International Construction Consulting, LLC

HDD Design, Calculations, and Cost Estimate

Bow Tie to Industrial Park; Soyo, Angola

Sonangol
Gás Natural

INTERNATIONAL CONSTRUCTION CONSULTING, LLC

JOB No: NA **PREPRD.BY:** G Lamberson **DATE:** 16-Jan-18
CLIENT: Sonangol Gas Natural **CHECKD.BY:**
PROJECT: 24" Gas Pipeline from Bow Tie to Industrial Park-Soyo, Angola
SUBJECT: HDD General Calculations; Length & Angle & General Design Analysis; Cost Estimate

Input Parameters

Diameter (in.) =	**24.000**	
Wall Thickness (in.) =	**0.500**	
SMYS (psi) =	**65,000**	
Type of Service =	**Gas**	
Design Pressure =	**1,440**	
Safety Factor =	**0.72**	
Installation Temperature (degrees F) =	**90.00**	
Ground Temperature (degrees F) =	**60.00**	
Operating Temperature (degrees F) =	**80.00**	
Cover on Bottom (Ft) =	**10.00**	
Groundwater table head (feet) =	**10.00**	
Groundwater Table Elevation =	**15.38**	
Concrete Coated Pipe =	**No**	
Concrete Coating Thickness (inches) =	**0.00**	
Concrete Compressive Strength (PSI) =	**0**	
Depth of Pipe relative to entry/exit at Lowest Point =	35.00	
Horizontal Length of Drill (Ft) =	**1,918.00**	

Key Calculated Values

D/t ratio =	48.00	
r_o (in.) =	12	
r_i (in.) =	11.5	
E (psi) =	3.05E+07	Young's modulus for steel (*see calculation sheet*)
I (in^4) =	2549.351198	Moment of interia, = PI/4*(r_o^4 - r_i^4)
R (in.) =	16,631	Radius of curvature in inches
Deflection Angle =	0.0009	Radians/15 Feet
Deflection Angle =	0.0517	Degress/15 Feet
Deflection Angle =	0.0902	%/15 Feet
M = (in-lb) =	4,670,570	M = EI/R
A = (in^2) =	36.914	Cross sect. area = PI*(D - t)*t
W = (in^3) =	216.868	(elastic) section modulus = PI/4*(D - t)^2*t
Calculated R.O.C. =	1,386	Feet (average of calculation methods)
Results of this preliminary Technical Evaluation =	**This preliminary design has been evaluated and is deemed acceptable subject to a full design review.**	

Length, Angles, & Misc Input and Calculations

Top Bank at Entry of X-ing (Elev in Ft) =	**0.000**	Ft
Top Bank at Exit of X-ing (Elev in Ft) =	**0.000**	Ft
Bottom of X-ing (Elev in Ft) =	**-25.000**	Ft
Entry Angle, Deg	**12.000**	Deg
Entry Elevation, ft	**16.00**	Ft
Minimum Depth Elevation, ft	35.00	Ft
Horizontal Dist. @ Depth, ft	1,639.70	Ft
Exit Angle, Deg.	**10.000**	Deg
Exit Elevation, ft	**0.00**	Ft
Minimum Radius, ft	1,385.93	Ft
Entry Point to PC	-231.87	Ft
PC to PT	288.15	Ft
PT to PC	1,639.70	Ft
PC to PT	240.66	Ft
PT to Exit Point	-317.91	Ft
Length of Bore - Total Entry to Exit	**1,923**	Ft
Maximum Pullback Force	**224,841**	Lbs
Maximum Pullback Force	**1,000**	kN

General Longitudinal Stresses (Sigma $_x$)

for positive compressive forces, N = 0, i.e., no push or pull

$Sigma_x$ (psi) = $Sigma_x^N$ + $Sigma_x^M$ = N/A + M/W

where	$Sigma_x^N$ =	0	$Sigma_x^N$ = N/A
and	$Sigma_x^M$ =	21,536	$Sigma_x^M$ = M/W

