

2010 Liquid Pipeline Toolbox - Included Applications

Applications Description	Reference, Standard or Document Source
1. Pipeline Facilities	
1.1 Pipeline Pumps <ul style="list-style-type: none"> • Required Pump Horsepower • Affinity Laws-Impeller Diameter Change Only • Pump Specific Speed • Suction Specific Speed • Temperature Rise Due to Pumping • Reciprocating Pump-Displacement & Actual Capacity • Reciprocating Pump-Piston Rod Load • Reciprocating Pump-Acceleration Head • Pump Station Piping-Pipe Diameter • Pump Station Piping-Pipe Wall Thickness • Pump Station Piping-Average Flow Velocity • Local Atmospheric Pressure Calculation 	<ul style="list-style-type: none"> • Engineering Data Book, Vol-1, Gas Processors Suppliers Association, Tenth Edition • Pump Handbook, Fourth Edition, McGraw-Hill Professional • API RP 14E • American Gas Association, Report No.3
1.2 Reinforcement of Welded Branch Connection	ASME B31.4 - 1998 Edition "Pipeline Transportation Systems for Liquid Hydrocarbons and other Liquids", Art. 404.3.1(c)
1.3 Relief Valves <ul style="list-style-type: none"> • Valves Requiring/Not Requiring Liquid Capacity Certification <ul style="list-style-type: none"> ○ Orifice Area Sizing ○ Discharge Flow Sizing • Reactive Force 	ASME Section VIII and API RP 520 Part I - Sizing and Selection, Sixth Edition, March 1993 Standard Handbook for Mechanical Engineers, McGraw-Hill
2. Hydraulics	
2.1 Liquid Pipeline Hydraulics <ul style="list-style-type: none"> ○ Darcy-Weisbach ○ Colebrook-White ○ Hazen-Williams ○ Heltzel ○ T.R. Aude ○ Shell/MIT 	Pipeline Design for Hydrocarbons Gases & Liquids, ASCE, Committee on Pipeline Planning Hydraulics for Pipeliners, Volume I: Fundamentals, Second Edition, C.B. Lester Hydraulics of Pipeline Systems, Bruce E. Larock, Ronald Jeppson, Gary Watters
2.2 Darcy-Weisbach Pressure Drop Per Mile	Flow of fluids, Technical Paper No.410, CRANE Hydraulics for Pipeliners, Volume I: Fundamentals, Second Edition, C.B. Lester Hydraulics of Pipeline Systems, Bruce E. Larock, Ronald W. Jeppson, Gary Z. Watters
2.3 Surge Analysis – Water Hammer	Streeter, V.L. and Wylie, E.B. (1967), Hydraulic Transients, McGraw-Hill, Streeter, V.L. (1969), Waterhammer Analysis. Jour. Hyd. Div., ASCE., Vol. 88, HY3, pp79-113 Streeter, V.L. (1972), Unsteady Flow Calculations by Numerical Methods, ASME Journal of Basic Eng., pp 457-466 J. P Tullis (1989), Hydraulic Pipelines, John Wiley & Sons
3. PL Design & Stress Analysis	

