

## Concrete Pipe Backfill Heights

### Round Pipe

Pipe Size (inches)	Pipe Class						
	Class I	Class II	Class III	Class IV	Class IV Alternate	Class V	Class V Alternate
	Round Reinforced Concrete Pipe Backfill Heights (feet)						
12			1-16	16-24		24-35	
15			1-16	16-24		24-35	
18			1-16	16-24		24-35	
21			1-16	16-24		24-35	
24			1-16	16-24		24-35	
27		3-11	1-3, 11-16	16-24		24-35	
30		3-11	1-3, 11-16	16-24		24-35	
33		3-11	1-3, 11-16	16-24		24-35	
36		3-11	1-3, 11-16	16-24		24-35	
42		3-11	1-3, 11-16	16-24		24-35	
48		3-11	1-3, 11-16	16-24		24-35	24-35
54		3-11	1-3, 11-16	16-24		24-35	24-35
60	6-9	3-11	1-3, 11-16	16-24	16-24	24-35	24-35
66	6-9	3-11	1-3, 11-16	16-24	16-24	24-35	24-35
72	6-9	3-11	1-3, 11-16	16-24	16-24	24-35	24-35
78	6-9	3-11	1-3, 11-16	16-24	16-24		24-35
84	6-9	3-11	1-3, 11-16	16-24	16-24		24-35
90	6-9	3-11	1-3, 11-16		16-24		24-35
96	6-9	3-11	1-3, 11-16		16-24		24-35
102	6-9	3-11	1-3, 11-16		16-24		24-35
108	6-9	3-11	1-3, 11-16		16-24		24-35

Backfill heights for Sewer Trench Conditions other than Class I				
Pipe Size	Pipe class			
	Class II	Class III	Class IV	Class V
	FT			
2" thru 54"	3-9	1-3, 9-13	13-23	23+
60" thru 108"	1-9	9-13	13-23	23+

## Concrete Pipe Backfill Heights

### Arch Pipe

Pipe Size	Pipe Class					
	Class II		Class III		Class IV	
Span - Rise	Normal Backfill	Sewer Trench	Normal Backfill	Sewer Trench	Normal Backfill	Sewer Trench
(inches)	Arch Reinforced Concrete Pipe Minimum and Maximum Cover Heights (feet)					
22x13	3-10		2-3, 10-14	2-13	1-2, 14-21	1-2, 13-50
29x18	3-10	4-6	2-3, 10-14	2-4, 6-12	1-2, 14-22	1-2, 12-26
36x23	3-10	3-7	1-3, 10-14	1-3, 7-13	14-22	13-25
44x27	2-10	2-8	1-2, 10-14	1-2, 8-13	14-22	13-25
51x31	1-10	2-8	10-15	8-14	15-22	14-25
58x36	1-10	1-8	10-15	8-14	15-22	14-25
65x40	1-11	1-8	11-15	8-12	15-22	12-21
73x45	1-11	1-8	11-15	8-12	15-22	12-21
88x54	1-12	1-9	12-15	9-13	15-23	13-22
102x62	1-12	1-9	12-16	9-14	16-23	14-22
115x72	1-14	1-13	14-17	13-16	17-24	16-24
122x78	1-14	1-13	14-17	13-16	17-24	16-24
138x88	1-14	1-14	14-18	14-17	18-25	17-25
154x97	1-15	1-14	15-19	14-17	19-25	17-25

## Concrete Pipe Backfill Heights

### Elliptical Pipe

Minimum and Maximum Cover for Reinforced Concrete Horizontal Elliptical Culverts											
Span	Rise	Class A		Class I		Class II		Class III		Class IV	
		Normal Backfill	Sewer Trench	Normal Backfill	Sewer Trench	Normal Backfill	Sewer Trench	Normal Backfill	Sewer Trench	Normal Backfill	Sewer Trench
inch	inch	feet	feet	feet	feet	feet	feet	feet	feet	feet	feet
91	58	1-4	1-2	4-6	2-4	6-12	4-9	12-15	9-13	15-23	13-22
98	63	1-4	1-2	4-6	2-5	6-12	5-9	12-15	9-14	15-23	14-22
106	68	1-4	1-3	4-7	3-5	7-12	5-9	12-16	9-14	16-23	14-22
113	72	1-5	1-3	5-8	3-5	8-12	5-9	12-16	9-14	16-23	14-23
121	77	1-5	1-3	5-8	3-5	8-13	5-9	13-16	9-14	16-23	14-23
128	82	1-5	1-3	5-8	3-6	8-13	6-10	13-17	10-14	17-23	14-23
136	87	1-5	1-4	5-8	4-6	8-13	6-10	13-17	10-14	17-23	14-23

- Fill heights in Class IV shown for information purposes only.