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Critical Longitudinal Stresses ($Sigma_{xcr}$)

when N acts alone, i.e., M = 0 and p = 0 N ~ axial	$Sigma_{xcr}^{N}$ (psi) =	63,180.0000	$Sigma_x^N = Sigma^F*[1-.001*(D/t)-20)]$ for 20 < D/t < 100
when M acts alone, i.e., N = 0 and p = 0 M ~ bending	$Sigma_{xcr}^{M}$ (psi) =	73,710.0000	$Sigma_x^M = Sigma^F*(1.35-0.0045*D/t)$

General Hoop Stress ($Sigma_y$)

Given by: $Sigma_y = (p_e - p_i) \times D / (2 \times t)$

where	p_e (psi) =	18.2	p_e = external pressure = $0.052*W_m*H$
	W_m (lbs) =	10	W_m = weight of mud, lbs./gal.
	H (ft.) =	35.00	H = feet of head (depth of burial)
	p_i (psi) =	0	p_i = internal pressure (assumed)
	$Sigma_y$ (psi) =	436.80	

conversion factor, 0.052 converts #/gal to psi/ft.

Critical Hoop Stress, ($Sigma_{ycr}$)

when p acts alone, i.e., N = 0 and M = 0	$Sigma_{ycr}$ (psi) =	13,793.22	$Sigma_{ycr} = Sigma_{yE} = E*(t / (D-t))^2$ for $Sigma_{yE} < 2/3\ Sigma_F$
	2 /3 $Sigma_F$ (psi) =	43,333.33	**OK**

ALPHA DETERMINATION:

Alpha =	1.20	Alpha = 1 + 300/(D/t)*$Sigma_y$/$Sigma_{ycr}$

Permissible Usage Factors, (Nu_{xp} and Nu_{yp})

Nu_{xp} is the permissible value of $Sigma_x/Sigma_{xcr}$, when $Sigma_y = 0$
Nu_{yp} is the permissible value of $Sigma_y/Sigma_{ycr}$, when $Sigma_x = 0$

BEST CASE			Zone 1, loading
	Nu_{xp} =	1.00	
	Nu_{yp} =	0.98	
WORST CASE			Installation, loading
	Nu_{xp} =	0.72	
	Nu_{yp} =	0.62	

Permissible Combination Of $Sigma_x$ and $Sigma_y$

$(Sigma_x/Nu_{xp}*Sigma_{xcr})^{alpha} + (Sigma_y/Nu_{yp}*Sigma_{ycr}) < 1$

BEST CASE	0.261341478	**OK**
WORST CASE	0.390539865	**OK**

Installation Stress Analysis

Longitudinal Stress from Bending =	21,985	psi	
% SMYS =	33.8%		
Hoop Stress =	34,456	psi	Hoop stress limited by design factor from 49 CFR Part 192.111. (72% for Class 1, 60% for Class 2)
% SMYS =	53.0%		
Longitudinal Compressive Stress from Hoop Stress =	10,337	psi	
% SMYS =	15.9%		
Longitudinal Stress from Thermal Expansion =	1,981	psi	
% SMYS =	3.0%		
Net Longitudinal Compressive Stress =	(9,667)	psi	
% SMYS =	14.9%		
Maximum Shear Stress =	22,062	psi	Shear stress limited to 45% of SMYS by 402.3.1 of ASME/ANSI B31.4
% SMYS =	33.9%		

Installation Design Results = **OK**

INTERNATIONAL CONSTRUCTION CONSULTING, LLC

JOB No: NA
CLIENT: Sonangol Gas Natural
PROJECT: 24" Gas Pipeline from Bow Tie to Industrial Park-Soyo, Angola
SUBJECT: Minimum Free Stress Radius of Curvature for Steel Pipe

PREPRD.BY: G Lamberson **DATE:** 16-Jan-18
CHECKD.BY: **SHEET:**

Pipe Parameters												Minimum Radius of Curvature (Ft) for Steel Pipe						
											Hoop Stress	Case 1	Case 2	Case 3	Case 4	Case 5		
Pipe Grade	OD	WT	ID	MAOP or MOP	SMYS	F	E	T	Pressure Rating at 72.% SMYS	Temperature of Pipe		Method of JD Hair	Pipeline Rules of Thumb Method	Quantum Equation	McDermott Equation	Texas Gas Transmission Method		
																Pipe	Stress on Concrete Coating (psi)	
																	Best Case	Worst Case
	Inches	Inches	Inches	psig	psi	195 & 192	195 & 192	192 only	psig	°F	psi	Note 1	Note 1	Note 1	Note 2	Notes 2 & 3	Note 4	Note 5
API 5L X-65	24.000	0.500	23.000	1,440	65,000	0.72	1.00	1.00	1,950	60	34,560	2,400 ft	977 ft	1,538 ft	1,032 ft	982 ft	0 psi	0 psi

