# COURSE OVERVIEW PE0262

# Flowline & Pipeline Transit Systems - Intermediate (E-Learning Module)

## Course Title

Flowline & Pipeline Transit Systems - Intermediate (E-Learning Module)

## Course Reference

PE0262

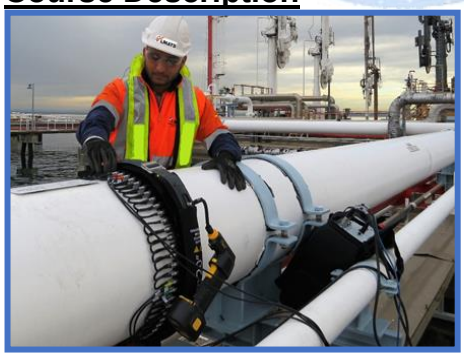
## Course Format & Compatibility

SCORM 1.2. Compatible with IE11, MS-Edge, Google Chrome, Windows, Linux, Unix, Android, IOS, iPadOS, macOS, iPhone, iPad & HarmonyOS (Huawei)

## Course Duration

30 online contact hours
(3.0 CEUs/30 PDHs)

## Course Description



This E-Learning is designed to provide participants with a detailed and up-to-date overview flowline and pipeline transit systems. It covers the piping system, piping engineering, flowlines and pipelines, transmission pipeline categories and properties of natural gas; the fabrication and construction, integrity assessment and repairs, piping specification, piping design and engineering principles, pressure components design and selection of pipe supporting devices; the pipeline control, pipeline automation system, layers of safety/protection, hydrocarbon measurement and petroleum products and petroleum hydrocarbons measurements; and the environmental degradation, block diagram, flow diagram, process flow diagram (PFD), piping and instrumentation diagram and equipment and piping layout.

Further, the course will also discuss the critical examination technique, piping system flexibility assessment, layout acceptance criteria, piping system flexibility considerations and reading piping and instrument diagram (P&ID); the plot plan fundamentals, piping - general arrangement drawings, piping materials, carbon steel, alloy steel, stainless steel and copper, nickel and aluminum and its alloys; the commonly used non-metallic piping materials and lining materials; and the piping material specification, flow regimes and the resistance coefficient method.

During this interactive course, participants will learn the Bernoulli's equation, Manning equation and Hazen-Williams equation; the piping sizing procedure, piping development process, basic heat transfer equation and classification of insulation; the thermal insulation types, vapor barrier, expansion joints, pressure thrust, bellows expansion, pipe hangers and flexible supports; the stress analysis of piping systems; the steam turbines, steam piping to turbines, centrifugal compressors, reciprocating compressors, exchangers and vertical vessels; the analysis methods, welding defects, joint preparation, welding techniques, hardness testing, piping inspection and corrosion monitoring system; the systematic approach of machinery troubleshooting, condition monitoring and leak detection, classification and testing; and the pipeline repair, in-service welding, hot tapping and valves troubleshooting, operating procedure and maintenance.

## Course Objectives

At the end of this course, the Trainee will be able to:-

- Apply and gain good working knowledge on flowline and pipeline transit systems
- Describe the operating principles of flowlines and pipeline transit systems
- Describe the operational modes and capacities of flowlines and pipeline transit systems
- Analyse process parameters and variables as per daily readings
- Record and register process parameters in daily logs for flowlines and pipeline transit systems
- Apply KOC operational procedures and standards for normal operations, start up and shut down, handover (preparation) for maintenance and reinstatement after maintenance of flowlines and pipeline transit systems
- Coordinate system and equipment malfunctions and failures with maintenance department
- Describe instrument and control systems associated with flowlines and pipeline transit systems
- Report abnormal system and equipment conditions to panel operator (OP-1) and perform initial troubleshooting
- Perform routine and non-routine operational activities on flowlines and pipeline transit systems
- Coach others on the operation of flowlines and pipeline transit systems
- Discuss piping system, piping engineering, flowlines and pipelines, transmission pipeline categories and properties of natural gas
- Carryout fabrication and construction, integrity assessment and repairs, piping specification, piping design and engineering principles, pressure components design and selection of pipe supporting devices

