

Ductility & Durability of HDPE Pipe

- Toughness over Strength!

Dustin Langston





- For many applications, ductility becomes more important than strength



Today's Topics

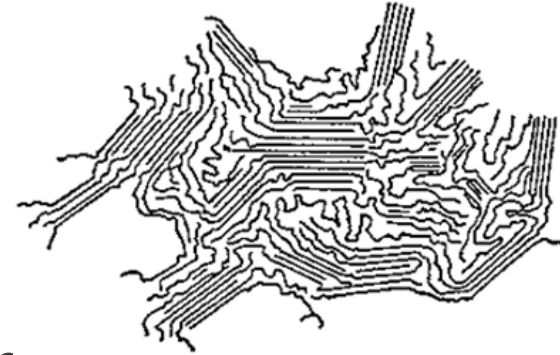
- ▶ Why is HDPE Pipe so Tough?
- ▶ Benefits of the Increased Ductility
- ▶ Demonstrations of Ductility
- ▶ When is Toughness More Important Than Strength?
- ▶ Case Study Examples



What is Polyethylene?

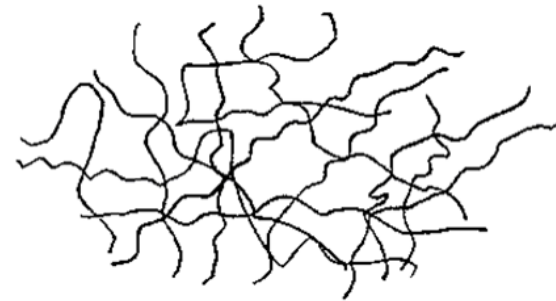
► Semi-Crystalline Polymer

- Molecules pack in Tight Formations
- Up to 90% Crystalline region
- Side branching effects Density
- Tensile Strength, Stiffness, Abrasion, Hardness, Chemical Resistance

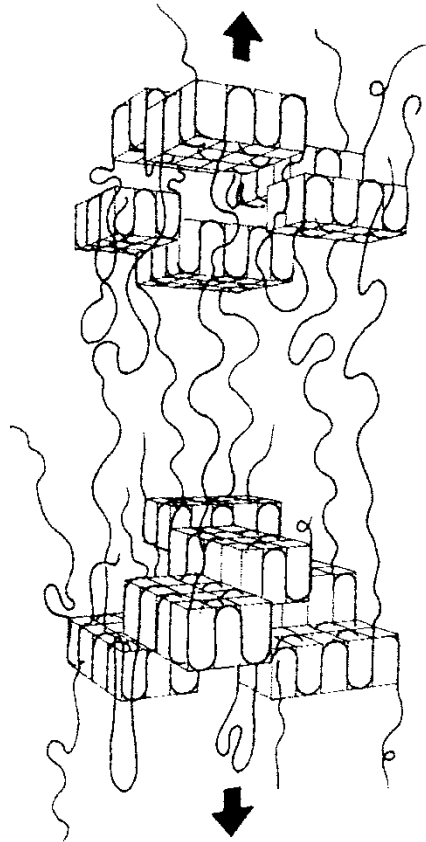


► Thermoplastic

- Plastic that can be repeatedly softened by heating and hardened by cooling
- Process is reversible and repeatable
- Retains all physical properties



