Appendix P

MANUFACTURING
YOUTH APPRENTICESHIP

MAINTENANCE, INSTALLATION, AND REPAIR PATHWAY
INDUSTRIAL EQUIPMENT - BASIC AND ADVANCED (UNITS 9-10)
Unit 9: Maintenance, Installation, and Repair Pathway
Industrial Equipment- Basic

Competency

1. Read technical drawings and work orders

Performance Standard Condition

Competence will be demonstrated

at the worksite

Performance Standard Criteria

Performance will be successful when learners:

- Review technical drawing
- Gather reference materials as needed
- Determine type of print and views used
- Determine material specifications
- Determine critical dimensions and tolerances
- Analyze supplementary data
- Determine product or job instructions and specifications

Interpret equipment symbols and procedure

Learning Objectives

- Explain the need for technical drawings, also known as blueprints, schematics, part prints, or engineering drawings
- Explain how technical drawings detail work piece design parameters, lay out and specifications
- Explain how product design and production are related
- Discuss different types of technical drawings
- Identify terminology related to technical drawings
- Describe how to interpret views, projections and elements from a technical drawing
- Identify common terms, components, revisions, symbols, assembly sequence, dimensions, tolerances, scale, and list of materials from technical drawings or work orders

Comments:
Unit 9: Maintenance, Installation, and Repair Pathway
Industrial Equipment- Basic

Competency

2. **Interpret equipment symbols and procedures**

Performance Standard Condition

**Competence will be demonstrated**

at the worksite

Performance Standard Criteria

**Performance will be successful when learners:**
- Interpret technical drawings accurately as needed for job task
- Use appropriate terminology
- Identify lines, views, symbols, and representations on the drawings
- Interpret dimensions, tolerances, and scale on the drawings
- Interpret threads, tapers, and shop notes on the drawings
- Interpret the maintenance, installation and/or repair plan from a technical drawing which includes tools, equipment, speeds, feeds, fixtures and holders as applicable

Learning Objectives
- Define and explain the use of lines, views, symbols, dimensions, scale, and tolerances on technical drawings
- Identify different lines by name, type, order of usage, and application such as object, hidden, center, section, dimension, extension, cutting plane, short break, long break, phantom
- Demonstrate standard view placement practices
- Compare pictorial format, orthographic projection, sectional views, and detail schedules
- Discuss the standards for production document lines
- Describe the standard usage of metric (SI) linear units in drafting
- Identify and interpret drawings as to type, part name, part number, callouts, components, and part size dimensions
- Determine the relationship of one part to another from assembly drawings
- Determine procedure number cross-references to technical drawings

Comments:
Unit 9: Maintenance, Installation, and Repair Pathway
Industrial Equipment- Basic

Competency
3. **Maintain schedules, communication, and documentation**

Performance Standard Condition
   **Competence will be demonstrated**
   at the worksite

Performance Standard Criteria
   **Performance will be successful when learners:**
   - Identify frequency of maintenance tasks, i.e., daily, every other day, weekly, monthly, yearly, etc.
   - Update schedules as maintenance is completed
   - Schedule preventive and repair maintenance with all internal and external parties with limited disruption to production
   - Communicate maintenance and repair needs clearly
   - Use the correct reporting formats for documentation and communication
   - Document maintenance and repair activities accurately
   - Report back and document any maintenance and repair issues in a timely manner
   - Maintenance is documented clearly and completely
   - Maintenance communication is timely and accurate
   - Maintenance communication is documented

Learning Objectives
- Discuss how to schedule repair and maintenance functions with respect to production requirements and production levels
- Explain how communication for repair and maintenance issues demonstrates a knowledge of customer and business needs
- List the parties that need to be involved of repair and maintenance issues
- Describe the importance of documenting communications
- Describe the process of reporting and documenting preventive and corrective actions
- Discuss why preventive/corrective records must be retained

Comments:
Unit 9: Maintenance, Installation, and Repair Pathway
Industrial Equipment- Basic

Competency

4. Monitor equipment for correct operation

Performance Standard Condition

Competence will be demonstrated
at the worksite

Performance Standard Criteria

Performance will be successful when learners:
- Review equipment quality measures for trends and problems as required
- Compare current equipment performance to optimal equipment operations on a regular basis
- Report any noted deviations from expected performance
- Review all relevant data before making suggestions
- Assist worksite professional to investigate abnormal equipment conditions in a timely manner
- Continuously monitor equipment that is corrected to ensure that the corrective action solved the problem
- Document all monitoring activities
- Assure that repair history is complete, current and accurate

Learning Objectives

- Identify basic approaches to maintenance
- Explain how to read and review repair history records
- Describe how trends for malfunctioning equipment might appear in production records
- List common tools and equipment that must be monitored and maintained
- Define Total Productive Maintenance (TPM)
- Describe how monitoring and diagnostic device are used to find out which equipment is operating correctly
- Define statistical distributions
- Calculate mean, median, mode and standard deviation
- List possible sources of variation inherent in data collection
- Identify the purpose of a control chart
- Identify conditions that require preventive or corrective actions
- Explain ways to spot data inaccuracies and respond to them
- Describe quality statistical tools such as histograms, CpK, X bar, and R charts and range

