COURSE OVERVIEW ME0772
Special Calculations in Pipes (E-Learning Module)

Course Title
Special Calculations in Pipes (E-Learning Module)

Course Reference
ME0772

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 course is designed to provide participants with a detailed and up-to-date overview of special calculations in pipes. It covers the fundamentals of hydro-dynamics including steady state flow, the continuity equation (conservation of mass), fluid flow and pressure energy; the Bernoulli's principle, pump engineering, centrifugal pumps/fluid density, system performance curves and ASME code standard & specification; and the pipe and tube, pipes classification, the different types of gaskets and centrifugal pumps/calculation.

Further, the course will also discuss the Moody diagram, Darcy friction factor, pipe fitting head loss, recommended velocities and piping sizing guidelines; the NPSH calculations, pumping methods, pump selection and centrifugal pumps classification; the centrifugal pump spectrum and construction including impeller, shaft, casing, diffuser, seals and wear rings; the surge protection, pipeline design, pipeline construction and transportation and distribution of pipelines; the fabrication and construction, operations, integrity assessment and repairs; the internal pressure calculations; and the design of pressure components wall thickness calculation.

Moreover, the course will also cover the weld joint strength factor, wall thickness calculation, bend calculations and design considerations; the dynamic effects, branch connections, brittle fracture control, mechanical crack arrestors, flanges and blanks; the special fittings, clamp connectors, compact flanges, over-pressure protection and pipeline layout and supports; and the pipe supports design standards, pipeline flexibility, flexibility requirements and design for longitudinal stress.

During this course, participants will learn the required leak test methods, pressure tests hydrostatic, pneumatic, and combination tests; the pigging and cleaning of pipelines, pigging for pipeline efficiency and pre-inspection preparation; the welder qualification, performance qualification by others and welding procedure specification (WPS); the shielded metal arc welding, gas metal arc welding, flux cored arc welding and gas tungsten arc welding; and the welding processes, weld preparation, preheating, heat treatment, bending, forming, assembly, erection and alignment.

Course Objectives

Upon the successful completion of this course, participants will be able to:-

- Apply and gain an in-depth knowledge on special calculations in pipes
- Discuss the fundamentals of hydro-dynamics including steady state flow, the continuity equation (conservation of mass), fluid flow and pressure energy
- Explain Bernoulli's principle, pump engineering, centrifugal pumps/fluid density, system performance curves and ASME code standard & specification
- Differentiate pipe and tube, classify pipes, identify the different types of gaskets and apply centrifugal pumps/calculation
- Illustrate Moody diagram and recognize Darcy friction factor, pipe fitting head loss, recommended velocities and piping sizing guidelines
- Apply NPSH calculations, pumping methods, pump selection and centrifugal pumps classification
- Describe the centrifugal pump spectrum and construction including impeller, shaft, casing, diffuser, seals and wear rings
- Illustrate surge protection, pipeline design, pipeline construction and transportation and distribution of pipelines
- Apply fabrication and construction, operations, integrity assessment and repairs
- Carryout internal pressure calculations and design of pressure components wall thickness calculation
- Identify the weld joint strength factor and perform wall thickness calculation, bend calculations and design considerations
- Recognize dynamic effects, branch connections, brittle fracture control, mechanical crack arrestors, flanges and blanks
- Discuss special fittings, clamp connectors, compact flanges, over-pressure protection and pipeline layout and supports

- Explain pipe supports design standards, pipeline flexibility, flexibility requirements and design for longitudinal stress
- Apply required leak test methods as well as pressure tests hydrostatic, pneumatic, and combination tests
- Employ pigging and cleaning of pipelines, pigging for pipeline efficiency and pre-inspection preparation
- Review welder qualification, performance qualification by others and welding procedure specification (WPS)
- Describe shielded metal arc welding, gas metal arc welding, flux cored arc welding and gas tungsten arc welding
- Illustrate welding processes, weld preparation, preheating, heat treatment, bending, forming, assembly, erection and alignment

Who Should Attend

This course covers systematic techniques on special calculations in pipes for project engineers, process engineers and plant engineers in the oil, chemical and other process industries who require the necessary skills to be able to analyze the flow of oil and gas through pipes. No prior knowledge of the topic is required and participants will be taken through all the fundamental principles of the subject of fluid mechanics using a level of mathematics which at all times is purposely kept to a minimum level. The course makes use of a very substantial number of worked examples giving the participants the necessary time and opportunity to learn from practical problem-solving.