- Employ pipeline control, pipeline automation system, layers of safety/protection, hydrocarbon measurement and petroleum products and petroleum hydrocarbons measurements
- Illustrate environmental degradation, block diagram, flow diagram, process flow diagram (PFD), piping and instrumentation diagram and equipment and piping layout
- Apply critical examination technique, piping system flexibility assessment, layout acceptance criteria, piping system flexibility considerations and reading piping and instrument diagram (P&ID)
- Discuss plot plan fundamentals, piping - general arrangement drawings, piping materials, carbon steel, alloy steel, stainless steel and copper, nickel and aluminium and its alloys
- Identify the commonly used non-metallic piping materials and lining materials as well as piping material specification, flow regimes and the resistance coefficient method
- Discuss the Bernoulli's equation, Manning equation and Hazen-Williams equation
- Apply piping sizing procedure, piping development process, basic heat transfer equation and classification of insulation
- Identify thermal insulation types, vapor barrier, expansion joints, pressure thrust, bellows expansion, pipe hangers and flexible supports
- Carryout stress analysis of piping systems and describe steam turbines, steam piping to turbines, centrifugal compressors, reciprocating compressors, exchangers and vertical vessels
- Employ analysis methods, minimize welding defects, joint preparation, welding techniques, hardness testing, piping inspection and corrosion monitoring system
- Implement a systematic approach of machinery troubleshooting, condition monitoring and leak detection, classification and testing
- Apply pipeline repair, in-service welding, hot tapping and valves troubleshooting, operating procedure and maintenance

## Who Should Attend

This course provides an intermediate overview of flowline and pipeline transit systems for those who are involved in the operation, optimization and problem solving of pipeline systems in oil and gas fields. Field operation engineers, process engineers, pipeline engineers, station supervisors and SCADA pipeline staff will gain an excellent knowledge from the practical and problem-solving aspects of this course.

**Course Certificate(s)**
Internationally recognized certificates will be issued to all participants of the course.

**Certificate Accreditations**
Certificates are accredited by the following international accreditation organizations: -

- USA International Association for Continuing Education and Training (IACET)

  Haward Technology is an Authorized Training Provider by the International Association for Continuing Education and Training (IACET), 2201 Cooperative Way, Suite 600, Herndon, VA 20171, USA. In obtaining this authority, Haward Technology has demonstrated that it complies with the **ANSI/IACET 1-2013 Standard** which is widely recognized as the standard of good practice internationally. As a result of our Authorized Provider membership status, Haward Technology is authorized to offer IACET CEUs for its programs that qualify under the **ANSI/IACET 1-2013 Standard**.

  Haward Technology's courses meet the professional certification and continuing education requirements for participants seeking **Continuing Education Units** (CEUs) in accordance with the rules & regulations of the International Association for Continuing Education & Training (IACET). IACET is an international authority that evaluates programs according to strict, research-based criteria and guidelines. The CEU is an internationally accepted uniform unit of measurement in qualified courses of continuing education.

  Haward Technology Middle East will award **3.0 CEUs** (Continuing Education Units) or **30 PDHs** (Professional Development Hours) for participants who completed the total tuition hours of this program. One CEU is equivalent to ten Professional Development Hours (PDHs) or ten contact hours of the participation in and completion of Haward Technology programs. A permanent record of a participant's involvement and awarding of CEU will be maintained by Haward Technology. Haward Technology will provide a copy of the participant's CEU and PDH Transcript of Records upon request.

- British Accreditation Council (BAC)

  Haward Technology is accredited by the **British Accreditation Council** for **Independent Further and Higher Education** as an **International Centre**. BAC is the British accrediting body responsible for setting standards within independent further and higher education sector in the UK and overseas. As a BAC-accredited international centre, Haward Technology meets all of the international higher education criteria and standards set by BAC.

**Course Fee**
As per proposal

## Training Methodology

This Trainee-centered course includes the following training methodologies:-

- Talking presentation Slides (ppt with audio)
- Simulation & Animation
- Exercises
- Videos
- Case Studies
- Gamification (learning through games)
- Quizzes, Pre-test & Post-test

Every section/module of the course ends up with a Quiz which must be passed by the trainee in order to move to the next section/module. A Post-test at the end of the course must be passed in order to get the online accredited certificate.