Comments:
Unit 9: Maintenance, Installation, and Repair Pathway
Industrial Equipment- Basic

Competency

5. Identify maintenance requirements

Performance Standard Condition

Competence will be demonstrated

at the worksite

Performance Standard Criteria

Performance will be successful when learners:

Locate and review applicable technical drawings, work orders, and/or procedures for maintenance work

Review procedure and any safety requirements

Identify setup needed

Consult with worksite professional to verify production schedule, deadlines, and timeframes to perform maintenance

Learning Objectives

Describe how a maintenance plan is developed from a technical drawing for process, equipment, tools, and holders

Identify terminology related to equipment systems, maintenance and repair

List function and characteristics of major types of equipment systems e.g., mechanical, hydraulic, pneumatic, electrical, etc.

Comments:
Unit 9: Maintenance, Installation, and Repair Pathway
Industrial Equipment- Basic

Competency
6. Layout and plan work

Performance Standard Condition
   Competence will be demonstrated
   at the worksite

Performance Standard Criteria
   Performance will be successful when learners:
     Identify maintenance requirements
       Plan sequencing, tools, and equipment needed for maintenance procedure
       Select tools and maintenance equipment to be used
       Gather all resources needed at the workstation

Learning Objectives
   List common tools and equipment used in equipment maintenance
   Outline applications of each tool and equipment
   Describe and demonstrate the safety requirements and safeguards for each tool and equipment
   Identify, name, and explain the function of specific equipment you will maintain

Comments:
Unit 9: Maintenance, Installation, and Repair Pathway
Industrial Equipment- Basic

Competency

7. Perform safety checks

Performance Standard Condition

Competence will be demonstrated
at the worksite

Performance Standard Criteria

Performance will be successful when learners:

*Layout and plan work*
Review safety requirements of procedure
Verify safety equipment and any Personal Protective Equipment (PPE) needed for maintenance process
Inspect tools and work area for safety considerations
Examine equipment labeling and safeguarding
Ensure Lock Out/Tag Out procedures have been implemented as required prior to maintenance

Learning Objectives

List the common types of labeling used on tools and equipment to indicate whether a tool or piece of equipment is functional and safe to use
List the safety rules and PPE required for the equipment you will be maintaining

Comments:
Unit 9: Maintenance, Installation, and Repair Pathway
Industrial Equipment- Basic

Competency

8. Use hand tools

Performance Standard Condition

**Competence will be demonstrated**

at the worksite

Performance Standard Criteria

**Performance will be successful when learners:**

- Review safety procedures
- Select the appropriate hand tool for the job
- Use hand tools according to established guidelines for the task to be completed
  - Cut metal stock with a hand hacksaw
  - Cut threads with hand taps and dies
  - Ream holes with hand reamer
  - Tap holes using hand tools
  - Deburr using hand tools
- Piece(s) meet specification

Learning Objectives

- Distinguish between common hand tools including hammers, wrenches, pliers, punches, taps and dies, etc.
- Identify cutting and non-cutting hand tools
- Compare basic tools and tool-holding devices

Comments:
Unit 9: Maintenance, Installation, and Repair Pathway
Industrial Equipment- Basic

Competency
9. Perform preventive maintenance (PM)

Performance Standard Condition
Competence will be demonstrated
at the worksite

Performance Standard Criteria
Performance will be successful when learners:
- Complete scheduled preventive maintenance (PM) tasks in a timely manner
- Communicate PM to production and other applicable parties
- Assure that alternative equipment is available if needed by production
- Consult worksite professionals, technical drawings, maintenance manuals, and equipment history for PM
- Determine type of lubrication requirements
- Gather equipment and supplies needed to perform PM
- Ensure that equipment is properly labeled and pulled from production use
- Follow appropriate Lock Out/Tag Out procedures prior to performing PM
- Follow all safety requirements and wears appropriate Personal Protective Equipment (PPE) as required
- Assist worksite professional to follow PM schedule to calibrate and maintain equipment, tools and workstations
- Assist worksite professional to re-qualify equipment for operation
- Document preventative actions completed
- Evaluate PM through follow up

Learning Objectives
- Discuss preventive maintenance methods
- Compare preventive maintenance to predictive maintenance
- Identify when to use preventive action and when to use corrective action
- Explain why verification is essential to prevention and correction
- Describe how diagrams schematics, equipment manuals, and equipment specifications to determine the schedule and process for PM

Comments:
Unit 9: Maintenance, Installation, and Repair Pathway
Industrial Equipment- Basic

Competency
10. Perform lubrication procedures

Performance Standard Condition
Competence will be demonstrated
at the worksite

Performance Standard Criteria
Performance will be successful when learners:
Follow preventive maintenance and repair of equipment steps
Perform safety checks
Check lubricant levels
Check for and correct any leakages
Draw lubricant samples for analysis
Test lubricant for contamination and viscosity
Drain lubricant if required
Fill reservoir with correct lubricant
Use procedures to avoid contamination
Clean inlet strainer and filters if required
Add additional lubrication if required
Document lubrication procedures completed

