COURSE OVERVIEW ME0988
Make & Break Flanges & Protocols - Advanced (E-Learning Module)

Course Title
Make & Break Flanges & Protocols - Advanced (E-Learning Module)

Course Reference
ME0988

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 course is designed to provide participants with a detailed and advanced overview of making and breaking flanges and protocols. It covers the flanges, gaskets and bolting; the various types of pipe flange; the bases for flange selection, pressure class, fire resistance, blow-out resistance and the tendencies to leak; the material toughness, piping component standards, some listed and unlisted components and slip-on flange fluid service requirements; the flexitallic spiral wound gaskets, bolting fluid service requirements, gasketed joints and their effects in flange joints; the factors that affect sealing capability of gaskets; the gasket installation and centralization; the flange gasket design; and the effect of temperature, member stiffness, proof strength of bolts and bolt specifications.

Further, the course will also discuss the tension and flange behaviour, clamping force and pretension, decompression, fatigue failure and reliability of a joint; the threads and the advantages of controlled tightening; the torque tightening, bolts – tightening sequences, bolts – hydraulic tightening, bolt tensioning and tensioning operation; the API classification of flanges, ASME (ANSI/ASA) flanges and bolts tightening sequence; the shear, torsion, bending and others conditions; and the long bolt flanges and standard bolted flanges.

During this course, participants will learn the standard procedures for the assembly of flange joints; the joint cleaning, bolts installation, joint alignment, joint tightening, torque tightening procedure, bolt tensioning procedure, final tensioning and hydraulic flange bolt tensioning; the exploded view of joint assembly, torqueing action resistance and exploded flange assembly; the flanged joint inspection, flange management and joint integrity, joint cleaning and joint inspection; the failure of joints including flange face imperfections, embedment relaxation, gasket creep, bolt creep, vibration, elastic interactions and differential thermal expansion; the hot torqueing and hot bolting of flanges, bolt tightening sequence, hot bolting, potential risk of leakage and allowable flanges; and the fatigue issues, stress concentration and notch sensitivity.

Course Objectives

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

- Apply and gain an advanced knowledge on making and breaking flanges and protocols
- Explain the reasons for using line specifications and design standards (prior to make and break flange and where to find these)
- Explain the impact of incorrect fitting of pipe and flanges and the main reasons for incorrect fitting
- Demonstrate flange inspection requirements
- Demonstrate why safe isolation of plant and equipment techniques is important
- Coach others on applying and implementing elements of KOC make and break flanges and protocols procedures and standards
- Explain what is required to make and break flange connections correctly
- Explain the purpose of the design and engineering practices with respect to the choice of bolts and gaskets etc.
- Demonstrate the implications and requirements of the permit to work system
- Assess the technical competence of others in implementing KOC make and break flanges and protocols procedures and standards
- Discuss flanges, gaskets and bolting and identify the various types of pipe flange
- Recognize bases for flange selection, pressure class, fire resistance, blow-out resistance and the tendencies to leak
- Determine material toughness, piping component standards, some listed and unlisted components and slip-on flange fluid service requirements
- Interpret flexitallic spiral wound gaskets, bolting fluid service requirements, gasketed joints and their effects in flange joints
- Identify the factors that affect sealing capability of gaskets and apply gasket installation and centralization
- Illustrate flange gasket design and identify the effect of temperature, member stiffness, proof strength of bolts and bolt specifications
- Recognize bolt tension and flange behaviour, clamping force and pretension, decompression, fatigue failure and reliability of a joint

- Discuss threads and the advantages of controlled tightening as well as apply torque tightening, bolts – tightening sequences, bolts – hydraulic tightening, bolt tensioning and tensioning operation
- Select flanges and ratings and explain API classification of flanges, ASME (ANSI/ASA) flanges and bolts tightening sequence
- Discuss shear, torsion, bending and others conditions covering thread stripping strength and brittle fracture, torque versus tension, stress relaxation and creep
- Identify long bolt flanges and standard bolted flanges as well as apply standard procedures for the assembly of flange joints
- Carryout joint cleaning, bolts installation, joint alignment, joint tightening, torque tightening procedure, bolt tensioning procedure, final tensioning and hydraulic flange bolt tensioning
- Use teflon or alternate gasket and discuss exploded view of joint assembly, torqueing action resistance and exploded flange assembly
- Employ flanged joint inspection, flange management and joint integrity, joint cleaning and joint inspection
- Discuss the failure of joints including flange face imperfections, embedment relaxation, gasket creep, bolt creep, vibration, elastic interactions and differential thermal expansion
- Interpret hot torqueing and hot bolting of flanges, bolt tightening sequence, hot bolting, potential risk of leakage and allowable flanges
- Recognize fatigue issues, stress concentration and notch sensitivity

Who Should Attend

This course covers systematic techniques and methodologies on making and breaking flanges and protocols for engineers involved in the design, construction or maintenance of pressurized equipment utilizing flanged joints for the petroleum, refining, chemical, power and process industries, maintenance technicians working with pressurized fluids piping and pipelines, shop supervisors in charge of crews working in process plant environments and for piping and pipeline inspectors.

