

Pipeline Lowering Stress Assessment

API RP 1117 — Lowering In Place Analysis

PROJECT NAME

Demo - Case #1

CLIENT

ABC Pipeline

CALCULATED BY

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DATE

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PIPELINE LOWERING STRESS ASSESSMENT

API RP 1117 — Lowering In Place Analysis

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1. EXECUTIVE SUMMARY

MINIMUM TRENCH LENGTH

372.0 ft

Max Support Spacing: 134.7 ft | Total Longitudinal Stress: 58,477 psi

Pipe Properties

OD:	24.000 in
Wall Thickness:	0.500 in
Grade:	X-65
SMYS:	65,000 psi
ID:	23.000 in
Moment of Inertia:	2549.35 in4
Section Modulus:	212.45 in3

Material Properties

Elastic Modulus:	29,000,000 psi
Poisson's Ratio:	0.30
Thermal Expansion:	0.0000065 /deg F

Operating Conditions

Internal Pressure:	1,000 psig
Install Temperature:	80 deg F
Operating Temperature:	60 deg F
Existing Stress (Sc):	0 psi

Design Parameters

Design Factor (Fd):	0.90
Desired Deflection:	5.0 ft
Stress Limit (Fd*SMYS):	58,500 psi

2. STRESS ANALYSIS RESULTS

Stress Components

Stress Component	Value (psi)	Description
Pressure Stress (S_p)	7,200	$S_p = P \cdot D \cdot \mu / (2 \cdot t)$
Thermal Stress (S_T)	3,770	$S_T = E \cdot \alpha \cdot (T_1 - T_2)$
Existing Stress (S_E)	10,970	$S_E = S_p + S_T + S_C$
Elongation Stress (S_S)	13,985	$S_S = 2.67 \cdot E \cdot (\Delta/L)^2$
Bending Stress (S_B)	33,522	$S_B = w \cdot L^2 / (12 \cdot S)$
Allowable Bending (S_{Allow})	33,545	$F_D \cdot SMYS - S_E - S_S$

Final Stress Assessment

Parameter	Value	Status
Total Longitudinal Stress (S_L)	58,477 psi	$S_E + S_B + S_S$
Stress Limit ($F_D \times SMYS$)	58,500 psi	—
Assessment	$S_L \leq S_{Limit}$	PASS

Key Dimensions

Parameter	Value	Unit
Minimum Trench Length (L_{min})	372.0	ft
Max Support Spacing (L_s)	134.7	ft
Desired Deflection (Δ)	5.0	ft

3. CALCULATED TRENCH PROFILE

The profile below shows the deflected shape the pipeline must follow as it is lowered into the trench. The pipe is supported at each end and sags to the target depth at midspan. Lowering the line along this curve keeps the combined longitudinal stress within the allowable limit ($F_d \times SMYS$).

Min. Trench Length

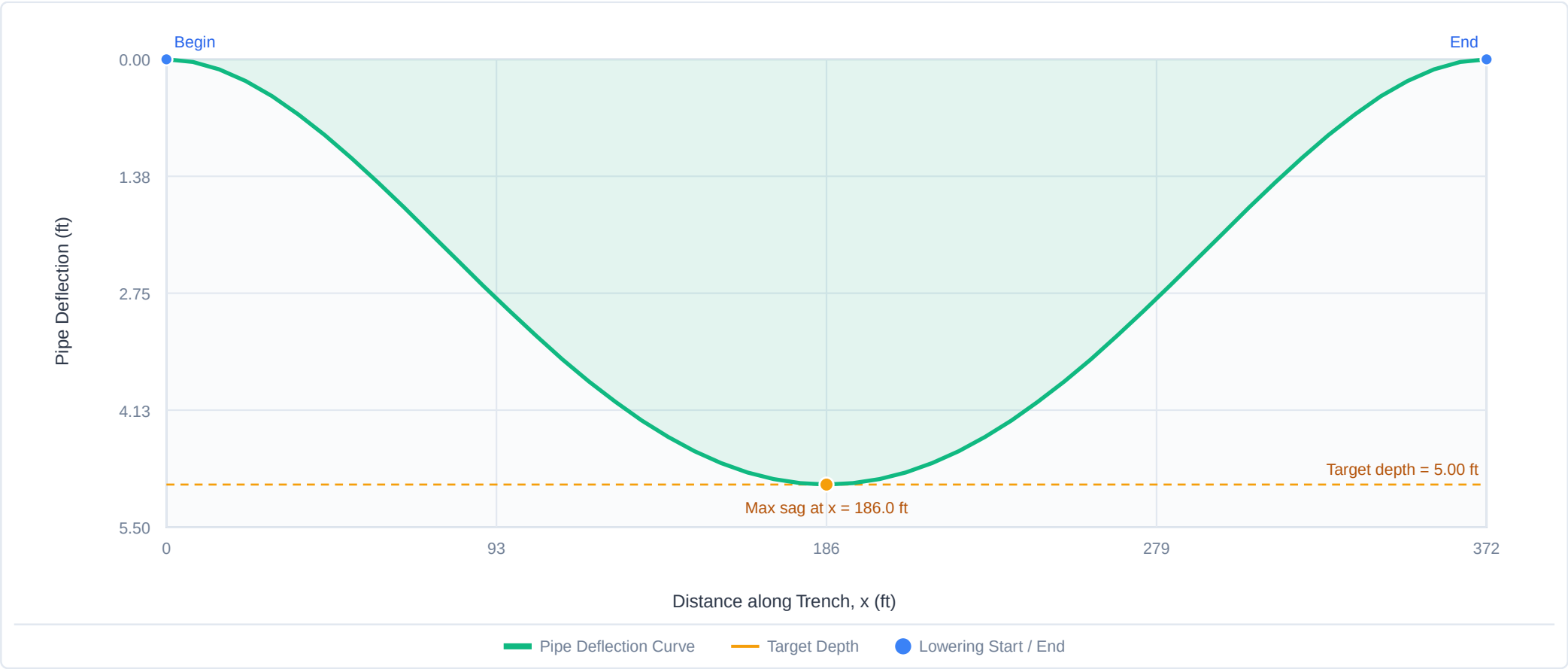
372.0 ft

Target Deflection

5.00 ft

Max. Support Spacing

134.7 ft



3. CALCULATED TRENCH PROFILE (CONT.)

Profile Coordinates

Deflection values along the trench at 10% span intervals. Midspan (maximum deflection) is highlighted.

Station x (ft)	% of Span	Deflection (ft)	Deflection (in)
0.0	0%	0.000	0.00
37.2	10%	0.648	7.78
74.4	20%	2.048	24.58
111.6	30%	3.528	42.34
148.8	40%	4.608	55.30
186.0	50%	5.000	60.00
223.2	60%	4.608	55.30
260.4	70%	3.528	42.34
297.6	80%	2.048	24.58
334.8	90%	0.648	7.78
372.1	100%	0.000	0.00

4. CONCLUSIONS AND RECOMMENDATIONS

Design Verification

Total longitudinal stress (58,477 psi) is within the allowable limit (58,500 psi) — PASS

Minimum trench length required: 372.0 ft

Maximum support spacing during lowering: 134.7 ft

The pipeline section can safely be lowered with the specified deflection

Construction Recommendations

1. Open trench to minimum length of 372.0 ft before lowering
2. Place pipe supports at maximum spacing of 134.7 ft
3. Lower pipeline uniformly to avoid localized bending concentrations
4. Monitor deflection during lowering — do not exceed 5.0 ft
5. Verify pipe material meets Grade X-65 through MTRs
6. Document as-built conditions and actual deflections for records