## Course Contents

- Expectation and Responsibility of a Piping Engineer
- What is Piping?
- What is a Piping System?
- Piping Systems
- Oil and Gas Piping Systems
- Piping Engineer Description and Profile
- Piping Engineer Duties and Responsibilities
- Piping Engineer Required Skills
- A Piping Engineer According to ASME B31.3
- Piping Engineering
- Piping Engineering Interfaces
- Flowlines and Pipelines
- What Are Flowlines?
- What Are the Lengths of Flowlines?
- Additional Characteristics of Flowlines?
- Flowlines Applications
- Flowline Technology Maturity
- Key Metrics
- Decision Drivers
- Operational Issues/Risks

- Opportunities/Business Case
- Alternative Technologies
- Transmission Pipeline
- Transmission Pipeline Categories
- Flowlines and Pipelines
- Comprehension Check
- ASME B31.8 Gas and B31.4 Oil Transmission and Distribution Piping Systems
- Why Pipelines
- Welding
- What it Covers
- Gas Pipelines
- Onshore Transmission
- Offshore Transmission
- Distribution
- Metering Station
- Right-of-Way (ROW)
- Geo. Info. Sys. (GIS) in Gas Distribution Companies
- Major Layers of GIS
- ASME B31.8 Gas
- B31.8 Appendices
- B31.8 Multiphase or Gas Pipeline – Introduction
- Gas where it comes from
- Properties of Natural Gas
- Heating Value
- Properties of Natural Gas
- Ignition Temperature
- Six Fundamental Areas
- System Design (Process Design, P&ID)
- System Design
- Materials
- Detailed Design
- Fabrication and Construction
- Operations

- Integrity Assessment and Repairs
- Pipeline Incidents 2004-2009 (DOT)
- Third-Party Damage
- Pipeline Leaks 2004-2009 (DOT)
- Pipeline Failures 2004-2009 (DOT)
- Pipeline-Related Standards
- Regulation 49 CFR
- Piping in a Project
- Piping Systems
- Piping
- Piping Specification
- Piping Specification on Instrument Piping
- Piping Specification Limits
- Piping Specification Details
- Phases and Various Disciplines in Projects
- Cost of Piping in Projects
- Sample - Piping Cost in a Project
- Piping Completion in a Project
- Comprehension Check
- Piping Design in an Organization
- Piping Engineering in an Organization
- Piping Layout & Mechanical Engineering
- Piping Engineering in Industrial Plants
- Piping Design Software Aids
- Piping Engineering in Industrial Plants
- Comprehension Check
- Fundamental Piping Design
- What is Piping?
- Piping Engineering
- ASME B36 Pipe Stds.
- Pipe Sizes
- Pipe Sizes – Schedules
- Why is Piping Engineering Seemingly Hard?

- Piping Engineering Reliability
- Comprehension Check
- Piping Codes and Standards
- 1815-1860's
- 1865 – Steamboat "Sultana" Boiler Explosion
- 1880's Oil Tanks
- 1880's Pipeline Joining
- 1880's-1900
- 1900 – 1920
- 1905 Repair Sleeve
- 1920-1940
- 1940-1960
- 1960-1990
- 1990-2007
- Boiler Explosions
- ASME Background
- ASME B31 History
- ASME Piping System Standards
- ASME Piping Codes - Allowable Stresses (S)
- Comparison of Results for Min. Wall Thickness
- More ASME Piping System Standards
- Other Piping System Standards
- British Standards History
- British Piping Standards
- Standards Comparison
- Comparison of Pressure Vessel Codes
- Additional Pressure Vessel Codes
- PD 8010-2 Subsea Pipelines
- PD 8010-2 Structure
- PD 8010-2 Sections 1, 2 and 3
- PD 8010-2 Section 4
- PD 8010-2 Section 5
- PD 8010-2 Section 6

- PD 8010-2 Section 7
- PD 8010-2 Section 8
- PD 8010-2 Section 9
- PD 8010-2 Section 10
- PD 8010-2 Section 11
- PD 8010-2 Section 12
- PD 8010-2 Section 13
- PD 8010-2 Section 14
- PD 8010-2 Appendix A - Quality Assurance
- PD 8010-2 Appendix B - Records and Document Control
- PD 8010-2 Appendix C - Hazards in Pipeline Design
- PD 8010-2 Appendix D - Safety Evaluation of Pipelines
- PD 8010-2 Appendices E – F
- References
- American Standards
- What is a 'Standard'?
- American [Piping] Standards
- ASME B31.1 Jurisdictional Limits for Piping – Drum-Type Boilers
- ASME B31.3 Jurisdictional Limits for Piping vs. Equipment
- ASME B31.4 Scope of Applicability for CO2 Pipeline Systems
- American Standard Pipe Schedules (ANSI)
- Comprehension Check
- American Petroleum Institute (API) Standards
- API Standards – Publications
- API Standards – Recommended Practices
- API Standards – Specifications
- API Refinery Standards
- API Piping Component Standards
- API Electrical Installations and Equipment Stds.
- API Heat Transfer Equipment Standards
- API Instrumentation and Control Manuals
- API Series 2 Stds. – Offshore Structures
- API Series 5 Standards – Tubular Goods