3.1 Design Pressure-Steel Pipe	DOT Part 195 & ASME B31.4
3.2 Wall Thickness- Straight Steel Pipe	ASME B31.4
3.3 Design Pressure-Polyethylene Pipe	API 15LE
3.4 Wall Thickness - Polyethylene Pipe	API 15LE
3.5 Flume Design - Rational Method	ASCE, FHWA
3.6 Buoyancy Analysis & Concrete Coating Requirements	A.G.A. GEOP Series, Book T-1
3.7 Pipe Anchor Force Analysis	Pipe Line Industry, Wilbur, W.E., February 1963 Theory of Elasticity, Timoshenko, S.
3.8 Maximum Impact Load & Penetration Depth	DOT Code Part 192
3.9 Internal Pressure - % SMYS	DOT/TSI Gas Distribution Handbook
3.10 Hoop Stress & Longitudinal Stress	DOT/TSI Gas Distribution Handbook
3.11 Requirements to Move Unpressured Pipe	DOT Alert Notice 1/7/1992
3.12 Bending Stress & Deflection	DOT/TSI Gas Distribution Handbook
3.13 Maximum Allowable Pipe Span Length	Williams Gas Pipeline Documentation
3.14 Bending Stress Caused by Fluid Flowing Around Pipeline	DOT/TSI Gas Distribution Handbook
3.15 Linear Thermal Pipeline Expansion	DOT/TSI Gas Distribution Handbook
3.16 Installment of Pipelines by Horizontal Directional Drilling	PRCI Report PR-227-9424
3.17. Longitudinal Stress in Movement of In-Service Pipelines (API 1117)	API RP 1117 - Movement of In-Service Pipeline, Second Edition, August 1966
3.18 Blasting Analysis	A.G.A "Pipeline Response to Buried Explosive Detonations
4. Steel Pipeline Crossings	
4.1 Steel Pipelines Crossing Railroads & Highways	API RP-1102
4.2 Wheel Load Analysis	<ul style="list-style-type: none"> ASME B31.8 - 1998 Edition of Pipeline Transportation Systems for Liquid Hydrocarbons and other Liquids, Art. 404.3.1(c) Evaluation of Buried Pipe Encroachments, BATTELLE, Petroleum Tech Center, 1983
4.3 Track Load Analysis	<ul style="list-style-type: none"> ASME B31.8 - 1998 Edition of Pipeline Transportation Systems for Liquid Hydrocarbons and other Liquids, Art. 404.3.1(c) Evaluation of Buried Pipe Encroachments, BATTELLE, Petroleum Tech Center, 1983
4.4 Design of Uncased Crossings	GPTC Guide for Transmission and Distribution Systems, A.G.A., Appendix G-192-15
5. External Corrosion Direct Assessment Toolset	
5.1 Remaining Life of Corroded PL & Re-assessment Interval for ECDA Region	GTI Report GRI-04/0093.6, NACE RP 0502, ASME B31.4, ASME B31.8, ASME B31.8S
5.2 Potential Impact Radius (PIR)	Potential Impact Radius Formula for Flammable Gases Other than Natural Gas", DOT/OPS TTO Number 13 Final Report
5.3 DCVG - % IR Drop	CATH- TECH, Cathodic Technology Limited
6. Pipeline Testing	
6.1 Pipeline Hydrostatic Testing	DOT/TSI Gas Distribution Handbook Pipeline Rules of Thumb Handbook, 3rd Edition

6.2 Pipeline Pressure Testing–Req'd Time	DOT/TSI Gas Distribution Handbook
6.3 Pipeline Pressure Testing – Maximum Pressure Drop	DOT/TSI Gas Distribution Handbook
6.4 Pipeline Blowdown – Time/Volume Lost	DOT/TSI Gas Distribution Handbook
6.5 Purging Calculations	DOT/TSI Gas Distribution Handbook
6.6 Pack in Pipeline	DOT/TSI Gas Distribution Handbook
RSTRENG V5 – Evaluating Remaining Strength of Externally Corroded Pipe	Pipeline Research Council International (PRCI)
7. Pipeline Corrosion	
7.1 Evaluation of MAOP in Corroded Areas	ASME B31G
7.2 Maximum Allowable Longitudinal Extent of Corrosion	ASME B31G
7.3 Rate of Electrical Current Flow Through the Corrosion Cell	DOT/TSI Gas Distribution Handbook
Relationship Resistance & Resistivity	DOT/TSI Gas Distribution Handbook
7.4 Electrolyte Resistance from Surface of an Electrode to any Distance	DOT/TSI Gas Distribution Handbook
7.6 Corrosion Current - Ohm's Law	DOT/TSI Gas Distribution Handbook
7.7 Electrical Resistance of a Conductor	DOT/TSI Gas Distribution Handbook
8. Cathodic Protection	
8.1 Estimated Weight of a Magnesium Anode	DOT/TSI Gas Distribution Handbook
8.2 Resistance to Earth of an Impressed Anode Ground Bed	DOT/TSI Gas Distribution Handbook
8.3 Rudenberg's Formula for the Placement of an Anode Ground Bed	National Association of Corrosion Engineers, Control of Pipeline Corrosion
8.4 Resistance to Earth of a Single Vertical Anode	National Association of Corrosion Engineers, Control of Pipeline Corrosion
8.5 Resistance to Earth of Multiple Vertical Anodes	National Association of Corrosion Engineers, Control of Pipeline Corrosion
8.6 Resistance to Earth of a Single Horizontal Anode	National Association of Corrosion Engineers, Control of Pipeline Corrosion
8.7 Required Number of Anodes & the Total Current Requirement	National Association of Corrosion Engineers, Control of Pipeline Corrosion
8.8 Power Consumption of a Cathodic Protection Rectifier	National Association of Corrosion Engineers, Control of Pipeline Corrosion
8.9 Cathodic Protection Attenuation Calculation	ISO 15589 – Cathodic Protection Pipeline Transportation Systems
9. Polyethylene (PE) Pipe Design & Stress Analysis	
9.1 Distributed Static Surcharge Load on Buried PE Pipe	1. Soil Engineering, Spangler, M.G. and Handy, R.L. 2. Structural Mechanics of Buried Pipes, Watkins, R.K, and Loren, R, A, 3. Polyethylene Pipe Handbook: Design of PE Piping Systems, Plastic Pipe Institute, Inc.
9.2 Surcharge Live Load on Buried PE Pipe & Pipeline Crossings	
9.2.1 Aircraft Load on Buried PE Pipe	1. Soil Engineering, Spangler, M.G. and Handy, R.L. 2. Structural Mechanics of Buried Pipes, Watkins, R.K, and Loren, R, A, 3. Polyethylene Pipe Handbook: Design of PE Piping Systems, Plastic Pipe Institute, Inc.