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 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

Course Contents

- Fluid Flow, ΔP & NPSH Calculations
- Fundamentals of Hydro-Dynamics
- Example: Pressure Drop
- Steady State Flow
- The Continuity Equation (Conservation of Mass)
- Fluid Flow
- Flow Trough Pipes
- Energy Relationships
- Energy of A Fluid In Motion
- Pressure Energy
- Pressure, Gage & Absolute
- Gauge and Absolute Pressure
- Specific Gravity
- Pumps Terms
- Head
- Vapor Pressure (P_{vap})
- Bernoulli's Principle
- Pump Engineering
- Definition of Pump Head
- Centrifugal Pumps/Fluid Density
- Static Head
- Static Losses
- System Performance Curves
- Total Head Problem Calculation
- Total Head Problem
- ASME Code Standard & Specification
- Standard
- Various Standards
- Standard Use for Designers & Fabricators
- Why Standard Require?

- Code
- Why did Code Require?
- Specification
- Why Specification Require?
- What is ASME Stand for?
- Which Code is Used for Process Piping & Power Piping?
- What are the Most Commonly used ASME Sections?
- NACE means National Association of Corrosion Engineers
- What is the Difference between Pipe & Tube?
- Difference between Tube & Pipe
- Pipe Size
- What is Nominal Pipe Size?
- What is DN Pipe Size?
- Classification of Pipes
- What is the ANSI/ASME Dimensional Standard for Steel Flanges & Fittings?
- Spades and Spectacle Plates
- What are Weldolet & Sockolet? And where they are Used?
- What are the Different Types of Gaskets?
- ΔP Calculations
- General
- Valves & Fittings ΔP
- ΔP of Valves & Fittings
- Centrifugal Pumps/Calculation
- Centrifugal Pump Head Calculation
- Pump head Calculation
- Valves and Fittings Friction loss
- Valves and Fittings Friction loss, alternate calculation
- Total head Calculation
- Various Tables
- Moody Diagram
- Darcy Friction Factor
- Pipe Fitting Head Loss
- Recommended Velocities

- Economic Pipe Diameter
- Equivalent Lengths of Fittings
- Recommended Velocity
- Piping Sizing Guidelines
- Maximum Continues Liquid Velocity
- System Curve
- Pipe Fitting Head Loss
- NPSH Calculations
- Net Positive Suction Head (NPSH)
- Methods of Pumping
- Pump Selection
- Typical Centrifugal Pump
- Typical Centrifugal Pump Volute
- How Do Centrifugal Pumps Work?
- Calculating the NPSHa
- What is Velocity Head?
- NPSHA Problem
- Pipe Fitting Head Loss
- Centrifugal Pumps
- Introduction
- How Do Centrifugal Pumps Work?
- Generation of Centrifugal Force
- Conversion of Kinetic Energy to Pressure Energy
- Classification of Centrifugal Pumps
- 1. Radial Flow Pump
- 2. Axial Flow Pump
- 3. Mixed Flow Pump
- Classification with Respect to the Liquid Flow
- The Centrifugal Pump Spectrum
- Centrifugal Pumps Construction
- Centrifugal Pump
- 1. Impeller
- Impeller – Open Type

- Impeller – Semi Open Type
- Impeller – closed type
- Enclosed - End Suction - Radial Flow
- Impeller Vanes
- Impeller Suction
- Impeller Positioning
- Impeller Number
- Multiple Impellers in Series
- Balancing Drum
- Centrifugal Pumps Construction
- Other Centrifugal Pumps
- Centrifugal Pumps Arrangement
- ANSI Pump Unit
- Premium Fabricated Steel
- Baseplates
- Shaft
- Casing
- Diffuser
- Discharge Outlet
- Seals
- Wear Rings
- Wear Ring Clearance
- 1. The impeller size
- 2. The liquid cleanliness
- 3. Impeller RPM
- What is the effect of wrong wear ring clearance?
- 1. Small clearance
- 2. Big clearance than the specified value
- Centrifugal Compressors
- How Centrifugal Compressor Works?
- Centrifugal Compressor Components
- Compressor Casing
- 1. Horizontally split Process Centrifugal Compressors (MCH)

