

Course Outline

Process Piping Design & Engineering

Piping Fundamentals

- Introduction to Process Plants
- Scope of Piping in Projects

ASME Codes & Standards

- Introduction to ASME Pressure Piping Design Codes
- ASME Standards for Common Piping Elements
- ASTM Standards for Common Piping Elements

Definition & Application of Pipe

- Pipe Designators-IPS, NPS, NB/DN
- Pipe Wall Thickness- Schedule Number, Pipe Weight
- Pipe- Lengths, Ends, Joining Method, Manufacturing Methods
- Pipe Symbols

Pipe Fittings

- ASME Standards, Application, Drawing Symbols & Dimensioning Exercises
- Types of Fittings- Screwed, Socket Welded, Butt Welded
- Elbow-90 degree (LR, SR), 45 degree, Reducing Elbow
- Pipe Bends- Miter Bends, 180 degree return
- Branch Connections- Straight & Reducing Tee, Cross, Lateral
- Fabricated Branch Connections- Stub-In, Stub-On
- Reducers- Concentric & Eccentric
- Coupling- Full Coupling, Reducing Coupling, Half Coupling

Pipe Flanges

- Classification of Flanges- As per P-T Ratings

- As per type of Connection- Slip on, Socket Welded, Threaded, Weld Neck, Blind, Lap Joint, Orifice
- As per Flange Face- Flat Face, Raised Face, Ring Type Joint, Tongue & Groove, Male & Female
- As per Flange Face Finish- Smooth, Serrated
- Gaskets- Types
- ASME Standards, Application, Drawing Symbols & Dimensioning Exercises

Valves

- ASME Standards, Application, Drawing Symbols & Dimensioning Exercises
- Valve Functions
- Valve parts
- Valve Types- Gate, Globe, Ball, Check, Butterfly, Angle, Relief, Plug, Diaphragm, Needle, Control Valve Manifold- layout representation
- Valve Operators
- Valve Data Sheet

Flow Diagrams

- Types- Block Flow Diagram (BFD), Process Flow Diagram (PFD), Piping & Instrumentation Diagram (P&ID), Utility Flow Diagram (UFD)
- Line Numbering
- Line List
- Piping Material Specification (PMS)
- Insulations & Heat Tracing

Plot Plan, Equipment Layout & Piping Layout

- Plot Plan development & requirements
- Equipment Layout Terminology

Course Outline

Process Piping Design & Engineering

- Control Points & Battery Limits
- Preparation of Equipment Layout
- Pump G.A. Drawing & Layout consideration
- Tank & Vessel Layout Consideration
- Piping G.A. Drawing requirement & Layout Procedure
- G.A.- Print Reading Exercise

Piping Isometrics

- Drawing Piping Isometrics
- Isometrics Dimensions
- Isometrics offsets
- Exercises on creation of Isometrics from Piping Plans & Sections

Piping Spools

- Definition
- Types of Spool Drawings
- Exercises on creation of Piping Spools from Piping Isometrics
- Preparation of MTO

Pipe Supports

- Classification of Supports- Primary & Secondary
- Anchor, Guide, Limit, Pipe Shoe, Dummy Leg, Rigid Hanger-Rod & Clevis, Flexible Hanger-Variable & Constant
- Pipe Rack Design- Types, Height & Width Calculations
- Pipe Arrangements on Pipe Rack

Pressure Design of Process Piping System as per ASME B 31.3

- Design Pressure & Temperature for Piping System
- Fluid Service Categories
- P-T Ratings of Flanges

- Butt Weld & Socket Welded Fittings ratings
- Pressure Design of Straight Pipe under Internal Pressure- Wall Thickness Calculations
- Pipe Line Wall Thickness Calculations as per ASME B 31.4 & ASME B 31.8
- Pressure Design of Miter Bends
- Reinforcement Pad Calculations
- Pressure Design of Blanks
- Piping Material Selection as per ASME Code

Hydraulic Design of Piping System

- Pipe Sizing
- Reynolds Number
- Recommended Velocities for Water & Steam Piping
- Pressure Drop due to Friction- Hazen Williams Equation, Darcy Weisbach Equation
- Minor Losses in Pipe Fittings- Equivalent Length Method, K Factor Method
- Friction Factor- Moody Diagram, Cole Brook White Equation
- Pump Calculations
- NPSH Required & NPSH Available for Pumps
- Total Dynamic Head of Pumps-Static Head, Pressure Head, Friction Head, Velocity Head
- Pump Horse Power Required

Pipe Stress Analysis

- Objective & Definition of Stress Analysis
- Piping Loads- Static & Dynamic, Primary & Secondary Stresses

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- Requirement of ASME B 31.3 for Stress Analysis
- Bending Moment due to Weight of Pipe
- Critical Line List
- Information required for Stress Analysis
- Theory of Failure
- Stresses acting in Pipe due to Internal Pressure

Pipe Span Calculations

- Based on Limitation of Stress
- Based on Limitation of Deflection
- Pipe Span Reduction Factor for Elbows, Concentrated Loads
- Suggested Support Span for Steel Piping

Flexibility Analysis

- Concept of Thermal Expansion
- Purpose of Flexibility
- Minimum Leg required to Absorb Thermal Expansion- Guided Cantilever Method
- Flexibility Analysis using Nomo-Graph
- Expansion Loops- Types of Expansion Loops, Expansion Loop Sizing for Hot Piping
- Expansion Joints- Types, Application & Selection

Flexibility Analysis using ASME B 31.3 Code Equations

- Thermal Expansion Stress
- Code Allowable Thermal Displacement Stress Range
- In Plane & Out Plane Bending Moments
- Stress Intensification Factor (Sif)