JM Eagle™
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TECHNICAL BULLETIN

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MINIMUM AND MAXIMUM BURIAL DEPTH RECOMMENDATIONS FOR EAGLE CORR PE™

MINIMUM COVER HEIGHT

Minimum cover height for 4-inch to 48-inch (100 mm to 1200 mm) diameters shall be at least 1 foot. Minimum cover height for 60-inch (1,500 mm) diameter pipe shall be at least 2 feet. Minimum cover height is measured from the crown of the pipe to the bottom of a flexible pavement section or to the top of a rigid pavement section. In addition to the minimum cover height requirements, an extra foot of temporary cover is recommended where heavy-duty construction equipment may travel over the pipe during the construction phase of the project.

Table 1

MINIMUM COVER HEIGHTS	
NOMINAL ID IN (MM)	MINIMUM COVER FT (M)
ID ≤ 48" (1200)	1 (0.3)
Id = 60 (1500)	2 (0.6)

BURIAL DEPTH RECOMMENDATIONS

The information contained herein describes the maximum allowable cover height for Eagle Corr PE™ (Dual Wall). These recommendations address maximum burial depths for pipe meeting the requirements of AASHTO M252 Type S, AASHTO M294 Type S, ASTM F2306 and ASTM F2648. This analysis is based on the design method developed by the Plastic Pipe Institute. The PPI design method is based on the actual pipe corrugation profile, which is conservative as evidenced by a long history of analytically predicted burial depths matching successful field installations.

MAXIMUM COVER HEIGHT ANALYSIS

The type and compaction of backfill around the pipe significantly influence the maximum burial depth. The influence of the backfill and compaction is illustrated in Table 2 below. Table 2 was developed assuming the pipe is installed in accordance with ASTM D2321. These maximum cover height recommendations assume the native soil is of adequate strength and is suitable for installation. Additionally the calculations assume no hydrostatic load and soil density of 120 pounds per cubic feet. Detailed calculations for each of the conditions described in Table 2 are available upon request.

Table 2

MAXIMUM COVER PPI DESIGN METHOD (FT)								
NOMINAL ID IN (MM)	CLASS 1		CLASS 2			CLASS 3		
	COMPACTED	DUMPED	95%	90%	85%	95%	90%	85%
4 (100)	60	20	40	28	20	28	21	19
6 (150)	63	22	43	30	22	31	23	21
8 (200)	61	20	41	28	20	29	21	19
10 (250)	61	20	40	28	20	28	21	19
12 (300)	55	17	35	24	17	25	18	16
15 (375)	55	17	35	24	17	24	18	15
18 (450)	53	16	34	23	16	23	17	14
24 (600)	54	16	34	23	16	24	17	14
30 (750)	51	14	32	21	14	22	15	13
36 (900)	49	13	31	20	13	21	14	12
42 (1050)	48	13	31	20	13	21	14	12
48 (1200)	48	13	30	20	13	20	14	11
60 (1500)	50	13	31	20	13	21	14	12

Notes:
1. Backfill material classes are based on backfill material as described and defined in ASTM D2321.
2. All compaction levels are based on standard proctor density.
3. Compaction and backfill material should be uniform throughout the backfill zone.
4. Backfill material and compaction levels (not shown in Table 1) may be acceptable; however special designs must be approved by JM Eagle or an engineer.
5. Deeper burial depths may be obtained by consulting an engineer for special designs.

PIPE PROPERTIES

Key pipe profile properties that influence the performance of the soil/pipe structure interaction include the moment of inertia of the profile (I), distance from the inside diameter to the neutral axis (c), and the section area of a longitudinal profile section (As). Pipe stiffness (PS) is also important criteria. The minimum pipe stiffness, defined by AASHTO was used for this analysis. These key properties are summarized in Table 3 below:

Table 3

SECTION PROPERTY SUMMARY						
NOMINAL ID DIAMETER (IN)	OUTSIDE DIAMETER (IN)	PIPE STIFFNESS, PS (PSI)	CROSS SECTIONAL AREA, A_s (IN^2/IN)	DISTANCE FROM INSIDE DIAMETER TO NEAUTRAL AXIS, C (IN)	MOMENT OF INERTIA, I (IN^4/IN)	PITCH (IN)
4.0	4.7	50	0.076	0.14	0.0012	0.65
6.0	6.9	50	0.122	0.19	0.0037	0.78
8.0	9.1	50	0.146	0.28	0.0085	0.97
10.0	11.4	50	0.180	0.33	0.0171	1.29
12.0	14.3	50	0.183	0.47	0.0366	1.94
15.0	17.5	42	0.222	0.51	0.0549	2.59
18.0	20.8	40	0.244	0.58	0.0824	3.10
24.0	27.5	34	0.330	0.72	0.1593	3.10
30.0	34.6	28	0.370	0.95	0.3118	3.88
36.0	41.5	22	0.410	1.12	0.4986	5.17
42.0	47.4	20	0.448	1.18	0.5531	5.17
48.0	53.8	18	0.498	1.21	0.6551	5.17
60.0	66.7	14	0.660	1.44	1.2766	7.76

Notes:
1. Section property data is considered conservative however properties may change based on actual production dimensions.

JM EAGLE CORRUGATED DESIGN CALCULATIONS

Example:

Date of Calculations: 5/8/2009

Project Name: JM-Eagle; Eagle Corr Max. Burial

Live Load Type	No Load	
Pipe Type	Eagle Corr	
ASTM D2321 Backfill Class	II	
Compaction	100% - 95%	
Material Density	120	(pcf)
Calculation Basis	Long-Term	

Input Values:

ID =	30	(in)
H =	32	(ft)
Hw =	0	(ft)

Constants:

v =	0.4	
gamma w =	62.4	(pcf)
Fys =	3000	(psi)
Fyl =	900	(psi)
Es =	110,000	(psi)
El =	22,000	(psi)
SF =	1.5	
SFi =	2.0	

Assumed Values:

Dl =	1	
gamma s =	120	
K =	0.11	

Calculated Values:

OD =	34.63	(in.)
PS =	28	(pii)
As =	0.37	(in^2/inch)
c =	0.95	(in.)
I =	0.31	
E' =	3000	(psi)
Wc =	923.467	(lb/lin. In.)
Psp =	26.931	(psi)
Ms =	3674	(psi)
Sh =	6.479	
VAF=	0.359	
Wa =	9.667	(psi)
Wl =	0.000	(lb/lin. In.)
Pl =	FALSE	(psi)
Cl =	0.0	
Pw =	0.000	(psi)
Rw =	1.00	
Df =	4.9	(in)
Dm =	31.9	in
Yo =	1.365	(in)

Wall Thrust (Burns & Richards)

$$T_{cr} = (F_y)(A_S)(\phi_p) = 333 \text{ lb/in}$$

$$T = 1.3\left(1.5W_A + 1.67 * P_l * C_l + P_W\left(\frac{OD}{2}\right)\right) = 326.4 \text{ lb/in}$$

Tcr > T so Wall Buckling will not occur.

Pipe Deflection

$$\Delta y = \frac{K[(D_L)(W_C) + W_L]}{(0.149)(PS) + (0.06)(E')} = 0.54 \text{ in}$$

Deflection = **1.81 %**

Within allowable limit.

Pipe Buckling

$$P_{cr} = \frac{0.772}{SF_i}\left[\frac{(E')(PS)}{1-\nu^2}\right]^{1/2} = 122.1 \text{ psi}$$

$$P_V = \frac{(R_W)(H)(\gamma_S)}{144} + \frac{(\gamma_S)(H_W)}{144} + \frac{W_L}{OD} = 26.7 \text{ psi}$$

Pcr > Pv so Pipe Buckling will not occur.

Bending Stress

$$\sigma_b = \frac{(2)(D_f)(E)(\Delta y)(y_0)(SF)}{D_m^2} = 235.4 \text{ psi}$$

Bending Stress is within allowable limit.

NOTE: Bending Stress calculated using long term conditions

Bending Strain

$$\varepsilon_b = \frac{(2)(D_f)(\Delta y)(y_0)SF}{D_m^2} = 0.011 \text{ in/in}$$

Bending Strain is within allowable limit.

Performance Assessment: ***Pipe should perform well under given conditions.***

* Structural design calculations based on PPI design manual.

** Example analysis for illustrative purposes only. Specific site conditions may be necessary. Performance subject to proper installation.