

PE Pipe HDD Stress Analysis Report

ASTM F1962 — PE Pipe Installation by HDD

PROJECT NAME

Demo - Case #1

CLIENT

ABC Pipeline

CALCULATED BY

John Smith, PE

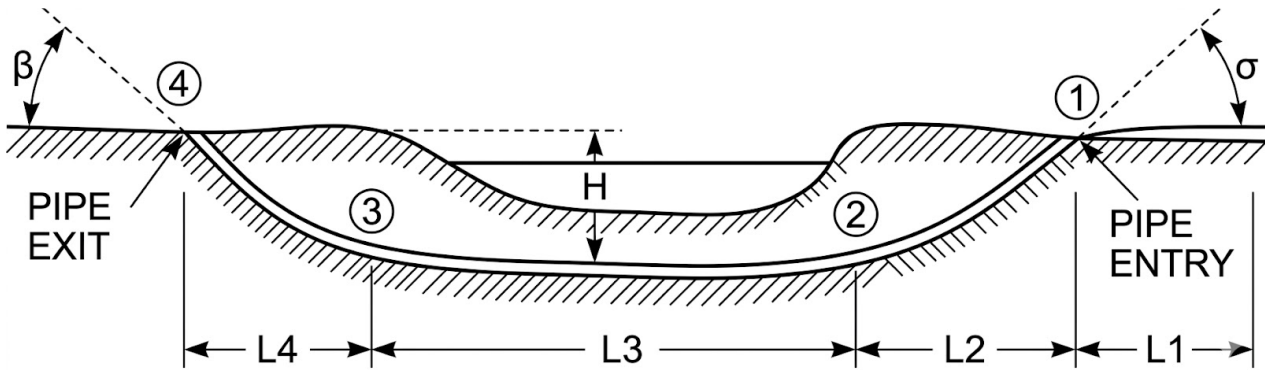
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June 29, 2026

PE PIPE HDD STRESS ANALYSIS

Polyethylene Pipeline — Horizontal Directional Drilling Design Report

1. PE HDD BORE PROFILE



2. DESIGN INFORMATION

Project Summary

Pipe Material	PE4xxx	—	Dimension Ratio (DR)	11	—
Outside Diameter	8.63	in	Inside Diameter	7.06	in
Wall Thickness	0.78	in	Hole Diameter (D_{bh})	14.00	in

HDD Bore Geometry

Hole Diameter, D_{bh}	14.00	in	Weight of Contents, W	0.00	lb/ft
Entry Angle, α	12.00	°	Exit Angle, β	14.00	°
Entry Radius, R_{entry}	1,200	ft	Exit Radius, R_{EXIT}	800	ft
Surface Drag, L_1	1,129.00	ft	Entry Slope Length, L_2	385.00	ft
Bottom Tangent, L_3	450.20	ft	Exit Slope Length, L_4	303.70	ft

Bore Pipe Properties

Outside Diameter, O.D.	8.63	in	Dimension Ratio, DR	11	—
Wall Thickness, $t = OD/DR$	0.78	in	Inside Diameter, ID	7.06	in
Mean Diameter, D_{av}	7.84	in	Pipe Material Grade	PE4xxx	—

Soil Conditions

Soil Type (USCS)	—	—	Groundwater Height, H_W	56.40	ft
Unit Weight of Soil, γ_{soil}	62.60	lb/ft ³	Friction Angle, δ	30.00	°
Unit Weight of Mud, γ_{mud}	78.54	lb/ft ³	Unit Weight of Water, γ_w	62.40	lb/ft ³
Borehole-to-Pit Diff., H	56.40	ft	Soil Cover above Crown, HC	50.00	ft

PE Pipe HDD Stress Analysis

Installation & Pullback Stresses

3. INSTALLATION & PULLBACK STRESSES

Installation Inputs					
Hole Condition	Deformed	—	Duration	12 hr	—
Safe Pull Stress, T_{allow}	943	psi	Temperature	90.00	°F
Temp. Multiplier	0.82	—	Internal Pressure, P_i	0.00	psi
Surcharge, P_{sur}	0.00	psi	Friction (Borehole), μ_b	0.25	—
Hydrokinetic Pressure, P_{hk}	8.00	psi			
Deformation Condition	Arching Factor	—			

Pressure & Deflection Results					
Modulus of Elasticity, E	51,660	psi	Earth Pressure, P_e	0.81	psi
Drilling Slurry, P_{mud}	30.76	psi	Ring Deflection, $\Delta y/D$	0.000522	in/in
Arching Factor, k	2.598076	—	Earth Pressure Coeff., K_a	0.333333	—
Ovality Factor, f_0	0.996084	—	Unconstrained Buckling, P_{uc}	129.05	psi
Compressive Wall Stress, S_c	157.87	psi	Buckling SF, S_{fcr}	158.97	—

Pull Forces					
Pipe Weight, W_p	7.95	lb/ft	Buoyant Force, W_b	23.92	lb/ft
F1 — Surface Drag	3,590.73	lbf	F2 — Entry Curve	7,434.45	lbf
F3 — Bottom Tangent	10,126.15	lbf	F4 — Exit Curve	10,764.00	lbf
Safe Pull Force, F_s	18,213.54	lbf	Hydrokinetic Force, F_{hk}	764.09	lbf