- 2. Vertically split Process Centrifugal Compressors (BCH)
- 3. Overhung Centrifugal Compressors (POB)
- Suction Plenum
- Guide Vanes
- The Function of the Guide Vanes
- Centrifugal Compressors – Components
- Impellers
- The Compressor Rotor
- Shafts
- Shaft Sleeves
- Diffuser
- U Bend and Return Channel
- Diaphragms
- Discharge Volute
- Centrifugal Compressors – Arrangement
- Balancing Drum
- Centrifugal Compressors Surge Protection
- Surge Point
- Dynamic Compressors – Centrifugal
- Surge – Definition
- What Does Surge Do?
- Surge causes serious damage to compressors
- Surge Protection
- Pipeline Design
- History of Pipelines 1820 – 1880's
- History of Pipelines 1880's Oil Tanks
- History of Pipelines 1880's Pipe Joiners
- History of Pipelines 1880's – 1900
- History of Pipelines 1900 – 1920
- History of Pipelines 1920 – 1940
- Transportation Cost Comparison
- Introduction
- Pipeline Cost

- Products Transported by Pipelines
- Crude oil
- Carbon dioxide
- History of Pipeline Construction Industry
- Technological a Historical Over View
- Historical Perspective 1890's
- Historical Perspective 1916
- The pipe joint
- Oxyacetylene welding
- Disadvantage
- In 1928 - electric arc weld
- Historical Perspective 1926 Welding
- History of Pipelines 1920 – 1940
- History of Pipelines 1940 – 1960
- History of Pipelines 1880's Pipe Joiners
- History of Pipelines 1960 – 1990
- History of Pipelines 1990 – 2010
- Purpose of Pipelines
- Gathering Pipelines
- Transportation Pipelines
- Distribution Pipelines
- Types of Pipelines
- Classification from location
- Classification from product handled
- ASME B31 Pressure Piping Code
- B31.3 Tank and Process Facilities
- ASME B31.3
- ASME B31.3 Process
- ASME B31.3 Appendices
- B31.4-B31.8 Transmission Pipeline
- B31.3-B31.4-B31.8 Station Piping
- B31.3-B31.4-B31.8 Mainline Valves
- ASME B31.4 Liquids

- ASME B31.8 Gas
- General Provisions and Definitions
- B31.8 Appendices
- B31.4 and B31.8 Introduction
- Six Fundamental Areas
- System Design (Process Design, P&ID)
- System Design
- Materials
- Detailed Design
- Fabrication and Construction
- Operations
- Integrity Assessment and Repairs
- ASME Boiler & Pressure Vessel Codes
- API Codes and Standards: 500
- API Codes and Standards: 600
- API Codes and Standards: 5
- API Codes and Standards: 1100
- API Codes and Standards: 2200
- ASME B16 Dimensional and Pressure Rating Standards
- NACE means National Association of Corrosion Engineers
- NACE Recommended Practice
- Operating & Design Pressure Layout & Support
- Operating & Design Pressure
- Definitions
- Internal & External Pressure
- Pipeline Loadings
- Internal Pressure Calculations
- ASME B31.3 - Process Piping
- Straight Pipe
- Design of Pressure Components Wall Thickness Calculation
- Design of Pressure Components
- Straight Pipe
- Weld Joint Quality Factor E

- ASME B31.3 - Process Piping
- Weld Joint Strength Factor
- Coefficient Y
- Design of Pressure Components
- Wall Thickness Calculation
- Straight Pipe
- Elbows & Bends
- Bend Calculations
- Pipe Bends
- Straight Pipe - External Pressure
- Pipeline Thickness under External Load
- UG – 28
- Branch Connections
- ASME B31.4 – Liquid Hydrocarbons
- Design Considerations
- Dynamic Effects
- Weld joint factor E for API 5L Pipe
- Weld joint factor E for Unknown Pipe
- Branch Connections
- ASME B31.8 – Gas Pipelines
- Fracture Control And Arrest
- Brittle Fracture Control
- Ductile Fracture Arrest
- Mechanical Crack Arrestors
- Flanges and Blanks
- Listed Flanges & Blanks
- Unlisted Flanges & Blanks
- Listed Blank Example
- Bolt Loads - Section VIII, Div. 1
- Gasket Factors
- Gasket Factors "M" And "Y"
- Other Components [304.7.2]
- Pressure Design of Fittings