9.2.2 AASHTO Std H20 Vehicular Loading for Paved & Flexible/Unpaved Surfaces	<ol style="list-style-type: none"> 1. Soil Engineering, Spangler, .G. and Handy, R.L. 2. Structural Mechanics of Buried Pipes, Watkins, R.K, and Loren, R, A, 3. Polyethylene Pipe Handbook: Design of PE Piping Systems, Plastic Pipe Institute, Inc. 4. Modulus of Soil Reaction for Buried Flexible Pipe, ASCE Geotechnical Journal Vol. 103, Howard, A.K. 5. Evaluation of Modulus of Soil Reaction E' and Its Variation with Depth, Report No.UCB/GT/82-02, Duncan,JM/Hartley,JD, Univ. of Calif, Berkeley
9.2.3 Off Road Crossing-Concentrated Point Load Single Wheel	
9.2.4 Off Road Crossing-Concentrated Point Load Multiple Wheel	
9.2.5 Off Road Crossing- Concentrated Point Load Not over Buried PE Pipe	
9.2.6 Off Road Crossing-Unpaved Road Only (Timoshenko Equation)	
9.2.7 Cooper E-80 Railroad Load on Buried PE Pipe	
9.3 Installation of Polyethylene Pipelines by Horizontal Directional Drilling(HDD)	
9.3.1 PE Pipe – Pull Force & Installation Stress Analysis	ASTM F 1962 05
9.3.2 HDD PE Pipe - ATL Allowable Tensile Load During Pull-In Installation	ASTM F 1962 - 05 and ASTM F 1804 - 08
9.3.3 PE Pipe - Post-Installation Stress Analysis	ASTM F 1962 - 05
10. Data Bases	
10.1 Physical Properties of Fluids	British Gas - GasVLE
10.2 Pipe Databases for Steel, Polyethylene & Custom Pipe	<ul style="list-style-type: none"> • Spec. for Line Pipe, API 5L • Std Steel Pipe, ASTM B36.10 • Spec. for Polyethylene Line Pipe, API 15LE
11. Gas Properties Calculations	
11.1 Gas Mixture Properties	AGA-8 & API MPMS Chapter 14.5
11.2 Local Atmospheric Pressure	AGA Part 3
12. Utilities	
12.1 Gas Mixture Properties	GPA Standard 2172, AGA Report No. 8,API MPMS 14.2
12.2 Physical Properties of Fluids	Various
12.3 Document Management Module	Application developed by TTI
12.4 Applications Integration Module	Application developed by TTI
12.5 Units Conversion Module	<ul style="list-style-type: none"> • International System of Units (SI) • ASTM Metric Guide E380-72E • ANSI Standard Z201.1
13. Standards/Regulations/Forms	
13.1 Pipeline Safety Laws	US Department of Transportation
13.2 DOT Regulations	US Department of Transportation 49 CFR - Parts 190-195
13.3 DOT Forms & Instructions for Reporting	US Department of Transportation 49 CFR - Parts 190-195
13.4 Canadian Pipeline Standards	Internet Link provided to CSA website.