## Corrugated Steel Pipe Backfill Heights<sup>i</sup>

### Round Pipe

		2-2/3" x 1/2" Corrugations				
Pipe Size (inches)	Minimum cover (inches)	Steel Thickness (gauge)				
		16	14	12	10	8
		Galvanized Thickness (inches)				
		0.064	0.079	0.109	0.138	0.168
Corrugated Steel Pipe Backfill Heights (feet)						
12	12	219	273			
15	12	183	228	255		
18	12	146	182	191		
24	12	109	137	191		
30	12	87	108	153		
36	12	73	91	127	164	
42	12	62	78	109	141	172
48	12	55	68	96	123	150
54	12		61	85	109	134
60	12			76	98	120
66	12				89	109
72	12				82	100
78	12					89
84	12					77

<sup>i</sup>The Table is based on the following criteria (ASTM/ASSHTO embankment)

1. Pipe Type = Helical
2. Design Method = LRFD
3. Fill Density = 120pcf (prism above pipe)
4. Flexibility factor = 0.043
5. Safety Factor on Wall Area = 2.00
6. Safety Factor on Buckling = 2.00 based on equations of AASHTO/ASTM
7. Seam Strength check not required for helical pipe
8. Minimum Fill height taken as Span/8 but not less than 12"
9. Minimum cover for unpaved roadways is from the top of surfacing.
10. Minimum cover for paved roadways is from the top of subgrade.

## Corrugated Steel Pipe Backfill Heights<sup>ii</sup>

### Round Pipe

		3" x 1" Corrugations				
Pipe Size (inches)	Minimum cover (inches)	Steel Thickness (gauge)				
		16	14	12	10	8
		Galvanized Thickness (inches)				
		0.064	0.079	0.109	0.138	0.168
Corrugated Steel Pipe Backfill Heights (feet)						
48	12	63	78	110	142	173
54	12	56	70	98	126	154
60	12	50	63	88	113	139
66	12	46	57	80	103	126
72	12	42	52	73	94	116
78	12	39	48	68	87	107
84	12	36	45	63	81	99
90	12	33	42	59	76	92
96	12		39	55	71	87
102	24		37	52	67	82
108	24			49	63	77
114	24			46	60	73
120	24			44	57	69

<sup>ii</sup> The Table is based on the following criteria (ASTM/ASSHTO embankment)

1. Pipe Type = Helical
2. Design Method = LRFD
3. Fill Density = 120pcf (prism above pipe)
4. Flexibility factor = 0.033
5. Safety Factor on Wall Area = 2.00
6. Safety Factor on Buckling = 2.00 based on equations of AASHTO/ASTM
7. Seam Strength check not required for helical pipe
8. Minimum Fill height taken as Span/8 but not less than 12"
9. Minimum cover for unpaved roadways is from the top of surfacing.
10. Minimum cover for paved roadways is from the top of subgrade.

## Corrugated Steel Pipe Backfill Heights<sup>iii</sup>

### Round Pipe

3/4" x 3/4" Rib @ 7-1/2"					
Pipe Size (inches)	Minimum cover (inches)	Steel thickness (gauge)			
		16	14	12	10
		Galvanized Thickness (inches)			
		0.064	0.079	0.109	0.138
Corrugated Steel Pipe Backfill Heights (feet)					
15	12	130	182	302	
18	12	108	151	252	
24	12	72	100	167	
30	12	57	80	134	
36	12	48	67	111	
42	12	41	57	95	
48	12	36	50	83	
54	18		45	74	
60	18		40	67	97
66	18			61	88
72	18			56	81
78	24			51	75

<sup>iii</sup> The Table is based on the following criteria (ASTM/ASSHTO embankment)

1. Pipe Type = Helical
2. Design Method = LRFD
3. Fill Density = 120pcf (prism above pipe)
4. Flexibility factor =  $0.0217 I^{1/3}$
5. Safety Factor on Wall Area = 2.00
6. Safety Factor on Buckling = 2.00 based on equations of AASHTO/ASTM
7. Seam Strength check not required for helical pipe
8. Minimum Fill height taken as Span/8 but not less than 12"
9. Minimum cover for unpaved roadways is from the top of surfacing.
10. Minimum cover for paved roadways is from the top of subgrade.