Case 1: per JD Hair; Radius = f(OD)
Case 2: per PipeLine Rules of Thumb Handbook Method, 2nd Ed; Radius = f (OD,SMYS,F,ID,Es)
Case 3: per Quantum Equation; Radius = f (OD,SMYS)
Case 4: per McDermott Equation; Radius = f (OD,SMYS,F,MAOP,WT,Es)
Case 5: per TGT Method; Radius = f (OD,SMYS,F,ID,MAOP,WT,Es,Temp.)
Concrete: Per TGT Method:
(Best) T & C = f (Ec,(OD/2+WTc),Radius)
(Worst) T = f(SMYS,F,Ec,(OD/2+WT),Es,OD)

Construction Temperature	90 °F
Minimum Ground Temperature	60 °F

Concrete Parameters			
Thickness	0.00	inches	
Compressive Strength	0	psi	Ccs
Tensile Strength (*)	0	psi	= 7 x (Ccs^½)
Modulus of Elasticity (*)	0.00E+00	psi	= 57000 x (Ccs^½)

Note 1: This case does not allow for stress due to internal pressure.
Note 2: This case allows for stress due to internal pressure.
Note 3: If MAOP/MOP = 0 then pipe is assumed to be casing.
Note 4: The calculated quantity is the tension and compression (in psi). Best case assumes free relative motion between concrete inner surface and pipe outer surface.
Note 5: The calculated quantity is the tension (in psi). Worst case assumes no relative motion between concrete inner surface and pipe outer surface.
This case does not take radius of curvature into account as the interaction between the pipe and concrete is the worst case.

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JOB No: NA | PREPRD.BY: G Lamberson | DATE: 28-Dec-17
CLIENT: Sonangol Gas Natural | CHECKD.BY:
PROJECT: 24" Gas Pipeline from Bow Tie to Industrial Park-Soyo, Angola
SUBJECT: HDD General Calculations; Length & Angle & General Design Analysis; Cost Estimate

GENERAL DATA

Pipe Diameter:	24.000	Inches
Wall Thickness:	0.500	Inches
SMYS:	65,000	Psi
Young's Modulus:	30.469E+06	Psi
Total Pipe Length:	2,326	ft
Moment of Inertia:	2548.199797	Inches^4
Pipe Face Surface Area:	36.91371368	Inches^2
Diameter/wall thickness ratio:	48	
Poisson's ratio for Steel:	0.3	
Mud Weight:	**89.00**	Lb/cu.ft
Coefficient of Soil Friction.:	0.30	
Fluid Drag Coefficient.:	0.05	Psi

PIPE WEIGHT DATA

Pipe Weight in Air:	125.49	Lb/ft
Pipe Interior Vol.:	2.88524742	cu.ft/ft
Pipe Exterior Vol.:	3.14159265	cu.ft/ft
Air Line Weight:	**0**	Lb/ft
Air Line Diameter:	**0**	Inches
Air Line Ext. Vol.:	0.000	cu.ft/ft
Weight of Water:	0	Lb/ft
Displaced Mud Weight:	279.601746	Lb/ft
Water density		
Enter 0 for no buoyancy control:	**0.00**	Lb/cu.ft
Effective Wt. of pipe:	-154.111746	Lb/ft

Note: positive value indicates downward force

ANALYSIS OF LOADS FOR STRAIGHT SECTION PULLED DOWNSLOPE

Measured Length:	121.28	ft
Angle of Inclination:	12	degrees
=	0.20943951	radians
Drag Forces from Mud:	5,487	Lb
Friction from Soil:	5,485	Lb
Effective Weight of Pipe:	(3,886)	Lb

PULL LOAD AT POINT B

Tension on section:	14,857	Lb
Cumulative Force exerted:	14,857	Lb

Axial Tension limited by RP2A-WSD
Comparison: 402 Psi < 58,500

Longitudinal Bending limited by RP2A-WSD
Comparison: 0 Psi < 42,940

External Hoop Stress limited by RP2A-WSD
Comparison: 374 Psi < 7,758

Combined Stresses, Tensile & Bending, limited by RP2A-WSD
Comparison: 0.00688017 < 1