- API Series 6 Stds. – Valves & Wellhead Eqpt.
- API Drilling Equipment Standards
- Standards for Subsea Production Systems
- Comprehension Check
- ANSI/ASME Standards
- Organizations for Piping Codes
- ASME Codes
- More ASME Piping System Standards
- B31.1 - Power Piping
- B31.3 - Process Piping
- B31.4 - Pipeline Transportation Systems for Liquid Hydrocarbons and Other Liquids
- B31.5 - Refrigeration Piping and Heat Transfer Components
- B31.8 - Gas Transmission and Distribution Piping Systems
- B31.8S - Managing System Integrity of Gas Pipelines
- B31.9 - Building Services Piping
- B31.11 - Slurry Transportation Piping Systems
- Division of the Codes
- Non-metallic Materials
- B31.3 Scope
- Organization of the Code
- B31.3 Fluid Service Definitions
- Examination Requirements by Code for Buried Pipelines
- ANSI - Piping Pressure Classes
- Allowable Stresses (S)
- Comparison of Results for Min. Wall Thickness
- B31.3 Publication
- B31.3 Interpretations
- Comprehension Check
- References
- Piping Design and Engineering Principles
- Design of Pressure Piping
- Design of Pressure Components
- Design of Pressure Components - Pressure-Temperature Rating

- Design of Pressure Components
- Design of Pressure Components Wall Thickness Calculation
- Design of Pressure Components - Test Pressure
- Design of Pressure Components - Miter Bends
- Design of Pressure Components Branch Connections
- Pipe Supporting
- Pipe Supporting – Span
- Pipe Supporting – Drainage
- Pipe Supports & Hangers
- Hangers Example
- Hangers Example – Movement
- Hanger Supports
- Rod Hanger Assembly
- Variable Hanger Assembly
- Variable Hanger Supports
- Constant Load Support
- Constant Load Hanger
- Spring Hangers
- Selection of Pipe supporting Devices
- Guide Supports
- Limit stop Supports
- Supports Friction
- Restraint Supports
- Limit stop Supports
- Pipe Rack Supports
- Stiffness & Flexibility
- Stiffness & Flexibility – Concepts
- Expansion & Stresses
- Expansion and Stresses - Cold Springing
- Class Quiz
- References
- Stress and Strain in Piping Material
- Strength of Materials

- Bases for Design Stresses
- Comprehension Check
- Cathodic Protection (CP) Design Land Pipelines
- Sacrificial CP
- Aluminium Alloy Anodes Used for Submarine Pipelines
- Pipeline CP Design Current Densities
- Sacrificial Anodes
- Hygroscopic Backfill for Magnesium Anodes
- Hygroscopic Backfill for Zinc Anodes
- Placement of Sacrificial Anode in Trench Side Pocket
- Sacrificial Anode
- Vertical Anode Output
- Horizontal Anode Output
- Anode Resistance
- Magnesium Anodes
- Cast Galvanic Anodes
- Magnesium Anodes Before Bagging
- Impressed Current CP
- Transformer Rectifiers (T/R)
- Transformer/Rectifier + Anode Boxes
- Transformer Rectifier and Anode Junction Box
- Transformer Rectifiers
- Transformer Rectifier Units
- Intrinsically Safe T/R for Wellheads
- Impressed Current CP Anodes
- Anode Fabrication
- Cables for Inert Anodes
- Graphite Anodes
- Silicon Iron Anodes
- Comprehension Check
- Pipeline Automation (PAS) and Supervisory Control and Data Acquisition (SCADA) Systems
- Pipeline Control
- Pipeline Automation System (PAS)