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

- Flanges, Gaskets and Bolting
- What is a Pipe Flange
- Pipe Flange Types
- Gaskets
- Flange Bolts
- Bases for Flange Selection
- Pressure Class
- Flange P-T Ratings— Gray Iron (PSI) (Class Rated in Accordance with ASME B16.1)
- Flange P-T Ratings— Gray Iron (Bar) (Class Rated in Accordance with ASME B16.1)
- Flange P-T Ratings — Carbon Steel (PSI) (Class Rated in Accordance with ASME B16.5)
- Flange P-T Ratings — Carbon Steel (Bar) (Class Rated in Accordance with ASME B16.5)
- Flange P-T Ratings — Carbon Steel (Bar) (PN Rated in Accordance with EN 1092-1)
- Flange P-T Ratings — Carbon Steel (Bar) (K Rated in Accordance with JIS B2220)
- Cl 300 Flange Ratings — Several Materials (PSI) (Class Rated in Accordance with ASME B16.5, B16.24 And B31.3)
- Cl 300 Flange Ratings — Several Materials (Bar) (Class Rated in Accordance with ASME B16.5, B16.24 and B31.3)
- Fire Resistance
- Blow-Out Resistance
- Blow-Out Resistance (Gaskets)
- Tendencies to Leak
- Material Toughness
- Piping Component Standards
- Some Listed Components – ASME B31.3
- Listed Components
- Unlisted Components [ASME B31.3, 302.2.3, 326.2.2]
- Flanges (ASME B16.5)
- Slip-On Flange Fluid Service Requirements

- Joints Similar to Lapped Joint
- Flange Facings (ASME B16.5)
- Gaskets
- Gasket Configurations
- Gasket Types
- Important Gasket Characteristics
- Gaskets – Rubber
- Chemical Resistant
- Gaskets — Reinforced Rubber
- Flexitallic Spiral Wound Gaskets
- Style CG
- Style CGI
- Flexitallic Ring Joint Gaskets
- STYLE R
- Gaskets for Dissimilar Materials
- Gaskets – Fluoropolymer
- Gaskets - Flexible Graphite
- Foil Insert
- Tang Insert
- Corrugated Insert
- Gaskets - Spiral Wound
- Gaskets – Kammprofile
- Gaskets - Ring Joint
- Bolting
- 1st and 2nd Degree Burns
- Bolting Fluid Service Requirements
- More Bolting Fluid Service Requirements
- Flanged Joints
- Flanges
- Flange Types
- Flange Facings
- Now Let's Have a Wee Look at Some Flanges
- SLIP-ON FLANGE (SOF)

- Flanges
- Weld Neck Flange (WNF)
- Lap Type Joint Flange (LTJ)
- Threaded Flange
- Socket Weld
- Reducing Flange
- Blind Flange
- Unlisted Flanges & Banks
- Flange Bolts
- Drafting of Flanges
- References
- Comprehension Check
- Gasketed Joints
- Gaskets
- Gaskets – Do's
- Comprehension Check
- Gaskets and their Effects in Flange Joints Effect of Temperature on Flanged Joints
- Why Gaskets are Used
- Factors That Affect Sealing Capability of Gaskets
- Spiral-Wound Gaskets
- Gasket and Gasket Sheets Storage
- Key Recommendations
- Gasket Installation and Centralization
- Bolt Tightening
- Flange Gasket Design
- Effect of Temperature
- Mechanical Tests
- Screening Tests
- Leakage Test
- Fire Tests
- Piping Design Central: Gaskets
- Comprehension Check
- Bolt/Member Theory