Combined Stresses, Tensile, Bending & Hoop limited by RP2A-WSD
Comparison: 0.00246128 < 1

ANALYSIS OF LOADS FOR CURVILINEAR SECTION PULLED DOWNSLOPE

Measured Length:	241.8897082	ft
Change in Inclination Angle:	10	degrees
=	0.174532925	radians
Radius of Curvature:	1386	ft
Center Displacement:	5.273866619	ft
Assumed Average Tension:	**4,191**	Lb
Normal Force:	32,076	Lb
Drag Forces from Mud:	10,943	Lb
Friction from Soil:	19,246	Lb
Effective Weight of Pipe:	(3,249)	Lb

PULL LOAD AT POINT C

Tension on section:	33,438	Lb
Average Tension:	31,576	Lb
Cumulative Force exerted:	48,295	Lb

Axial Tension limited by RP2A-WSD
Comparison: 1,308 Psi < 58,500

Longitudinal Bending limited by RP2A-WSD
Comparison: 21,985 Psi < 42,940

External Hoop Stress limited by RP2A-WSD
Comparison: 687 Psi < 7,758

Combined Stresses, Tensile & Bending, limited by RP2A-WSD
Comparison: 0.53435705 < 1

Combined Stresses, Tensile, Bending & Hoop limited by RP2A-WSD
Comparison: 0.22605637 < 1

ANALYSIS OF LOADS FOR HORIZONTAL STRAIGHT SECTION

Measured Length:	1,558.43	ft
Angle of Inclination:	0	degrees
=	0	radians
Drag Forces from Mud:	70,502	Lb
Friction from Soil:	72,052	Lb
Effective Weight of Pipe:	0	Lb

PULL LOAD AT POINT D

Tension on section:	142,553	Lb
Cumulative Force exerted:	190,848	Lb

Axial Tension limited by RP2A-WSD
Comparison: 5,170 Psi < 58,500

Longitudinal Bending limited by RP2A-WSD
Comparison: 0 Psi < 42,940

External Hoop Stress limited by RP2A-WSD
Comparison: 730 Psi < 7,758

Combined Stresses, Tensile & Bending, limited by RP2A-WSD
Comparison: 0.08837802 < 1

Combined Stresses, Tensile, Bending & Hoop limited by RP2A-WSD
Comparison: 0.02261897 < 1

INTERNATIONAL CONSTRUCTION CONSULTING, LLC

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SUBJECT: HDD General Calculations; Length & Angle & General Design Analysis; Cost Estimate

ANALYSIS OF LOADS FOR CURVILINEAR SECTION PULLED UPSLOPE

Measured Length:	241.8897082	ft
Change in Incl. Angle:	10	degrees
=	0.174532925	radians
Radius of Curvature:	1,386	ft
Center Displacement:	5.273866619	ft
Assumed Average Tension:	**8,713**	Lb
Normal Force:	26,534	Lb
Drag Forces from Mud:	10,943	Lb
Friction from Soil:	15,921	Lb
Effective Weight of Pipe:	(3,249)	Lb
PULL LOAD AT POINT E		
Tension on section:	23,614	Lb
Average Tension:	202,655	Lb
Cumulative Force exerted:	214,462	Lb

Axial Tension limited by RP2A-WSD				
Comparison:	5,810	Psi	<	58,500
Longitudinal Bending limited by RP2A-WSD				
Comparison:	21,985	Psi	<	42,940
External Hoop Stress limited by RP2A-WSD				
Comparison:	418	Psi	<	7,758
Combined Stresses, Tensile & Bending, limited by RP2A-WSD				
Comparison:	0.61130595		<	1
Combined Stresses, Tensile, Bending & Hoop limited by RP2A-WSD				
Comparison:	0.30145671		<	1

ANALYSIS OF LOADS FOR STRAIGHT SECTION PULLED UPSLOPE

Length of Section:	162.14	ft
Angle of Inclination:	10	degrees
=	0.174532925	radians
Drag Forces from Mud:	7,335	Lb
Friction from Soil:	7,382	Lb
Effective Weight of Pipe:	(4,339)	Lb
PULL LOAD AT POINT F		
Tension on section:	10,378	Lb
Cumulative Force exerted:	224,841	Lb