Axial Stresses & Bending					
σ_1 — Point 1	225.47	psi	σ_2 — Point 2	424.48	psi
σ_3 — Point 3	563.84	psi	σ_4 — Point 4	596.86	psi
Max Axial Stress, S_{max}	596.86	psi	Safe Pull Stress, T_{allow}	943	psi
Bending Strain (Entry), ϵ_a	0.000299	in/in	Bending Strain (Exit), $\epsilon_{a,ex}$	0.000449	in/in
Bending Stress (Entry), S_a	15.47	psi	Bending Stress (Exit), $S_{a,ex}$	23.21	psi

Pullback Safety					
Tensile Stress Ratio, r	0.632941	—	Pull Reduction Factor, FR	0.774200	—
Buckling During Pullback, PUC,PB	99.91	psi	Ring Collapse SF, $S_{FCR,PB}$	3.25	—

PE Pipe HDD Stress Analysis

Design Check — Installation & Pullback

Design Check — Installation & Pullback

Design Check	Actual	Limit	Unit	Status
Ring Deflection ($\Delta y/D$)	0.000522	0.05	in/in	PASS
Compressive Wall Stress (SC)	157.87	1150	psi	PASS
Buckling SF (SFCR)	158.97	2.0	—	PASS
Pull Force (F_4 vs Safe Pull)	10,764.00	18,213.54	lbf	PASS
Axial Stress — Point 1	225.47	943	psi	PASS
Axial Stress — Point 2	424.48	943	psi	PASS
Axial Stress — Point 3	563.84	943	psi	PASS
Axial Stress — Point 4	596.86	943	psi	PASS
Max Axial Tensile Stress	596.86	943	psi	PASS
Ring Collapse S.F.-pullback	3.25	2.0	—	PASS

4. POST-INSTALLATION STRESSES

Post-Installation — Inputs

Hole Condition	Deformed	—	Duration	1,000 hr (42 days)	—
Temperature	73.40	°F	Temp. Multiplier	1.00	—
Internal Pressure, P_i	0.00	psi	Surcharge, P_{SUR}	0.00	psi
Deformation Condition	Arching Factor	—			

Post-Installation — Results

Modulus of Elasticity, E	46,000	psi	Earth Pressure, P_E	0.81	psi
Drilling Slurry Pressure, PMUD	30.76	psi	Ring Deflection, $\Delta y/D$	0.000586	in/in
Arching Factor, k	2.598076	—	Earth Pressure Coeff., K_a	0.333333	—
Ovality Factor, f_0	0.995602	—	Unconstrained Buckling, PUC	114.85	psi
Compressive Wall Stress, S_c	157.87	psi	Allowable Comp. Stress	1150	psi
Buckling Safety Factor, $S.F._{buck}$			141.48		

Design Check — Post-Installation

Design Check	Actual	Limit	Unit	Status
Ring Deflection ($\Delta y/D$)	0.00	0.05	in/in	PASS
Compressive Wall Stress (SC)	157.87	1,150.00	psi	PASS
Buckling Safety Factor (SFCR)	141.48	2.00	—	PASS

5. IN-SERVICE STRESSES

In-Service — Inputs					
Hole Condition	Deformed	—	Duration	50 years	—
Temperature	73.40	°F	Temp. Multiplier	1.00	—
Internal Pressure, P _i	60.00	psi	Surcharge, P _{SUR}	0.00	psi
Deformation Condition	Arching Factor	—			

In-Service — Results					
Modulus of Elasticity, E	29,000	psi	Earth Pressure, PE	0.81	psi
Hydrostatic Pressure, PGW	24.44	psi	Ring Deflection, Δy/D	0.000930	in/in
Arching Factor, k	2.598076	—	Earth Pressure Coeff., Ka	0.333333	—
Ovality Factor, f ₀	0.993024	—	Unconstrained Buckling, PUC	72.22	psi
Compressive Wall Stress, S _c	-173.74	psi	Allowable Comp. Stress	1150	psi
Buckling Safety Factor, S.F. _{buck}				88.96	

Design Check — In-Service

Design Check	Actual	Limit	Unit	Status
Ring Deflection (Δy/D)	0.00	0.05	in/in	PASS
Compressive Wall Stress (SC)	173.74	1,150.00	psi	PASS
Buckling Safety Factor (SFCR)	88.96	2.00	—	PASS

6. MAINTENANCE STRESSES

Maintenance — Inputs

Hole Condition	Deformed	—	Duration	24 hr	—
Temperature	73.40	°F	Temp. Multiplier	1.00	—
Internal Pressure, P_i	0.00	psi	Surcharge, P_{SUR}	0.00	psi
Deformation Condition	Arching Factor	—			

Maintenance — Results

Modulus of Elasticity, E	60,000	psi	Earth Pressure, PE	0.81	psi
Hydrostatic Pressure, PGW	24.44	psi	Ring Deflection, $\Delta y/D$	0.000450	in/in
Arching Factor, k	2.598076	—	Earth Pressure Coeff., K_a	0.333333	—
Ovality Factor, f_0	0.996628	—	Unconstrained Buckling, PUC	149.96	psi
Compressive Wall Stress, S_c	126.26	psi	Allowable Comp. Stress	1150	psi
Buckling Safety Factor, $S.F._{buck}$				184.73	

Design Check — Maintenance

Design Check	Actual	Limit	Unit	Status
Ring Deflection ($\Delta y/D$)	0.00	0.05	in/in	PASS
Compressive Wall Stress (SC)	126.26	1,150.00	psi	PASS
Buckling Safety Factor (SFCR)	184.73	2.00	—	PASS