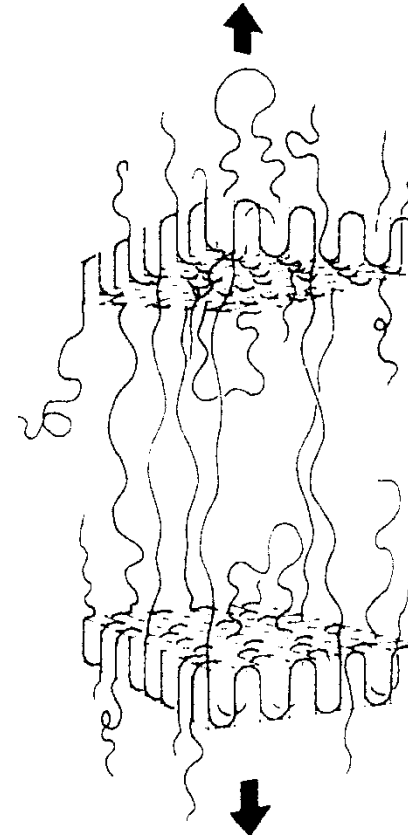
Ductile vs. Tensile



Ductile Yielding

Ductile tension yielding
(bursting) – crystal
structure ripped apart

SCG – sustained low
tension load separates
tie molecules from
crystal faces



SCG



Cornell University

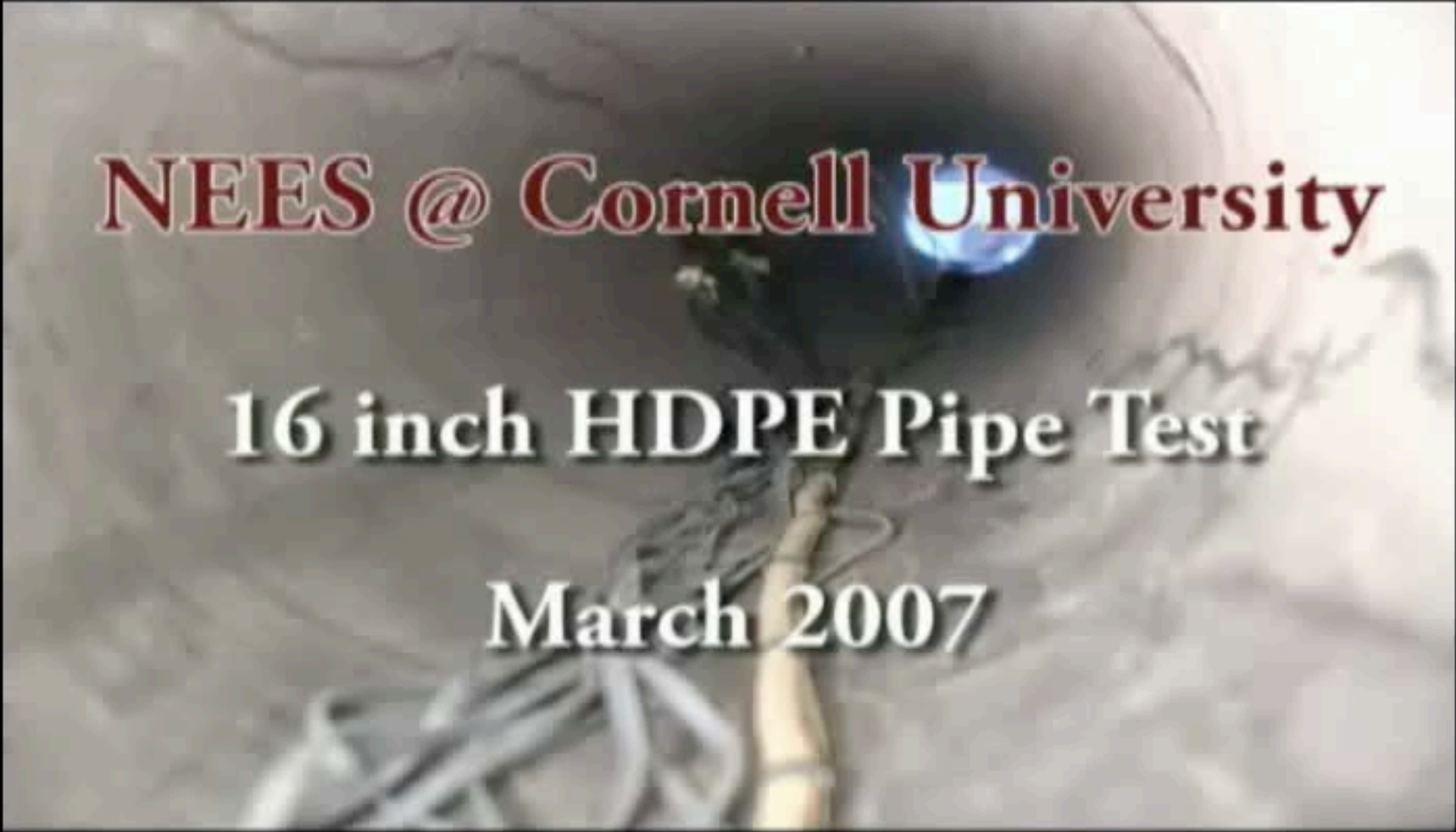
NEESeam4_Wireless_Aerial 2007-08-18 11:08:36



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NEES @ Cornell University

16 inch HDPE Pipe Test

March 2007

Pipe will conform with ground movement



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HDPE pipe expands with freeze thaw
and will not crack