- PAS & SCADA
- Geographical Information System (GIS)
- GIS
- Control Systems
- PAS and Human-Machine Interface (HMI)
- Layers of Safety/Protection
- Safety Manager
- Hydrocarbon Measurement
- API's Manual of Petroleum Measurement Stds.
- Lease Automatic Custody Transfer (LACT) Units
- LACT Units
- Typical LACT Unit Configuration
- Petroleum Products and Petroleum Hydrocarbons Measurements
- Petroleum Hydrocarbons
- Gas Chromatography
- Crude Oil and Petroleum Products Production
- Gasoline
- Diesel Fuel
- Weathering
- Environmental Degradation
- Infrared Spectrometric Methods for TPH Measurements
- Diesel Range Organics (DRO) and Gasoline Range Organics (GRO)
- Comparing DRO and GRO
- Volatile Petroleum Hydrocarbons (VPH)
- Comprehension Check
- Equipment and Piping Layout
- The Ultimate Objective
- A Typical Plant Design Project
- Block Diagram of Project Flow
- Flow Diagram
- Process Flow Diagram (PFD)
- Piping and Instrumentation Diagram
- Equipment and Piping Layout

- Equipment Layout/Unit Plot Plan Drawing Guidelines
- Access Platforms
- Philosophy of In-Plant Piping
- Yard Piping
- Yard Piping - Headroom
- Piping for Instruments
- Critical Examination Technique
- Equipment and Layout – Pumps
- Equipment and Layout – Piping
- Pipe Supports
- Comprehension Check
- Piping Layout
- Piping System Flexibility
- Piping System Flexibility Assessment
- Layout Acceptance Criteria
- Piping System Flexibility Considerations
- Fixing Problems
- Pop Quiz - Which system has greater flexibility?
- Layout Acceptance Criteria
- Designing for Flexibility
- Layout Acceptance Criteria
- Comprehension Check
- Pump Stations
- Series or Parallel Operation
- Pumps
- Pump Skid Module
- Electrical Equipment
- Electrical Equipment Shelter Module
- Advanced Batch Change Control
- Centrifugal Pumps
- Safety Integrity Level
- Twin Screw Pumps
- Multi-Phase Pump

- Basics of Piping Drawings
- Piping Drawing Types
- Piping Drawings
- Piping Joints
- Pipe - Flanged connection
- Piping Bends
- Piping - Vents, Drains & Supports
- Piping – Plan & Elevation
- Piping Symbols
- Engineering Drawings Sheet Sizes (ISO Std.)
- How to Start a Piping GA Drawing
- Development of Piping GA Drawing
- Spools
- Dimensioning of Drawings
- Checking of Piping Drawings
- Piping Coordination Systems - Symbols for Isometrics
- Piping & Instrument Symbols in Software
- ISO vs. American Drawing Sheet Size Comparison
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- General Idea About PFD and P&ID
- What is a “Process” in an Industrial Context?
- Types of Industrial Processes
- Industrial Processes
- The Process Flow Diagram (PFD)
- Process Flow Diagram Template
- Piping and Instrumentation Diagram (P&ID)
- Example: Steps, from PFD to P&ID
- Equipment Layout and Piping Arrangements
- Comprehension Check
- Piping Network Diagrams
- The Generic Block Flow Process Diagram
- Chemical Process Diagrams
- Comparison – Conceptual vs. Complexity

- Definitions of BFD
- The Block Flow Process Diagram
- The Block Flow Plant Diagram
- Symbols for Drawing PFDs
- Equipment Numbering
- Stream Numbering and Drawing
- Stream Information
- Stream Information – Flags
- Equipment Information
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- Additional Diagrams
- Scale Models and Virtual Plants
- 3-D Plant Diagrams
- Problem 1
- Solution to Problem 1
- Comprehension Check
- Plot Plan Fundamentals
- Plot Plan – Plant Data
- Plot Plan – Meteorological and Geological Data
- Plot Plan – Civil
- Plot Plan – Electrical
- Plot Plan – Non-Plant Facility
- Plot Plan – Utilities Data
- Plot Plan – Statutory Requirements
- Plot Plan – Expansion Philosophy
- Site, Property and Plant Development Dwgs.
- Plant Arrangements - Power Block
- Layouts for Oil Installations
- Plot Plan - Salalah Power System Privatization Project
- Plot Plan - Salalah Power – GT Area Layout
- Plot Plan - Salalah Power – Dyke Area Layout
- Plot Plan - Salalah Power – Fuel Oil Pump House