Axial Tension limited by RP2A-WSD				
Comparison:	6,091	Psi	<	58,500
Longitudinal Bending limited by RP2A-WSD				
Comparison:	0	Psi	<	42,940
External Hoop Stress limited by RP2A-WSD				
Comparison:	0	Psi	<	7,758
Combined Stresses, Tensile & Bending, limited by RP2A-WSD				
Comparison:	0.10411927		<	1
Combined Stresses, Tensile, Bending & Hoop limited by RP2A-WSD				
Comparison:	0.01372042		<	1

RESULTS

Total Pulling Force:	224,841	Lb
Stress Violations:	0	

The pulling force analysis performed indicate the design is adequate.

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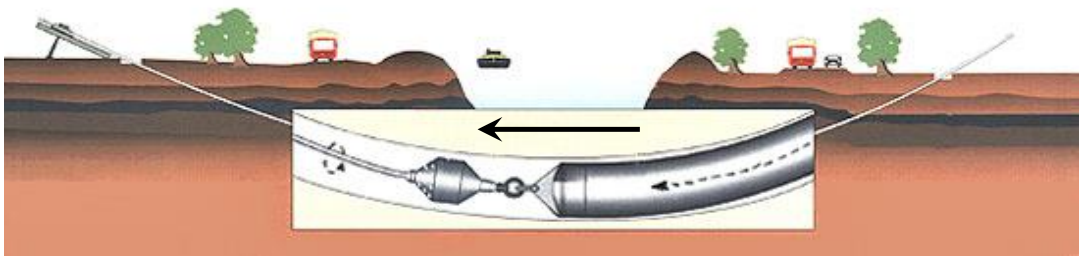
CLIENT:	Sonangol Gas Natural	**CHECKD.BY:**		**SHEET:**	
PROJECT:	24" Gas Pipeline from Bow Tie to Industrial Park-Soyo, Angola				
SUBJECT:	HDD Installation Stress Analysis				

GENERAL DATA

Pipe Diameter (inches):	24.00
Wall Thickness (inches):	0.500
SMYS (psi):	65,000
Maximum Allowable Operating Pressure (psi):	1,440
Poisson's ratio:	0.30
Young's Modulus:	3.0E+07
Radius of Curvature (feet):	1,386
Coefficient of Thermal Expansion (inches/inch/degree F):	6.5E-06
Installation Temperature (degrees F) =	90
Ground Temperature (degrees F) =	60
Operating Temperature (degrees F) =	80
Cover on Bottom (Ft) =	10
Groundwater table head (feet) =	10

HDD INSTALLATION STRESS ANALYSIS

Longitudinal Stress from Bending =	21,985	psi	
% SMYS =	33.8%		
Hoop Stress =	34,456	psi	Hoop stress limited by design
% SMYS =	53.0%		factor from 49 CFR Part 192.111.
			(72% for Class 1, 60% for Class 2)
Longitudinal Compressive Stress from Hoop Stress =	10,337	psi	
% SMYS =	15.9%		
Longitudinal Stress from Thermal Expansion =	1,981	psi	
% SMYS =	3.0%		
Net Longitudinal Compressive Stress =	(9,667)	psi	
% SMYS =	14.9%		
Maximum Shear Stress =	22,062	psi	Shear stress limited to 45% of
% SMYS =	33.9%		SMYS by 402.3.1 of ASME/ANSI B31.4
Installation Design Results =	**OK**		



INTERNATIONAL CONSTRUCTION CONSULTING, LLC

JOB No: NA
CLIENT: Sonangol Gas Natural
PROJECT: 24" Gas Pipeline from Bow Tie to Industrial Park-Soyo, Angola
SUBJECT: HDD Operational Stress Analysis

PREPRD.BY: G Lamberson 16-Jan-18
CHECKD.BY:

GENERAL DATA

Pipe Diameter:	24.000	Inches
Wall Thickness:	0.500	Inches
SMYS:	65,000	psi
Maximum Allowable Operating Pressure	1,440	psi
Poisson's ratio:	0.3	
Young's Modulus:	3.047E+07	Psi
Radius of Curvature:	1,386	feet
Coefficient of Thermal Expansion:	6.5E-06	inches/inch/°F
Installation Temperature:	90.00	°F
Operating Temperature:	80.00	°F
Groundwater Table Depth Relative to Entry Point:	-10.00	feet
Groundwater Table Elevation:	15.38	feet
Depth of Pipe relative to entry/exit at Lowest Point:	-35	feet
Groundwater Table Head:	25	feet

DATA ANALYSIS PER METHOD OF JD HAIR

Longitudinal Stress from Bending =	21,985	Allowable Stress per B31.4 = SMYS x F x E x T = Sa =	25,200 psi
% SMYS =	33.8%	% SMYS =	38.8%
Hoop Stress =	34,300	Hoop Stress limited by design factor from 49 CFR Part 192 or 195.	
% SMYS =	52.8%		
Longitudinal Stress from Thermal Expansion =	1,981		
% SMYS =	3.0%		
Net Longitudinal Compressive Stress =	-9,714	Additive Longitudinal Stress Limit = 0.75 x Sa =	18,900 psi
% SMYS =	14.9%	% SMYS =	29.1%
Maximum Shear Stress =	22,007	Shear stress limited to 45% of SMYS by 402.3.1 of ASME/ANSI B31.4	
% SMYS =	33.9%		

Based on the above calculations, the Operational Stress Analysis is Satisfactory

INTERNATIONAL CONSTRUCTION CONSULTING, LLC

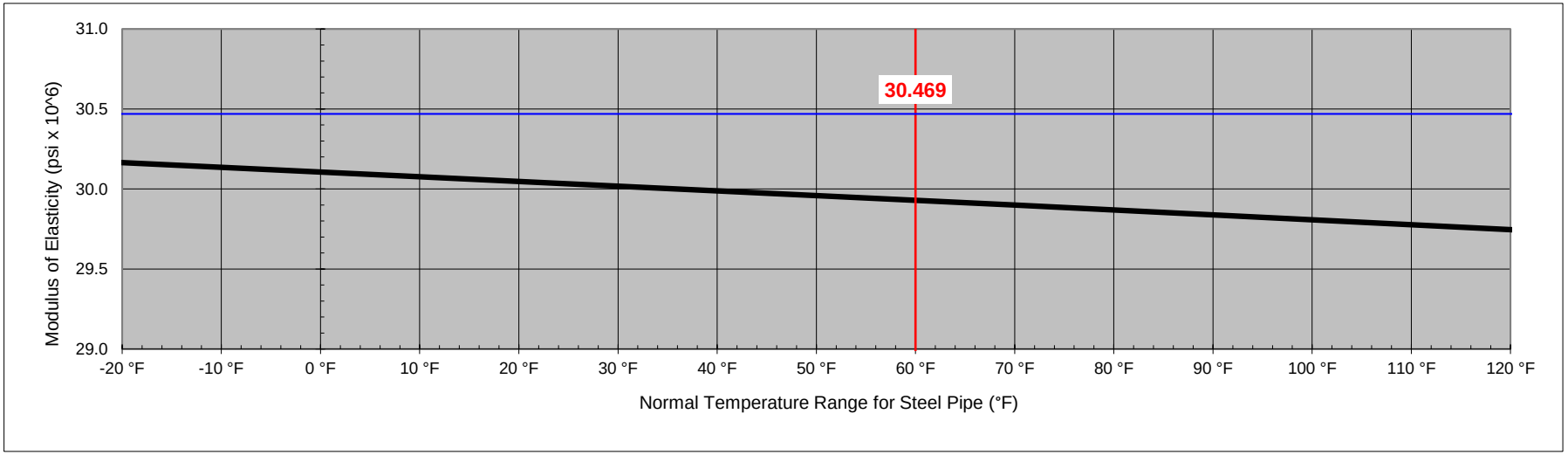
JOB No: NA
CLIENT: Sonangol Gas Natural
PROJECT: 24" Gas Pipeline from Bow Tie to Industrial Park-Soyo, Angola
SUBJECT: HDD - Modulus of Elasticity Calaculations