## Corrugated Steel Pipe Backfill Heights<sup>iv</sup>

### Round Pipe

3/4" x 1" Rib @ 11-1/2"				
Pipe Size (inches)	Minimum cover (inches)	Steel thickness (gauge)		
		16	14	12
		Galvanized Thickness (inches)		
		0.064	0.079	0.109
Corrugated Steel Pipe Backfill Heights (feet)				
15	12	95	134	225
18	12	79	111	188
24	12	53	74	125
30	12	42	59	100
36	12	35	49	83
42	12	30	42	71
48	12	26	37	62
54	18	23	33	55
60	18		30	50
66	18		27	45
72	18			42

<sup>iv</sup> The Table is based on the following criteria (ASTM/ASSHTO embankment)

1. Pipe Type = Helical
2. Design Method = LRFD
3. Fill Density = 120pcf (prism above pipe)
4. Flexibility factor =  $0.140 I^{1/3}$
5. Safety Factor on Wall Area = 2.00
6. Safety Factor on Buckling = 2.00 based on equations of AASHTO/ASTM
7. Seam Strength check not required for helical pipe
8. Minimum Fill height taken as Span/8 but not less than 12"
9. Minimum cover for unpaved roadways is from the top of surfacing.
10. Minimum cover for paved roadways is from the top of subgrade.

## Corrugated Steel Pipe Backfill Heights<sup>v</sup>

### Arch Pipe

2 2/3" x 1/2" Corrugations								
Equivalent Pipe Diameter	Span	Rise	Minimum Cover (inches)	Steel Thickness (gauge)				
				16	14	12	10	8
				Galvanized Thickness (inches)				
Inches				0.064	0.079	0.109	0.138	0.168
Corrugated Steel Pipe Backfill Heights (feet)								
15	17	13	18	14				
18	21	15	18	13				
21	24	18	18	14				
24	28	20	18	13				
30	35	24	18	13				
36	42	29	18	13				
42	49	33	18		13			
48	57	38	18			13		
54	64	43	18			13		
60	71	47	18				13	
66	77	52	18					13
72	83	57	18					13

<sup>v</sup> The Table is based on the following criteria (ASTM/ASSHTO embankment)

1. Pipe Type = Helical
2. Design Method = LRFD
3. Fill Density = 120pcf (prism above pipe)
4. Flexibility factor = 0.043
5. Safety Factor on Wall Area = 2.00
6. Safety Factor on Buckling = 2.00 based on equations of AASHTO/ASTM
7. Seam Strength check not required for helical pipe
8. Minimum Fill height taken as Span/8 but not less than 12"
9. Minimum cover for unpaved roadways is from the top of surfacing.
10. Minimum cover for paved roadways is from the top of subgrade.

## Corrugated Steel Pipe Backfill Heights<sup>vi</sup>

### Arch Pipe

3" x 1" Corrugations							
Equivalent Pipe Diameter	Span	Rise	Minimum Cover (inches)	Steel Thickness (gauge)			
				14	12	10	8
				Galvanized Thickness (inches)			
				0.079	0.109	0.138	0.168
Inches				Corrugated Steel Pipe Backfill Heights (feet)			
48	53	41	18	21			
54	60	46	18	21			
60	66	51	18	21			
66	73	55	18	21			
72	81	59	18	18			
78	87	63	18	17			
84	95	67	18	17			
90	103	71	18		17		
96	112	75	18		17		
102	117	79	24		17		
108	128	83	24			16	
114	137	87	24			16	
120	142	91	24				16

<sup>vi</sup> The Table is based on the following criteria (ASTM/ASSHTO embankment)

1. Pipe Type = Helical
2. Design Method = LRFD
3. Fill Density = 120pcf (prism above pipe)
4. Flexibility factor = 0.033
5. Safety Factor on Wall Area = 2.00
6. Safety Factor on Buckling = 2.00 based on equations of AASHTO/ASTM
7. Seam Strength check not required for helical pipe
8. Minimum Fill height taken as Span/8 but not less than 12"
9. Minimum cover for unpaved roadways is from the top of surfacing.
10. Minimum cover for paved roadways is from the top of subgrade.

