

**Pipe Design Calculations - Alphaliner™ RA 75/120 Fiberglass and Polyester Resin**

Liner Design Date	<b>2/8/2016</b>
Project Name	<b>Anytown USA Line 24-inch Rehabilitation</b>
Manhole Number	<b>MH 1</b>
Manhole Number	<b>MH 2</b>
Shot Number	<b>1</b>

**Design Input Parameters**

Description	Symbol	Value	Unit	Comment
Mean Inside Diameter of Original Pipe	D	24.00	in	Measured in the field
Minimum Inside Diameter of Original Pipe	Min ID	24.00	in	Measured in the field
Percentage Ovality of Original Pipe	q	2.00	%	2% should be used as an engineering estimate unless actual pipe dimensions can be measured (leave blank if actual dimensions are known)
Height of Soil above Invert	H	20.00	ft	
Height of Water above Invert	H <sub>w</sub>	17.00	ft	
Soil Density	w	120.00	lb/ft <sup>3</sup>	<a href="#">Soil Weight Table</a>
Modulus of Soil Reaction	E's	1,000.00	psi	
Factor of Safety	N	2.00	N/A	Industry standard unless specification states otherwise
Enhancement Factor of the Soil and Existing Pipe	K	7.00	N/A	Minimum value of 7.0 is recommended where there is full support of existing pipe
Live Load	P <sub>L</sub>	YES	psi	<a href="#">Live Load</a>

**Liner Properties**

Description	Symbol	Value	Unit	Comment
Initial Modulus of Elasticity for CIPP (Radial)	E	1,000,000    1,500,000    250,000    400,000	psi	
Long Term Modulus of Elasticity for CIPP (Radial)	E <sub>L</sub>	600,000    1,125,000    125,000    200,000	psi	
Short Term Tensile Strength for CIPP (Radial)	σ <sub>ST</sub>	25,000    30,000    3,000    3,000	psi	
Long Term Tensile Strength for CIPP (Radial)	σ <sub>LT</sub>	15,000    22,000    1,500    1,500	psi	

**Design Output Parameters**

Description	Symbol	Value	Unit	Comment
Live Load	P <sub>L</sub>	0.16	psi	<a href="#">Live Load</a>
Poisson's Ratio	v	0.270    0.290    0.300    0.300	N/A	Blue-Tek value
Reduction Factor	N/A	1.780    1.330    2.000    2.000	N/A	Blue-Tek value
Long-Term Flexural Strength for CIPP	E <sub>L</sub>	600,000    1,125,000    125,000    200,000	psi	Time corrected value
Percentage Ovality of Original Pipe	q	2.00%	%	
Ovality Reduction Factor	C	0.836	N/A	

**Design Summary**

Description	Design Wall Thickness (mm)	Actual Use Wall Thickness (mm)
RA75 Partially Deteriorated	7.52	7.70
RA120 Partially Deteriorated	6.08	6.30
Unfilled Resin Felt Liner Partially Deteriorated	12.50	13.50
Filled Resin Felt Liner Partially Deteriorated	10.72	12.00
RA75 Fully Deteriorated	8.64	9.10
RA120 Fully Deteriorated	7.00	7.70
Unfilled Resin Felt Liner Fully Deteriorated	14.57	15.00
Filled Resin Felt Liner Fully Deteriorated	12.46	13.50