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Bulletin PP-901

Pulling-In

Pulling-in involves cutting a trench, then pulling the pipe in from one end of the trench. Pulling-in may be accomplished as a simultaneous operation by attaching the leading end of the pipe behind the trench cutter, or as a separate operation after the trench has been opened. In either case, pulling-in requires a relatively straight trench and the pulling force applied to the pipe must not exceed the Allowable Tensile Load ATL, (safe pull strength) for the pipe. Therefore, this method is limited to shorter runs.

Allowable Tensile Load (safe pull strength) may be determined by:

$$ATL = TTD_2 \, fy \, ft \, Ty \left(1 - \frac{1}{DR}\right)^{J}_{DR^2}$$

Where

ATL = allowable tensile load,lb
D = pipe outside diameter,in
fv = tensile yield design (safety) factor, Table 29
fr = time under tension design (safety) factor,
Table 29 Tv = pipe tensile yield strength lb/in^2 (Table 30)
DR = pipe dimension ratio (DR or SDR)

When polyethylene pipe is subjected to a significant short term pulling stress, the pipe will stretch somewhat before yielding. However, if the pulling stress is limited to about 40% of the yield strength the pipe will usually recover undamaged to its original length in a day or less after the Stress is removed.

Table 29 Recommended ign Factors fior ATL

Factor	*Parameter*	*Recommended Value*		
fv	Tensile yield design factort	0.40		
fr	Time under tension design factor	1.0 for up to 1 h	0.95 for up to 12 h	0.91 for up to 24 h

t Design and safety factors are the inverse of each other. Multiplying by a 0.40 design factor is the same as dividing by a 2.5 safety factor.

Pipe yield strengths may be estimated by using the values from Table 30. Unlike more brittle materials, polyethylene pipe materials can stretch over 400% between tensile yield and tensile break. Further, tensile yield strength and tensile break strength are about the same value, so pulling load gauges will not show that a pipe has yielded because the pipe will stretch to the breaking point with little change in pulling force. The only indication will be that the trailing end stops while the pulling end continues to move.

Table 30 Approximate Tensile Yield Strength Values for PE4710

Material	*Tensile Yield Strength at Pipe Temperature*
	73°F *(23°C)*
HDPE	3500 lb/in^2
MDPE	2800 lb/in^2
Temperature Factor	Table 5

When pulling-in polyethylene pipe, especially smaller diameters, the pulling force should be monitored and kept below the ATL value for the pipe size, and both the pulling end and trailing end should be monitored for continuous, smooth movement. When pulling equipment can exceed the ATL value of the pipe install a weak-link device at the lead end of the polyethylene pipe. The weak-link device should be set to disengage at the ATL value or lower.

Because pull-in loads will cause the pipe to stretch, the leading end should be pulled past the termination point by 3-5% of the total pulled-in length, and the trailing end should be left long by the same amount. Final tie-ins should be made a day after the pull to allow the pipe to recover from the pulling stress and contract to its original pre-pull length. The extra length at both ends assures that the pipe won't recede back past the tie-in points as it recovers from the pull.

Table 31 Approximate Allowable Tensile Load for HOPE Pull Duration between 1 and 12 Hours at 73°F

IPS Size	ATLA, lb			
	SDR 17	SDR 13.5	SDR 11	SDR 9
2"	1,305	1,616	1,948	2,328
3"	2,834	3,511	4,230	5,055
4"	4,684	5,803	6,993	8,357
6"	10,153	12,578	15,156	18,112
8"	17,208	21,319	25,688	30,699
10"	26,733	33,118	39,906	47,690
12"	37,605	46,587	56,135	67,085
14"	45,340	56,169	67,682	80,884
16"	59,219	73,364	88,401	105,644
18"	74,949	92,852	111,882	133,706
20"	92,530	114,632	138,126	165,069
22"	111,962	138,704	167,133	199,734
24"	133,244	165,069	198,902	237,700

A ATL values in table are at 73°F and for pull duration of 1 to 12 hours using an allowable tensile pull stress of 1330 psi. Depending on the application, adjust the ATL value for temperature or pull duration or both. For elevated temperature, multiply ATL value by temperature factor from Table 5; for pull duration of 1 hour, multiply ATL value by 1.08; and for pull duration between 12 and 24 hours, multiply ATL value by 0.91.