## Corrugated Steel Pipe Backfill Heights<sup>vii</sup>

### Arch Pipe

3/4" x 3/4" Rib @ 7-1/2"							
Equivalent Pipe Diameter	Span	Rise	Minimum Cover (inches)	Steel Thickness (gauge)			
				16	14	12	10
				Galvanized Thickness (inches)			
				0.064	0.079	0.109	0.138
Inches			Corrugated Steel Pipe Backfill Heights (feet)				
18	20	16	12	16			
21	23	19	12	15			
24	27	21	12	14			
30	33	26	12	14			
36	40	31	12	14			
42	46	36	12	14			
48	53	41	18		14		
54	60	46	18		21		
60	66	51	18			21	
66	73	55	18			21	
72	81	59	20				18
78	87	63	22				17
84	95	67	24				17

<sup>vii</sup> The Table is based on the following criteria (ASTM/ASSHTO embankment)

1. Pipe Type = Helical
2. Design Method = LRFD
3. Fill Density = 120pcf (prism above pipe)
4. Flexibility factor =  $0.0217 I^{1/3}$
5. Safety Factor on Wall Area = 2.00
6. Safety Factor on Buckling = 2.00 based on equations of AASHTO/ASTM
7. Seam Strength check not required for helical pipe
8. Minimum Fill height taken as Span/8 but not less than 12"
9. Minimum cover for unpaved roadways is from the top of surfacing.
10. Minimum cover for paved roadways is from the top of subgrade.

## Corrugated Steel Pipe Backfill Heights<sup>viii</sup>

### Arch Pipe

3/4" x 1" Rib @ 11-1/2"						
Equivalent Pipe Diameter	Span	Rise	Minimum Cover (inches)	Steel Thickness (gauge)		
				16	14	12
				Galvanized Thickness (inches)		
				0.064	0.079	0.109
Inches			Corrugated Steel Pipe Backfill Heights (feet)			
18	20	16	12	16	21	
21	23	19	12	15	21	
24	27	21	12	14	21	
30	33	26	12	14	21	
36	40	31	12	14	18	
42	46	36	12	14	17	
48	53	41	18	14	17	
54	60	46	18		21	
60	66	51	18			21

<sup>viii</sup> The Table is based on the following criteria (ASTM/ASSHTO embankment)

1. Pipe Type = Helical
2. Design Method = LRFD
3. Fill Density = 120pcf (prism above pipe)
4. Flexibility factor =  $0.140 I^{1/3}$
5. Safety Factor on Wall Area = 2.00
6. Safety Factor on Buckling = 2.00 based on equations of AASHTO/ASTM
7. Seam Strength check not required for helical pipe
8. Minimum Fill height taken as Span/8 but not less than 12"
9. Minimum cover for unpaved roadways is from the top of surfacing.
10. Minimum cover for paved roadways is from the top of subgrade.

## Corrugated Aluminum Pipe Backfill Heights

### Round Pipe

2 2/3" x 1/2" Corrugations						
Pipe Size (inches)	Minimum cover (inches)	Aluminium Thickness (gauge)				
		16	14	12	10	8
		Galvanized Thickness (inches)				
		0.060	0.075	0.105	0.135	0.164
Corrugated Aluminum Pipe Backfill Heights (feet)						
18	12	30	30	52	54	56
24	12	22	22	39	41	42
30	12	18	18	31	32	34
36	12	15	15	26	27	28
42	12		26	43	43	44
48	12			40	41	43
54	12			35	37	38
60	12				33	34
66	12				30	31
72	12					29

### Arch Pipe

2 2/3" by 1/2" Corrugations									
Pipe Size (inches)	Minimum cover (inches)	Span Inches	Rise	Minimum cover (inches)	Aluminium Thickness (gauge)				
					16	14	12	10	8
					Galvanized Thickness (inches)				
					0.060	0.075	0.105	0.135	0.164
Corrugated Steel Pipe Backfill Heights (feet)									
18	12	18	11	18	51				
24	12	22	13	18	14				
30	12	25	16	18	12				
36	12	29	18	18	10				
42	12	36	22	18	9				
48	12	43	27	18		9			
54	12	50	31	18			8		
60	12	58	36	18				8	