- Pressure Rating / Wall Schedule
- Design of Fittings to ASME B16.9
- Special Fittings
- Clamp Connectors
- Clamp Connector Benefits
- Compact Flanges
- Over-pressure Protection
- Types of PRV
- Pipeline Layout and Supports
- Spacing of Pipe Supports
- Spacing Guide [ASME B31.1 – Power]
- Pipe Supports Design Standards
- ASME B31.8 – Supports and Anchorage
- Provision for Expansion
- Attachment of Supports or Anchors
- Anchorage for Buried Piping
- Supports for Buried Piping
- MSS SP Practices for Pipe Supports
- Pipeline Flexibility
- Expansion And Flexibility
- Amount of Expansion
- Flexibility Requirements
- Design For Longitudinal Stress
- Restrained Piping
- Unrestrained Piping
- ASME B31.3 Chapter VI Inspection, Examination and Testing
- Inspection, Examination & Testing
- Inspection
- The owner's inspector
- Examination
- The examiner
- Examination Requirements
- Acceptance Criteria

- Ultrasonic Examination
- Examination Methods
- Visual Inspection Tools
- Positive Material Identification
- Spark emission spectrography
- Liquid Dye Penetrant
- Magnetic Particle
- Radiography
- Ultrasonic
- n-Process
- Progressive Sampling for Examination
- Examination — Normal Fluid Service
- Examination — Severe Cyclic Conditions
- Examination Requirements – VT
- Examination Requirements – Other
- Testing
- Required Leak Test
- Leak Test Methods
- Hydrostatic — Test pressure
- Hydrostatic Test of Piping With Vessels
- Pneumatic
- Pressure Relief Device
- Test Pressure
- Procedure
- Initial Service
- Sensitive
- Alternative
- Other Leak Test Provisions
- Exam & Test Workshop
- Pressure Tests Hydrostatic, Pneumatic, and Combination Tests
- API 570 Pressure Testing Requirements
- ASME B31.3 Calculation of Test Pressures
- Hydrostatic Leak Test

- Test Pressure
- Pressure Tests
- Pneumatic Leak Test
- Hydrostatic-Pneumatic Leak Test
- Initial Service Leak Test
- Procedure
- Sensitive Leak Test
- Pigging and Cleaning of Pipelines
- What is a Pig?
- Pigging for Pipeline Efficiency
- Conventional Pigs
- Why Pig a Pipeline?
- Pigging
- Reasons to Clean a Pipeline during Operation Throughput Improvement
- Preventive Maintenance, Calendar Based
- Pre-Inspection Preparation
- Clearing a Known Obstruction
- What is a pig?
- Considering their Function
- Considering their Construction
- Foam Pigs (Polly-Pigs)
- Red Series Polly-Pigs
- Scarlet Series Polly-Pigs
- The disadvantages of Polly-Pigs
- Mandrel Pigs
- Spheres
- Inflatable Spheres
- Special Pigs
- Camera Pigs
- Hardened Pins Pigs
- Pigging During Pipeline Construction
- Pigging During Construction
- Specialist Pigs

- Why Clean? (Operator said it was clean)
- Pig Launching & Receiving
- Pig launchers
- Pig receivers
- Pig Launcher Operational Sequence
- Conventional
- Pigging
- Types of Pigs
- General tool specification, valid for all tool types
- Cleaning Pigs
- Dual Diameter Pig
- Chemical Treatment
- Abrasive Blasting
- Bi-Di Pig
- Change Pig Type – Bi-Di
- D-scaling Pig
- Cleaning
- Smart Pig
- Fabrication and Installation
- ASME B31.1 Chapter V Fabrication, Assembly, and Erection
- Welder Qualification
- Performance Qualification by Others
- Welding Procedure Specification (WPS)
- Procedure Qualification by Others
- Welding Processes — Fusion Weld
- Welding Processes — Arc Welding
- Shielded Metal Arc Welding
- Gas Metal Arc Welding
- Flux Cored Arc Welding
- Gas Tungsten Arc Welding
- Welding Processes
- Welding Processes Accepted
- Weld Preparation

- Typical Welds
- Typical Welds- Branch Connection
- Preheating
- Heat Treatment
- Bending and Forming
- Bend Flattening
- Bending Temperature
- Cold Bending and Forming
- Installation
- Assembly and Erection
- Alignment
- Flanged Joints alignment
- Flanged Joints
- Preparation for Assembly
- Bolting Torque
- Flange Joint
- Bolt Length
- Gaskets
- Tighten Procedure for Flange Joints
- Threaded Joints
- Straight-Threaded Joints