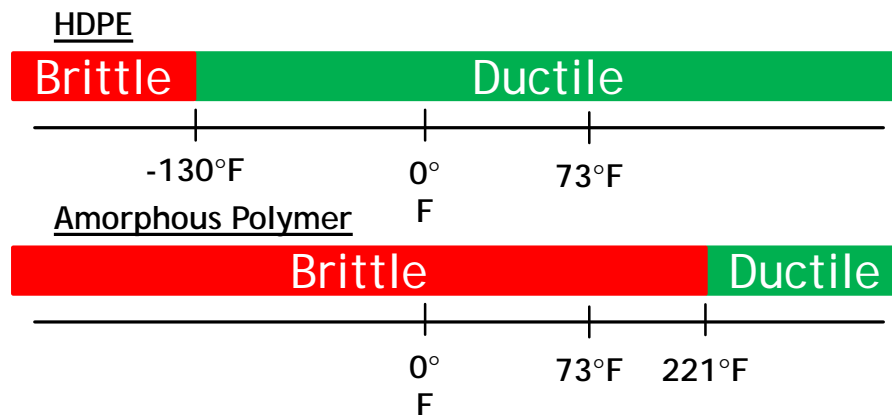
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Temperature Operation Range

- ▶ Water Can Freeze in HDPE pipe without Damage
- ▶ Pressure Service Temperature between -40°F to 140°F
- ▶ Glass Transition Temperature for Polyethylene is -130°F



- Increased Toughness, Larger Deformations, High Impact, RCP



Impact Resistant



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flexible

"squeeze
it flat"

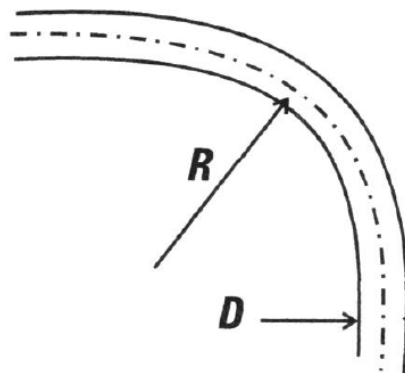
Squeeze tools available up to 24" OD



Bend Radius

1. Function of Pipe Size, DR and Bend Ratio
2. Lower DR = Tighter Bend Capability
3. Short Term vs. Long Term Bend Radius

Pipe DR	Minimum Long Term Bend Ratio, α	Minimum Short Term Bend Ratio, α
≤ 9	20 times pipe OD	10 times pipe OD
11 - 13.5	25 times pipe OD	13 times pipe OD
17 - 21	27 times pipe OD	17 times pipe OD
26	34 times pipe OD	-
32.5	42 times pipe OD	-
41	52 times pipe OD	-
Fitting or flange present in bend	100 times pipe OD	-

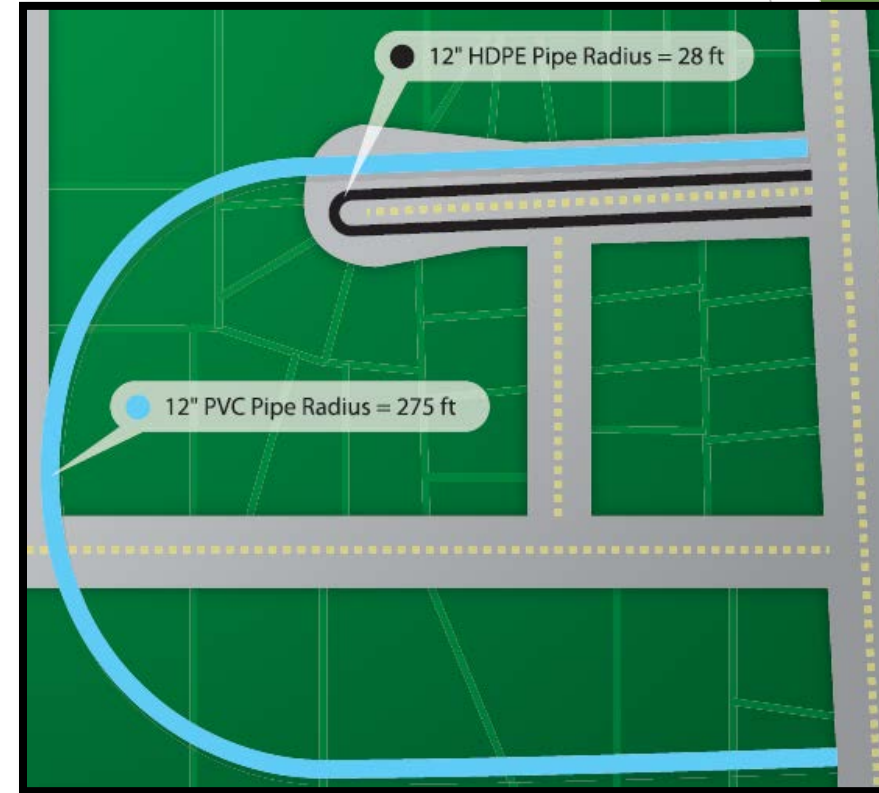


Bend Radius?

$$R = \alpha \times OD$$

Lay Length Required?

$$S = \theta \frac{\pi}{180^\circ} R$$



Example:

$$R = 25 \times 13.2" = 28 \text{ ft}$$

$$S = 90^\circ \times \frac{\pi}{180^\circ} \times 28' = 44 \text{ ft}$$





Flexible



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Self Restrained



Fusion joint as strong as the pipe itself



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Layout Benefits





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High Performance Pipe

Coiled/Reeled HDPE pipe available in diameters up to 8" DIPS in 500 ft lengths.