- Plot Plan - Cooling Tower Area - Haldia CCPP (combined cycle power plant)
- Plot Plan – Deaerator Area - Haldia CCPP (combined cycle power plant)
- Plot Plan – Station Building - Haldia CCPP (combined cycle power plant)
- Plot Plan – Xiamen Combined Cycle Power Plant
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- Presentation of GA Drawings
- GA Drafting Checklist – Sample
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- Vital Characteristics Required
- Classification of Piping Materials
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- Temperature Limitation of Piping Materials
- What Does ASME B31.3 Say About Materials?
- Ferrous Materials
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- Carbon Steel – Material Composition
- Alloy Steels
- Purpose of Alloying
- Influence of Alloying Elements
- Low Alloy Steel – Material Composition
- Stainless Steel
- Non-Ferrous Materials
- Copper and its Alloys
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- Aluminium and its Alloys
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- Polyvinyl-Chloride (PVC)
- Types of PVC
- PVC Material Properties
- Advantages of PVC Pipes
- Applications of PVC
- Tetrafluoroethylene (TEFLON)
- Polyethylene (PE)
- Applications PE
- Acrylonitrile-Butadiene-Styrene (ABS)
- Thermosetting Plastics
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- Concrete Piping Materials
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- Pipe Linings
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- What is a Material Specification?
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- Flow Regimes
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- Laminar and Turbulent Flows
- Definition of Reynolds Number
- Significance of Reynolds Number, Re
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- The Entrance Region
- Fully Developed Pipe Flow
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- Fully Developed Pipe Flow: Pressure drop
- Turbulent Flow: The Moody Chart
- Turbulent Flow: Fanning Diagram
- Types of Fluid Flow Problems
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- Minor Losses
- Loss Coefficients
- Piping Networks and Pump Selection
- Pipe Flow Example
- Pump and System's Curves
- Pipe Flow Summary
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- Typical Piping System
- Fluid Flow in Pipes
- Definition of Reynolds Number
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- Laminar and Turbulent Flows

- Fully Developed Pipe Flow
- The Average Flow Velocity
- The Conservation of Mass Principle
- The Entrance Region
- Turbulence: Flow Instability
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- Fully Developed Pipe Flow: Pressure Loss
- Fully Developed Pipe Flow: Friction Factor
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- Sources of Resistance to Flow
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- The Resistance Coefficient Method
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- Piping Fittings Friction Losses
- The Valve Flow Coefficient Method
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- Pressure Difference in Straight Pipe Elements
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- Pressure Loss in Shutoff Valves, and Fittings
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- Fluid Dynamics - The Bernoulli Equation
- A Simple Bernoulli Example
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- Bernoulli Assumptions
- Bernoulli Example Problem: Free Jets
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- Tank Example
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- Hydraulic Radius
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- The Hydraulic Radius in Open Channels
- The Hydraulic Radius: < ½ Full Pipe
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- Variables in Pipe Sizing Calculations
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- Determine Pipe (Inside) Diameter
- Pipe Flow Rate (Volume/Unit Time)

- Typical Pipe Flow Problems
- Piping System Pressure vs. Pressure Loss
- Pipe Stresses Due to Internal Pressure
- The Hoop Stress
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- Comparison of Results for Min. Wall Thickness
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- Steam and Electrical Heat Tracing
- History of Heat Tracing
- Basic Theory of Heat Tracing
- Heat Loss (H/L) Fundamentals
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- Heat Loss (H/L) Through Wet Insulation
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- Basic Heat Transfer Equation
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- Typical Steam Tracing System
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- Insulation Requirements
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- Insulation Thickness Calculation
- Insulation Thickness vs. Pipe Diameter
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- Typical Pipe Insulation
- Temperature Ranges for Insulation
- Insulation Types
- Why Use Insulation?
- Insulation Materials – Hot and Cold Application
- Insulation Selection
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- Vapor Barriers/Retarders
- Water Vapor Permeance
- Effect of Moisture on Insulation
- Insulation to Retain Heat…
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- Piping Insulation
- Understanding Vapour Barriers
- Understanding Vapour Barriers – Permeance
- Vapour Barrier Use in Chilled Water Piping
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- Expansion Joint Applicable Definitions
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- Pressure Thrust
- Installation of Expansion Joints Tied Bellows
- ANCHORS must be Designed for Full Pressure Thrust Based on Maximum Operating Pressure. (EJMA)
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- Bellows Expansion Joint Types
- Metal Bellows: Bellows Shapes (EJMA)
- Metal Bellows: Failure Modes
- Case Study: Flixborough Disaster
- Metal Bellows: Fatigue
- Metal Bellows: Special Designs
- Designer Responsibilities
- Installation and Testing
- Manufacturer Responsibilities
- Other Considerations
- Problems to Avoid
- Comprehension Check
- Pipe Supports and Restraints
- Pipe Hangers
- Flexible Supports
- Pipe Flexible (Spring) Hangers
- Variable Spring Hangers
- Selection of a Variable Spring Hanger from the Bergen-Power Catalogue

