T-shore Education

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Learning Scenario Manual

Module:
Bolt Tightening
Learning scenario:
Basic Bolt Tightening Techniques

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Note This is a fictive generic equipment checklist intended for training purposes and therefore may vary from the equipment checklist provided by a company. It is important that a technician always read and fill checklist carefully prior to any task.

Table of Contents

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1 List of tools

Table 1. List of tools for exercises 1,2,3

Tool name	Model / Version	Quantity
Service report	V01	1
Gloves	ANSI cut resistant level A1	1
Safety shoes	-	1
Safety googles	-	1
Safety helmet	-	1
Suitable working clothing	-	1
Manual torque wrench	All applicable with correct socket size align with training infrastructure	1 for each 2 x participants
Vernier calliper	No digital	1
Counter support/counter wrench/backup wrench	-	1
Impact gun	All applicable with correct socket size align with training infrastructure	1
Electrical torque wrench with reaction arm	All applicable with correct socket size align with training infrastructure	1

Table 2. List of tools for exercises 4 (demonstration)

Tool name	Model / Version	Quantity
Gloves	ANSI cut resistant level A1	1
Hydraulic gloves		1
Safety shoes	-	1

Safety googles	-	1
Safety helmet	-	1
Suitable working clothing	-	1
Vernier calliper	No digital	1
Counter support/counter wrench/backup wrench	-	1
Hydraulic torque wrench cassette type / other	align with hydraulic equipment infrastructure	1
Hydraulic pump with pendant	align with hydraulic equipment infrastructure	1
Hydraulic hoses and couplings	align with hydraulic equipment infrastructure	1

1 Instruction

1.1 Inspection preparation

Step 1: Documentation

- Fill out Table 1. Documentation overview and Table 2. Report overview of **Service report**

Step 2: Safety procedures

- Verify that all mechanical, electrical and hydraulic devices are safely shut down and properly cooled to allow safe access.
- Fill out *Table 3. Safety procedures* in **Bolt tightening service report**

1.2 Exercise 1 – Bolt loosening with an impact gun

Step 1: Planning for safety

- Discuss with instructor safety hazards due to points below and analyze how to mitigate them

  a) PPE (gloves, safety glasses, and hearing protection)

  b) Heavy lifting

c) Dropped objects (securing work area)

d) Electrical risk (electrocution, batteries, voltage supply)

e) Slipping/tripping hazards and workspace management

f) Noise exposure (especially during impact gun operation)

g) Two-man torquing procedures (line of sight, communication, site rules)

Step 2: Preparation

- Review the exercise manual and clarify any unclear points.
- Ensure all required PPE is worn before starting
- Verify zero energy in practical training (no mechanical, electrical, or hydraulic hazards).
- Inspect the impact gun for visible damage and perform a functional test.
- Measure the bolt nut size on the infrastructure using vernier caliper
- Select the correct socket
- Ensure stability of the component before proceeding.

Step 3: Loosening the bolts

- Position the impact gun properly – align the socket with the bolt nut to prevent slippage.
- Apply steady pressure and engage the trigger gradually (to prevent sudden movements).
- Loosen bolts in a controlled sequence, following manufacturer or instructor guidelines.
- Monitor tool performance for unusual noises or malfunctions.

Step 4: Post-Loosening Procedures

- Remove and store bolts and nuts securely.

Note Place them on a surface to identify which bolt fits into each specific hole.

- Inspect bolts and bolt holes for damage or contamination.
- Record all observations accurately in the service checklist *Table 4. List of service task points* in **Bolt tightening service report**

1.3 Exercise 2 - Bolt tightening with manual torque wrench

Step 1: Planning for safety

- Discuss with instructor safety hazards due to points below and analyze how to mitigate them

  a) PPE (gloves, safety glasses, and hearing protection)
  b) Heavy lifting
  c) Dropped objects (securing work area)
  d) Electrical risk (electrocution, batteries, voltage supply)
  e) Slipping/tripping hazards and workspace management
  f) Noise exposure (especially during impact gun operation)
  g) Two-man torquing procedures (line of sight, communication, site rules)

Step 2: Preparation

- Review the exercise manual and clarify any unclear points.
- Ensure all required PPE is worn before starting
- Verify zero energy in practical training (no mechanical, electrical, or hydraulic hazards).
- Inspect the torque wrench

Note Check for any visible damage and ensure it is functioning correctly. Verify that the calibration is within the valid range and perform a functional test.

- Measure the bolt and nut size using a vernier caliper.
- Select the correct socket.
- Ensure that the socket fits securely on the bolt head to avoid slipping.
- Set the torque wrench to the required torque value

Note Refer to the manufacturer's specifications for the correct torque settings – according to bolt, nut size dimension

Step 3: Tightening the Bolts

- Position the torque wrench properly to prevent slippage.
- Tighten bolts smoothly until the torque wrench signals the correct value (click or indicator).
- Follow the specified tightening sequence.

Step 4: Post-tightening procedures

- Re-check torque if necessary

Note Some bolts may require a final torque check to confirm they are correctly tightened.