Typical municipal pipe bursts and HDD installations are less than 500ft each when going hydrant to hydrant, or manhole to manhole.

Reduces jobsite footprint, eliminating potential pull string layout issues.



500ft Reel of 6" IPS DR9 - 250 psi Pipe



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HDPE HDD Installs – Easy to Handle



20" installed under I-5 California



Dual 42" DR17 Utah



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Others HDD – Not so Much

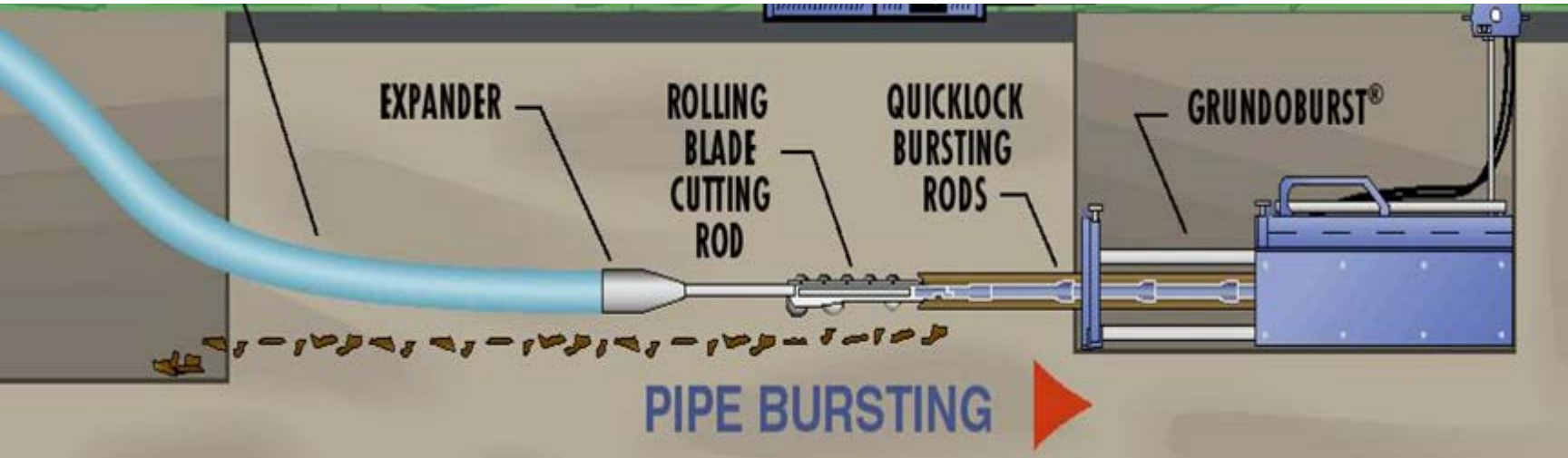


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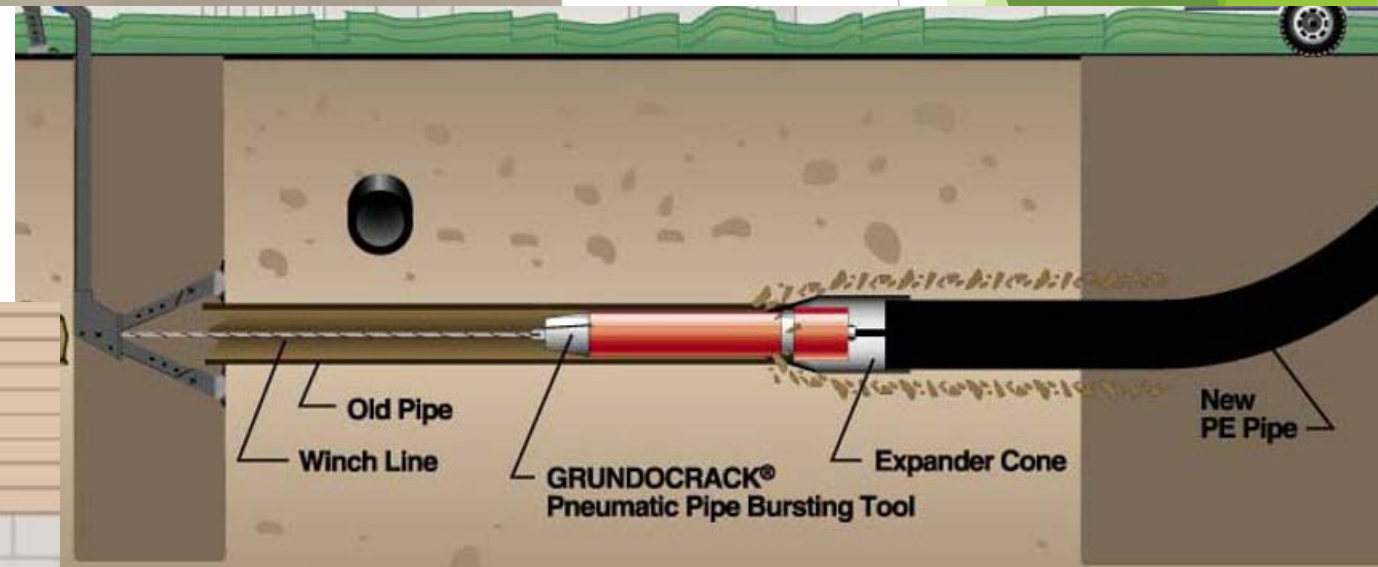


Smallest Entry/Exit Pits



Static

Pneumatic



Utility



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Plow / Trencher Installation

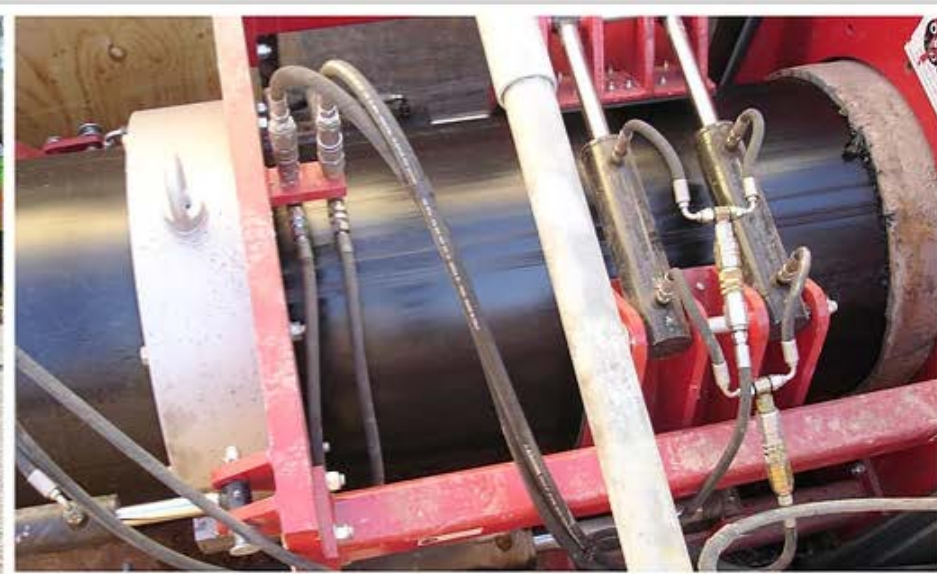


IN A SINGLE PASS

Plow Trenching — 24" OD HDPE Pipe 6FT Down

Other installation methods that only allow HDPE pipe because of its great ductility





LIFE EXTENDING TECHNOLOGY
FOR NEW AND EXISTING PIPELINES

Tight fitting HDPE liner. Aegions United offers this product along with Murphy Pipe and Construction. HDPE liner acts as corrosion inhibitor.



Pneumatic pipe bursting only allows HDPE pipe. Too violent for any other pipe material.



<https://www.youtube.com/watch?v=uA9cO9jiQ9M>

24" DR17 pneumatic pipe burst 575ft in 2 hours





CASE STUDIES

https://www.youtube.com/watch?v=_6N_217qq9I

Miami HDD 54" IPS DR17 4340ft

Competitions favorite lie is that DR9 is required when using HDPE pipe. Very few pulls require thick wall HDPE pipe. Record HDPE pull was DR17!





<https://www.youtube.com/watch?v=fFN5okTC4Rg>

California 36" DR11 2500 ft Under Hwy 1





King County Washington



Attempt 1 - Other

<https://www.kiro7.com/news/local/new-11-million-sewer-project-could-cost-double-to-fix/797108425>

The Fix - HDPE



Questions?

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