TECHNICAL
EDUCATION
ACADEMY

School of Engineering

COURSE PROGRAMME

000443

MECH025 – Advanced Bolt Tightening

As we all know, in the Oil & Gas industry we are using bolts and nuts for a lot of applications.



Learn from the Best in the Business!

Course overview

Intermediate level

Why take this course

As we all know, in the Oil & Gas industry we are using bolts and nuts for a lot of applications. In Drilling Operations, Work Overs, Production, Maintenance and Petroleum Equipment construction.

However, this does not stop at the Oil & Gas market. Wherever we look, plenty of things are being kept in place by bolts and nuts. From truck tires to forklifts, ships to airplanes, windmills to pumps and bridges to buildings.

The overall purpose of this course is to provide practical training in bolt tightening and shimming techniques and tools. Through the use of different types of exercises performed individually and/or in small groups the ability to safely and competently perform torqueing and tensioning of bolts as well as shimming are achieved.

Who it is for and how it helps

This course is designed for anyone involved in the assembly, disassembly or quality assurance of bolted joints.

What you will learn

- Know how to find documentation applicable to torqueing, tensioning and shimming
- Be skilled in using torque wrenches correctly to tighten bolts
- Be skilled in inspecting, assembling/dismantling, and adjusting hydraulic torque and tensioning tools
- Be skilled in using hydraulic torque and tensioning tools correctly to tighten bolts using the two-stage bolt tightening procedure
- Be skilled in inspecting, measuring, and filling in checklists as part of shimming
- Know how to use shimming tools for filling air gaps by following the applicable procedure
- Be able to select technical manuals and documentation for bolt tightening and shimming tasks to be performed under supervision
- Safely operate specialized tools used for bolt tightening and shimming
- Properly fill out appropriate checklists when working on the turbine

Curriculum

Modules 01–04

01 Introduction to Threaded Fasteners

- Understanding Thread Terminology
- When to Use Fine vs. Coarse Threads
- Bolt and Nut Strength Property Classes and Specifications
- Matching Nut Strength to Bolt to Prevent Thread Stripping
- Reasons for Preferring Bolt Tensile Fracture over Thread Stripping
- The Concept and Importance of Proof Load
- Identifying Markings on Bolt Heads and Nuts
- Thread Stress Area: Definition and Application
- Calculating the Tensile Strength of Threaded Fasteners
- How Pre-tensioned Bolted Joints Sustain Applied Loads

02 Preload Variation in Threaded Fasteners

- Causes and Consequences of Preload Variation
- Distribution of Torque between Threads and Nut Face
- Importance of Preload in Bolted Joints
- Accounting for Preload Variation at the Design Stage
- Effects of Tightening Methods on Preload Variation in Fasteners

03 Galling of Threaded Fasteners

- What is galling and what types of materials tend to be affected?
- Examples of fastener threads that have galled, sectioned and x-ray photos
- Four ways that galling can be eliminated

04 Methods of Tightening Threaded Fasteners

- Torque controlled tightening
- Torque-angle controlled tightening
- Yield controlled tightening
- Bolt stretch method. Heat tightening
- The use of load indicating methods
- The use of ultrasonics to determine bolt loading

Curriculum

Modules 05–07

05 Failure Modes of Threaded Fasteners

- Identifying Design vs. Manufacturing Failures
- Five Main Design-Related Failure Modes of Threaded Fasteners and Bolted Joints
- Importance of Clamp Force in Ensuring Structural Integrity
- How Joint Design Prevents Bolt Overloading
- Understanding Fatigue and Common Failure Points on Threaded Fasteners
- The Role of Bearing Stress in Ensuring Reliable Joints
- Internal and External Thread Stripping Failures

06 Vibration Loosening of Threaded Fasteners

- Fine Threads vs. Coarse Threads: The Inclined Plane Analogy
- Goodier and Sweeney's Research on Loosening Due to Variable Axial Loading
- ESNA's Work on Shock-Induced Loosening and Resonance
- MIL-STD 1312-7 Vibration Test for Fasteners
- Junker's Theory on Self-Loosening of Fasteners
- Junkers/Transverse Vibration Test for Fasteners
- Impact of Vibration Amplitude on Fastener Self-Loosening Rate
- Preload Decay Curves and Fastener Type Effectiveness in Resisting Vibrational Loosening
- Findings of Haviland and Kerley on Loosening Due to Bending, Shock, Impact, and Differential Thermal Expansion
- Research Conclusions and Preventive Measures for Loosening

07 Torque Control

- What is meant by a tightening torque?
- Units used to measure torque
- What are the consequences of not applying sufficient torque to a bolt
- How torque is absorbed by a nut/bolt assembly
- The torque-tension graph
- The relationship between the tightening torque and the resulting bolt preload (tension)
- The factors which affect the torque-tension relationship
- The nut factor method of determining the correct tightening torque

Curriculum

Modules 07–10 · Module 07 — continued

- Example calculation of how to determine the correct tightening torque
- Scatter in the bolt preload resulting from friction variations
- Determining the bolt preload (tension) resulting from a tightening torque
- Prevailing torque fasteners (such as those containing a nylon insert) and how they affect the torque distribution and the correct torque to use

08 Load Sensing Fasteners

- The use of strain gauged bolts
- The use of load cells
- The use of Rota bolts
- The use of Smart bolts
- The use of direct tension indicators (load indicating washers)
- Tension control bolts

09 Hydraulic Tensioning of Threaded Fasteners

- The principles behind hydraulic tensioning
- The number of tensioners that are used to tighten a joint – 100%, 50%, 33% and 25% tensioning methods
- The effect of elastic recovery on the tension induced into a bolt
- The use of hydraulic nuts and the sequence used to tighten them
- The use of oil filled nuts
- The use of rubber filled nuts

10 Tightening Procedures

- The problems of tightening multi-bolt assemblies
- Elastic interaction or bolt cross-talk
- The use of a tightening sequence
- The single pass tightening sequence
- Tightening sequences for non-circular bolt patterns
- Tests completed to verify tightening sequences
- The two pass tightening sequence
- The use of multiple tightening tools

Curriculum

Module 10 — continued

- Bolt cross talk and hydraulic tensioning
- Methods that can be used to check the tightening sequence
- The solder plug method
- The use of pressure sensitive films
- Establishing a tightening procedure

Joining the programme

Contact the Academy and quote course code 000443 to confirm dates, delivery format, prices and enrolment terms.

Training for your team

Tell us your business goals, the roles and number of participants, and your preferred dates and location. This will help us discuss the right training option.

Preparing for the programme

The published programme does not specify any prerequisites. Contact us before enrolling to confirm how to prepare.

Discuss your training needs

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