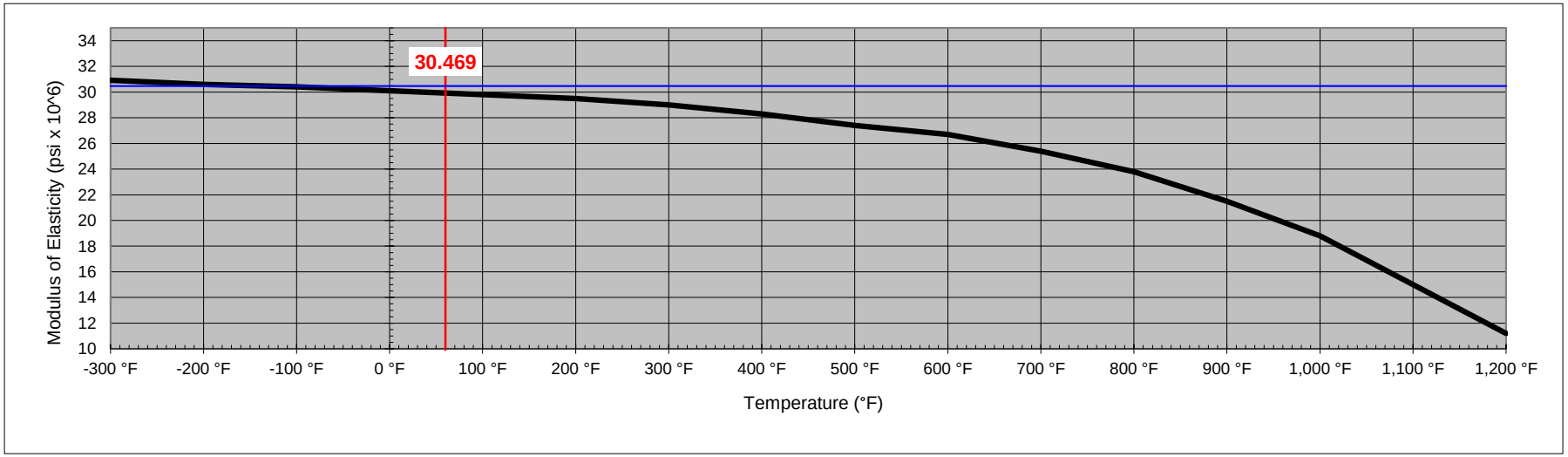
PREPRD.BY: G Lamberson **DATE:** 16-Jan-18
CHECKD.BY:

Reference Temperature = 60.00 °F
Modulus of Elasticity = 30.469 ksi = 30.469E+06 psi

The data below is calculated based on Perry's Chemical Engineer's Handbook, 6th Edition

Modulus of Elasticity (ksi) at Temperature (°F)															
Material:	-325 °F	-200 °F	-100 °F	70 °F	200 °F	300 °F	400 °F	500 °F	600 °F	700 °F	800 °F	900 °F	1,000 °F	1,100 °F	1,200 °F
above 0.30 percent (0.3%)	31	30.6	30.4	29.9	29.5	29.0	28.3	27.4	26.7	25.4	23.8	21.5	18.8	15.0	11.2

