALUMINUM PIPE ARCH				
ALLOWABLE FILL HEIGHTS - HS-20 LOADING				
2 2/3" x 1/2" Corrugation				
Size in Inches		Minimum Cover Ft.	Minimum Pipe Thickness in Inches	Maximum Cover Ft.
Equiv. Pipe Diam.	Span x Rise			
15	17 x 13	1.00	.060	15
18	21 x 15	1.00	.060	15
21	24 x 18	1.00	.060	14
24	28 x 20	1.00	.075	14
30	35 x 24	1.00	.075	13
36	42 x 29	1.25	.105	13
42	49 x 33	1.25	.105	12
48	57 x 38	1.25	.135	12
54	64 x 43	1.50	.135	11
60	71 x 47	1.50	.164	11
66	77 x 52	1.50	.164	10
72	83 x 57	1.50	.164	10

<b>CORRUGATED STEEL PIPE ARCH</b>					
<b>ALLOWABLE FILL HEIGHTS - HS-20 LOADING</b>					
<b>2 2/3" x 1/2" Corrugations</b>					
<b>Size in Inches</b>		<b>Minimum Specified Thickness Required in Inches</b>	<b>Maximum Height-of-Fill (ft.) Over Pipe-Arch for the Following Corner Bearing Pressures in Tons per Sq. Ft.</b>		
<b>Equiv. Pipe Diam.</b>	<b>Span x Rise</b>		<b>2 Tons</b>	<b>3 Tons</b>	<b>4 Tons</b>
15	17 x 13	0.064	15	22	30
18	21 x 15	0.064	14	21	28
21	24 x 18	0.064	12	19	25
24	28 x 20	0.064	12	18	24
30	35 x 24	0.064	12	18	24
36	42 x 29	0.064	10	15	20
42	49 x 33	0.079	9	14	19
48	57 x 38	0.109	9	14	19
54	64 x 43	0.109	9	14	19

Minimum Cover from top of pipe-arch to top of subgrade = 1 ft.

<b>CORRUGATED STEEL PIPE ARCH</b>						
<b>ALLOWABLE FILL HEIGHTS - HS-20 LOADING</b>						
<b>5" x 1" Corrugations</b>						
<b>Size in Inches</b>		<b>Minimum Specified Thickness Required in Inches</b>	<b>Minimum Cover in Inches</b>	<b>Maximum Height-of-Fill (ft.) Over Pipe-Arch for the Following Corner Bearing Pressures in Tons per Sq. Ft.</b>		
<b>Equiv. Pipe Diam.</b>	<b>Span x Rise</b>			<b>2 Tons</b>	<b>3 Tons</b>	<b>4 Tons</b>
60	66 x 51	0.109	12	21	31	42
66	73 x 55	0.109	12	21	31	42
72	81 x 59	0.109	12	17	26	35
78	87 x 63	0.109	12	17	26	35
84	95 x 67	0.109	12	17	26	34
90	103 x 71	0.109	18	17	25	34
96	112 x 75	0.109	18	17	25	34
102	117 x 79	0.109	18	16	25	34
108	128 x 83	0.109	24	16	25	33
114	137 x 87	0.109	24	16	25	33
120	142 x 91	0.138	24	16	25	32