- Variable Spring Manufacturers' Model Nos.
- Constant Load Hanger
- Pipe Anchors and Guides
- Pipe Supports with Guides
- Pipe Layout
- Piping on Pipe Rack
- Piping on Pipe Rack
- Pipe Lay in a Trench
- Pipe Support Structures
- Pipe Support Shoes
- Pipe Support with Saddles
- Equipment Nozzles and Piping Loads
- Dummy Leg Length
- Piping Free Spans
- Pipe Support Facts
- Pipe Support Drawing
- Pipe Support Drawing Detail
- Comprehension Check
- Stress Analysis of Piping Systems
- Stress/Failure Theories
- The Maximum Stress Theory
- The Maximum Shear Stress Theory
- The Stress Theories
- The Stress Theories Comparison
- Flexible Layout of Piping and Equipment
- Flexible Layouts: Pumps
- Flexible Layouts: Parallel Pumps
- Forces and Moments on Pump Nozzles
- American Petroleum Standard API 610
- Steam Turbines
- Steam Piping to Turbines
- Centrifugal Compressors
- Reciprocating Compressors

- Reciprocating Compressor Piping
- Reciprocating Compressors
- Exchangers
- Flexible Layouts – Exchangers
- Vertical Vessels
- Using Computer to run a Pipe Stress Analysis
- Comprehension Check
- Piping Thermal Stress
- Thermal Stresses and Rupture
- Thermal Stresses and Buckling
- Thermal Expansion Allowances
- Thermal Expansion of Basic Hard Pipe Elbow
- Thermal Expansion Loops
- Thermal Expansion Loops – Basic Loop Design
- Thermal Expansion Joints
- Stainless Steel Braids
- Thermal Expansion Joints
- Thermal Expansion Loops
- Flexible Loops Merits
- Bellows – Many Options
- Bellows – Squirm
- Internally-Pressurized Bellows
- Calculating Forces on Anchors
- Calculating Thrust Loads: Effective Areas
- Deflection Load – Spring Rate
- Deflection Load on Anchors
- Calculating Forces on Anchors
- Liners
- Typical Pipe Guide Installation
- Concentric Pipe Guide Spacing
- Bellows – Pros & Cons
- Ball Joints
- Slip-Type Joints – Pros & Cons

- Thermal Expansion Joints
- Comprehension Check
- Fabrication and Construction, Welding and Testing Pipelines (ASME B31.4 - B31.8)
- Lift and Bending
- Lifting Stress
- Lifting Stresses in Left Span
- Field Bending
- Ripples in Bends
- Severe Buckle Must Be Repaired
- Bend Ripples
- Gas Pipeline Ripples
- Ripple Severity Related to d/D
- Dents and Gouges in Pipelines
- Bellingham 16 inch Gasoline Pipeline 1456 psi (100 bar)
- Dents in Pipelines: Univ. of Thessaly. Greece and Delft Univ. Holland
- Dents in Pipelines
- Analysis Methods
- Braga Noronha et. al. (Petrobras)
- Pipeline Welding: API 1104, ASME IX
- Minimizing Welding Defects
- Vertical Down Welding
- Vertical Up Welding
- Joint Preparation
- Welding Techniques
- Shielded Metal Arc Welding (SMAW) Stick Welding
- Welding Techniques
- Tungsten Inert Gas Welding (TIG) Heli-Arc Welding
- Tungsten Inert Gas (TIG) Welding
- Metal Inert Gas Welding (MIG)
- Flux Core Arc Welding
- Flux Core Arc Welding (FCAW)
- Submerged Arc Welding (SAW)
- Welding Program: API 1104 or ASME IX