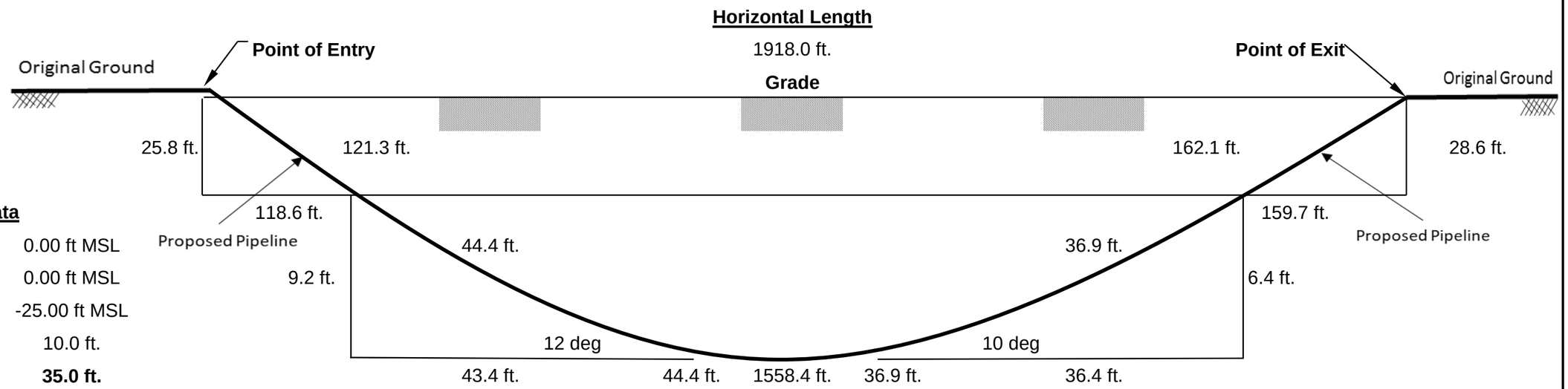




INTERNATIONAL CONSTRUCTION CONSULTING, LLC

JOB No: NA
CLIENT: Sonangol Gas Natural
PROJECT: 24" Gas Pipeline from Bow Tie to Industrial Park-Soyo, Angola
SUBJECT: HDD Profile Details

PREPRD.BY: G Lamberson
CHECKD.BY:
DATE: 16-Jan-18



Drill Data

Top Bank at Entry =	0.00 ft MSL
Top Bank at Exit =	0.00 ft MSL
Bottom of X-ing =	-25.00 ft MSL
Cover on Bottom =	10.0 ft.
Total Depth =	**35.0 ft.**

Entry Side - Curve Data

Radius =	982.00 ft
Angle =	12 deg
Length =	165.63 ft
Tangent =	44.35 ft

Total Length of Pipe - Entry to Exit

1923.1 ft.

Exit Side - Curve Data

Radius =	982 ft
Angle =	10 deg
Length =	199.06 ft.
Tangent =	36.92 ft.

Directional Drill Elevation
Not to Scale

INTERNATIONAL CONSTRUCTION CONSULTING, LLC

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CLIENT:	Sonangol Gas Natural	**PREPRD.BY:**	G Lamberson
PROJECT:	24" Gas Pipeline from Bow Tie to Industrial Park-Soyo, Angola		
SUBJECT:	HDD Cost Estimate		

HDD Cost Estimate

Pipe Diameter	24.000	
Pipe Wall Thickness	0.500	
Pipe Grade	65,000	
Hours per Shift	**12**	
Length of Drill	1,923	Feet
Mobe/Demobe Costs	**$ 150,000**	Each
Type of Soil	**Gravel**	
Pilot Hole Production Rate	55	Feet/Hr
Drilling Mud Flow Rate	5	BPM
Pilot Hole Duration	2.91	Shifts
Circulation Loss	50%	
Pilot Hole Mud Qty	315	Sacks
Pre-Ream Passes	3	Ea
Pre-Ream Travel Speed	2.5	Feet/Min
Pre-Ream Mud Flow Rate	10	BPM
Pre-Ream Duration	1.07	Shifts
Circulation loss	50%	
Pre-Reaming Mud Qty	692	Sacks
Pull Back Travel Speed	8	Feet/Min
Pull Back Mud Flow Rate	10	BPM
Pull Back Duration	0.33	Shifts
Circulation Loss	50%	
Pull Back Mud Quantity	72	
Mud Cost	**$ 125.00**	
Mobilization Time	**30**	Days
Time Required to Drill	12	Days
Total Time from Contract	42	Days

Activities	Time	Labor	Equipment	Misc	Totals
Mobilization				$ 150,000	$ 150,000
Rig Up	4	$ 60,000	$ 100,000		$ 161,019
Pilot Hole	2.91	$ 43,707	$ 72,845		$ 117,570
Ream	1.07	$ 16,026	$ 26,710		$ 43,752
Pull Back	0.33	$ 5,008	$ 8,347		$ 14,370
Rig Down	4	$ 60,000	$ 100,000		$ 161,019
Demobilization				$ 150,000	$ 150,000
Drilling Mud				$ 144,725	$ 144,725
Sub Total Cost					**$ 942,456**
Risk Premium	**30%**				**$ 282,737**
Profit	**20%**				**$ 245,038**
Total Cost					**$ 1,470,231**
Cost/Ft					**$ 127.42**