- Theory
- Member Stiffness
- With a Gasket
- Without a Gasket
- Approximation
- Proof Strength of Bolts
- Bolt Specifications
- Flange Joint
- The Resultant Bolt Load
- The Resultant Load on Connected Members
- Bolt Pre-Tension & Member Compression
- Flange Joints Tutorial 1
- Stiffness of Bolts
- Stiffness of Members
- Stiffness of a Bolt – Calculation
- Stress-Strain Diagram for Bolts
- Comprehension Check
- References
- Bolt Tension and Flange Behaviour
- Clamping Force and Pretension
- Basic Thread Profile for UN, UNR & Metric Threads
- Pretension
- Decompression
- Fatigue Failure
- Reliability of a Joint
- Comprehension Check
- Threads: Basic Theory and Definitions Stiffness of Members Bolt Strength Pre-Tensioning External Loads Torque versus Tensioning
- Threads – Basic Definitions and Theory
- Metric - Mechanical Property Classes
- Tension Joints – External Load
- Bolt Torque versus Bolt Tension
- Threads – Basic Definitions and Theory
- Advantages of Controlled Tightening

- Torque Tightening
- Bolts – Tightening Sequences
- Bolts – Hydraulic Tightening
- Bolt Tensioning
- Tensioning Operation
- Comprehension Check
- Selection of Flanges and Ratings
- Flanges
- API Classification of Flanges
- API Flanges
- Pressure Ratings – API Series
- Test and Working Pressures
- ASME (ANSI/ASA) Flanges
- Pressure Ratings – ANSI Flanges
- Flanges – Physical Characteristics
- Flanges – Make-Up
- Bolts Tightening Sequence
- Pipe Flanges – Do's
- Comprehension Check
- Shear, Torsion, Bending and Other Conditions
- Blind Flanges
- Flange Joints Subjected to Bending
- Additional Conditions that Flange Bolts/Studs must Endure
- Thread Stripping Strength
- Brittle Fracture
- Comprehension Check
- Torque Versus Tension
- Stress Relaxation and Creep
- Creep
- Comprehension Check
- Long Bolt Flanges
- Long Bolt Flanges
- Long Bolt Flangeless Valves

- Standard Bolted Flanges
- What can You Do?
- Summary
- Comprehension Check
- Standard Procedures for the Assembly of Flange Joints
- General Requirements
- Joint Cleaning
- Installation
- RTJ Installation
- Bolts Installation
- Joint Alignment
- Joint Tightening
- Torque Tightening Procedure
- Bolt Tensioning Procedure
- Final Tensioning
- Hydraulic Flange Bolt Tensioning
- Teflon or Alternate Gasket Use
- Example of Bolt Torque Values (ASME B16.5)
- Exploded View of Joint Assembly
- Torqueing Action Resistance
- Exploded Flange Assembly
- Comprehension Check
- Flanged Joint Inspection
- Flange Management and Joint Integrity
- Joint Cleaning
- Joint Inspection
- Bolts, Nuts and Gasket Inspection
- Flange Inspection
- Gasket Condition
- Joint Alignment
- Critical Flanges
- Responsibilities
- Gaskets – Allowable Depth Defect versus Width

- Gaskets – Circumferential Variation Tolerance T1
- Gaskets – Radial Variation Tolerance T2
- Material Quality Certificate (Sample)
- Comprehension Check
- Dismantling Joints
- What are 'Dismantling Joints'?
- Design Principle of 'Dismantling Joints'
- Installation of Dismantling Joints (Style DJ400)
- Precautions
- Common Installation Problems
- Comprehension Check
- Why do Joints Leak (and/or Fail)?
- Why Joints Fail
- Assembly
- Metal Faces
- Gasket Material
- Design Factors
- Failure due to Bolts Which are Insufficiently Tight
- Failure due to Bolts Which are Too Tight
- Failure due to Gasket
- Failure due to the Flange
- Flange Face Imperfections
- Flange Leakage
- Embedment Relaxation
- Gasket Creep
- Bolt Creep
- Vibration
- Elastic Interactions
- Differential Thermal Expansion
- Comprehension Check
- Hot Torqueing and Hot Bolting of Flanges
- Bolt Tightening Sequence
- Hot Bolting

- Potential Risk of Leakage
- Allowable Flanges
- Comprehension Check
- Fatigue Issues
- Fatigue Failures
- Case Study: The BA Comet Aircraft
- Fatigue Strength
- Endurance Limit Modifying Factors
- Corrosion
- Electrolytic Plating
- Metal Spraying
- Cyclic Frequency
- Frettage Corrosion
- Stress Concentration and Notch Sensitivity
- Endurance Limit Versus Tensile Strength
- Loading Factors of K_c
- Master Fatigue Diagram
- Temperatures Factors of K_d
- Reliability Factor of K_e
- Miscellaneous Effects Factor K_f
- Example
- Fatigue Issues – The Notch Factor
- Characterizing Fluctuating Stresses
- Fatigue Loading of Tension Joints
- Fatigue Loading in Flanged Joints
- Tutorial 4 - Fatigue Issues
- Comprehension Check