- Welder Qualification
- Residual Magnetism
- Magnetic Arc Blow: 500 Gauss □ 30 G (PeMex)
- Metallurgy of Welding
- Pearlite and Martensite Crystalline Structures
- Hardness Testing
- 824 and 825 Heat Treatment
- Comprehension Check
- API RP 574 Piping Inspection
- Piping Inspection Introduction
- Basic Piping Inspection Program Goals
- Basic Piping Inspection The Inspector
- Basic Piping Inspection Considerations
- Pressure Vessel Stress Areas
- Basic Piping Inspection
- Basic Piping Inspection for Corrosion
- Selecting Corrosion Monitoring Locations
- Remote Corrosion Monitoring System
- Piping Injection Point Example
- Basic Piping Inspection
- Comprehension Check
- Transient Flow in Piping Systems
- What is “Transient Flow”?
- Transient Flow Analysis
- Limits of Calculated Stresses Due to Occasional Loads (ASME B31.3 (2012) para. 302.3.6)
- Vibration in Pipelines
- Vortex Shedding Induced Erosion
- Pressure Transients and Fluid Hammer
- Pressure Transient Causes
- Transient Flow Phenomena
- Liquid System Flow Behavior
- Hydraulic Transients: Overview
- Hydraulic Transients

- Valves - Critical Closure Time - tcritical
- Valve Slow (normal) Closure
- Valve Fast Closure
- Pipeline Burst at River Crossing
- Valve Closure Transient
- Axial and Bending Loads
- Cavitation and Bubble Collapse in Pipes
- Bubble Collapse Pressure Spike
- Steam Hammer
- Two-Phase Liquid-Gas Flow Regimes
- Severe Slugging Damage
- Water Hammer
- Pressure variation over time
- Prevention of Liquid Waterhammer
- Solutions to Prevent Transient Phenomena
- Snubbers
- Methods of Controlling Transients
- Methods of Controlling Transients - Surge Tanks
- Use of Hydraulic Transients
- Ram Pump Working Design
- Comprehension Check
- Machinery Troubleshooting - “A Systematic Approach”
- What is Troubleshooting?
- The “So-What?” of Troubleshooting
- Useful Tools for Troubleshooting
- Useful Tools for Troubleshooting
- Useful Tools: O&M Manuals
- Useful Tools: Pump Performance Curve
- Matrix Approach
- Pipe Stress and Soft Foot Effects on Component Failure
- What is “Soft Foot”
- Pipe Stress and Soft Foot Exert Failure Producing Forces on the Equipment Casing from:
- External Force Design Assumptions

- Sources of Forces
- How Excessive Pipe Stress and Soft Foot Forces Cause Equipment Component Failure
- The Rotating Equipment Environment
- Possible Causes for Excessive Pipe Stress and/or Soft Foot (Design)
- Possible Causes for Excessive Pipe Stress and/or Soft Foot (Plant Conditions)
- Condition Monitoring Parameters and Their Alarm Limits
- Condition Monitoring Indications of Excessive Pipe Forces and/or Soft Foot
- Suggested Excess Pipe Stress Solution Procedure
- Pipe Considerations
- Obtain and Maintain Management Support by
- Leak Detection
- Why Leak Detection?
- Leak Detection System Requirements
- Causes of Pipe Leaks
- Leak Detection Options
- Methods of Detecting a Leak
- Leak Detection Instruments
- Leak Classification
- Remote Leak Detection System
- Detection of Leak Source Tracer Gas
- □P vs. time vs. Leak Rate (3” Pipe)
- Leak Testing
- Comprehension Check
- Pipeline Repair
- In-Service Welding
- Sleeves
- Sleeve-on-Sleeve Repair
- In-Service Repair
- Temper Bead Technique Applied to Sleeve Fillet Weld
- Composite wrap
- Putty
- Clock Spring Repair
- Armor Plate Repair

- Perma Wrap Repair
- Hot Tapping
- Hot Tapping - Fitting
- Line stopping
- Hot Tapping - Valve Insert Online
- Pipe Freezing
- Piping and Instrumentation Diagram (P&ID)
- Weld Defect - Burn-Through
- Weld Defect – Hydrogen Crack
- Weld Heat Input
- Valves Operational Issues
- Valves Failure Modes
- Valves Troubleshooting
- Trouble  Shooting - Gate Valve
- Trouble Shooting - Ball Valve
- Trouble Shooting - Butterfly Valve
- Trouble Shooting - Diaphragm Valve
- Valves Troubleshooting
- Operating Procedure
- Maintenance
- Comprehension Check