- Record all observations accurately in the service checklist – *Table 4. List of service task points* in **Bolt tightening service report**

1.4 Exercise 3 – Bolt tightening with electrical torque wrench with a reaction arm.

Step 1: Planning for safety

- Discuss with instructor safety hazards due to points below and analyze how to mitigate them
    a) PPE (gloves, safety glasses, and hearing protection)
    b) Reaction arms (pinching, crushing, hand position, placement of reaction arm)
    c) Heavy lifting
    d) Dropped objects (securing work area)
    e) Electrical risk (electrocution, batteries, voltage supply)
    f) Slipping/tripping hazards and workspace management
    g) Noise exposure
    h) Counter holds
- Two-man torquing procedures (line of sight, communication, following company and site rules and procedures)

Step 2: Preparation

- Ensure all required PPE is worn before starting
- Verify zero energy in practical training (no mechanical, electrical, or hydraulic hazards).
- Inspect the electrical torque wrench and reaction arm

Note Check for any visible damage and ensure the tool is functioning correctly. Perform a functional test before use.

- Verify documentation requirements (serial numbers, batch numbers, torque specifications).
- Check tool calibration.

Note Ensure calibration documents match tool labeling and are within the valid range.

- Visually inspect bolts, nuts, washers, tool components for damage or wear.

- Measure the bolt nut size on the infrastructure using vernier caliper
- Select the correct socket
- Verify lubrication needs as per manufacturer specifications.
- Set the torque wrench to the required torque value

Note Refer to the manufacturer's specifications for the correct torque settings and adjust the tool accordingly. Ensure correct torque values using pressure conversion charts where necessary.

- Ensure stability of the component and confirm the team is ready to proceed.

Note Communicate with team members and follow all safety protocols before starting.

Step 3: Positioning the reaction arm

- Properly position the reaction arm against a stable surface. Ensure the reaction arm is resting securely against a non-moving part of the structure to absorb the torque force.
- Verify alignment of the socket and reaction arm

Note The reaction arm should not interfere with moving parts or create unintended force on the component.

Step 4: Tightening the bolts

- Position the torque wrench properly.
- Apply gradual force (engage the trigger gradually, allowing the torque wrench to build up force evenly).
- Monitor reaction arm stability.
- Follow the manufacturer's recommended tightening sequence.
- Monitor tool performance (listen for unusual noises)

Step 5: Post-tightening procedures

- Re-check torque if necessary (Some bolts may require a final torque check to confirm they are correctly tightened.)
- Ensure the electrical torque wrench is switched off correctly and return the tool to its proper storage case
- Record all observations accurately in the service checklist – *Table 4. List of service task points* in **Bolt tightening service report**

ONLY FOR INSTRUCTOR

1.5 Exercise 4 – Demonstration of bolt tightening with hydraulic torque wrench

Step 1: Planning for safety

- Discuss with participants safety hazards due to points below and analyze how to mitigate them

  a) PPE (gloves, safety glasses, and hearing protection)
  b) Reaction arms (pinching, crushing, hand position, placement of reaction arm)
  c) Heavy lifting
  d) Dropped objects (securing work area)
  e) Hydraulics (heat, fluids, pressure, hydraulic injection, hose coupler ratings, fire hazard vaporised hydraulic fluid)
  f) Electrical risk (electrocution, batteries, voltage supply)
  g) Slipping/tripping hazards and workspace management
  h) Counter holds
  i) Two-man torquing procedures (line of sight, communication, following company and site rules and procedures)
  j) Working with pump pendant (single and dual action)

Step 2: Preparation

- Review the exercise manual and clarify any unclear points.
- Ensure all required PPE is worn before starting including hydraulic gloves when setting up hydraulic pump.
- Verify zero energy in practical training (no mechanical, electrical, or hydraulic hazards).
- Perform visual inspection of bolts and bolt components to distinguish between suitable and damaged or compromised bolts and components.
- Perform pre-use inspection of hydraulic pumps and hose components to ensure that they do not pose a safety or quality risk to the specified bolt torquing task
- Verify that the hydraulic pump or assembly is powered off and the pressure relief valve is in the open position.
- Position the equipment on a flat, stable surface away from any potential hazards.
- Examine the hydraulic pump and hose components for visible damage such as cracks, dents, or corrosion.
- Inspect all hose connections, seals and pump for any signs of leakage.
- Ensure that all fittings are tight and secure.

- Check that the pump is properly calibrated according to the nameplate or manual.
- Verify that torque tools are powered off and there is no pressure in tool
- Position the torque equipment on a flat, stable surface away from any potential hazards.
- Examine hydraulic torque tools for visible damage, cracks, or wear. Check connection points
- Check that the equipment is properly calibrated according to the nameplate or manual.
- Perform a functional test on hydraulic tools to ensure they operate correctly.

Note If needed take appropriate actions to mitigate damaged or malfunctioning pump, hose, and tool components as to ensure that they do not pose a safety or quality risk to the specified bolt torquing task.

Step 3: Setting up equipment for use

- Setup equipment and inspect the setup prior to use
- Manage the work environment in case of hazard risk
- Check pressure settings in manual
- Set the value with the gauge according to the calibration chart
- Test equipment by pressurise and depressurise hydraulic equipment, including correct communication and body positioning in relation to equipment to avoid injury from failing components and hydraulic injections

Step 4: Tightening the bolts

- Position the torque wrench properly
- Apply gradual force while engaging in the hydraulic system.
- Follow the manufacturer's recommended tightening pattern.
- Monitor tool performance

Step 5: Post-tightening procedures

- Re-check torque if necessary (Some bolts may require a final torque check to confirm they are correctly tightened)
- Correctly conduct a post-use inspection of equipment
- Disassemble and pack equipment for transport including de-energising, disconnecting hoses, placing caps on hoses and gathering all equipment

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