Learning Objectives
Describe the different types of lubricants, their uses, storage, and disposal requirements
Discuss how to use a viscosimeter and grease gun
Identify bearings that do not require lubricant
Describe how to determine when a bearing has the correct amount of grease/lubricant
Determine type of lubrication requirements
Determine locations requiring lubrication
Determine proper type of lubricant for each location
Determine amount of lubricant required for each location

Comments:
Competency

11. Assist with basic equipment problem identification and diagnosis

Performance Standard Condition

**Competence will be demonstrated**
- at the worksite
- while assisting a worksite professional

Performance Standard Criteria

**Performance will be successful when learners:**
- Ensure that equipment is properly labeled and pulled from production use
- Locate and interprets technical drawings for the equipment and process that is under investigation
- Locate the equipment reference materials and manuals
- Review previous preventative maintenance and repair history records on the equipment under investigation
- Assist worksite professional to identify the components to be checked for proper operation
- Ensure that appropriate safety devices and personal protective equipment are in place prior to diagnosis
- Ensure that all labeling and Lock Out/Tag Out procedures are in place prior to diagnosis
- Follow all safety requirements and wears appropriate Personal Protective Equipment (PPE) as required
- Assist the worksite professional to take appropriate readings using meters and testing equipment
- Assist the worksite professional in locating and determining the cause of the problems reported
- Assist worksite professional to match suggested remedies with problems for the inoperative systems
- Document testing and evaluation
- Ensure that equipment is properly labeled, pulled from production, and communicated regarding repair
- Investigation are complete, timely, and include indication of root cause

Learning Objectives

- Describe how diagrams, schematics, equipment manuals, and equipment specifications are used to determine repair
- Describe the most common causes of tool/equipment failure
- Explain the meaning of common alarms on equipment
- Compare common equipment and materials considered recyclable and not recyclable
- Describe the purpose, function, and components of common diagnostic testing equipment

Comments:
Unit 9: Maintenance, Installation, and Repair Pathway
Industrial Equipment- Basic

Competency
12. Assist with basic equipment repair

Performance Standard Condition
Competence will be demonstrated
at the worksite
while assisting a worksite professional

Performance Standard Criteria
Performance will be successful when learners:
Identify equipment problems through malfunction or production or quality indicators
Communicate repair needs to production and other applicable parties
Assure that alternative equipment is available if needed by production
Consult worksite professionals, technical drawings, maintenance manuals, and equipment history for repair
Determine type of lubrication requirements
Gather equipment and supplies needed to perform repair
Ensure that equipment is properly labeled and pulled from production use
Follow appropriate Lock Out/Tag Out procedures prior to performing repair
Follow all safety requirements and wears appropriate Personal Protective Equipment (PPE) as required

Assist with basic equipment problem identification and diagnosis
Assist worksite professional to isolate system and component failure
Assist worksite professional to repair equipment problem
Assist worksite professional to identify root cause of problem and develop corrective action plan
Assist worksite professional to re-qualify equipment for operation
Document repairs completed
Evaluate repair work through follow up

Learning Objectives
Explain concepts of simple machines and how they apply to disassembly of equipment
Identify when to use preventive action and when to use corrective action
Explain why verification is essential to prevention and correction
Describe how diagrams schematics, equipment manuals, and equipment specifications are used to repair specific systems on equipment

Comments:
Competency

13. Assist to re-qualify equipment

Performance Standard Condition

Competence will be demonstrated
at the worksite
while assisting a worksite professional

Performance Standard Criteria

Performance will be successful when learners:

Review the requirements for requalification

Perform safety checks

Assist the worksite professional to re-qualify the equipment
  o Level and fasten equipment as required
  o Set up repaired equipment
  o Perform a requalification run to test and validate the equipment operationally
  o Verify repair completed solved equipment problem
  o If equipment is customized or adjusted, test and validate for specific changes made
  o Obtain requalification sample to analyze if required

Place equipment back into service
Notify production
Document requalification and update maintenance schedules

Learning Objectives

Define components of equipment requalification
Compare types of repair situations which would or would not require requalification
Distinguish between initial operational qualification of equipment and routine performance qualification
Describe the impact of Total Quality Management (TQM) principles and ISO9000 certification on equipment qualification
Identify statistical tools used in performance qualification
Identify methods of inspecting materials, processes, and final products in qualifying equipment
Explain the purpose of documentation and record keeping for equipment qualification
Explain the importance of testing and documenting customized or adjusted equipment

Comments:
Unit 10: Maintenance, Installation, and Repair Pathway
Industrial Equipment- Advanced

Competency

1. Calibrate tools and equipment

Performance Standard Condition

Competence will be demonstrated
at the worksite OR in the classroom in a simulated setting. Simulation should ONLY be used IF there is no possibility of skill performance at the worksite.

Performance Standard Criteria

Performance will be successful when learners:
Follow schedule to calibrate tools and instruments

Perform safety checks
Check tool/instrument certification regularly by reviewing documentation and through observation of use
Clean and adjust instruments before calibrating
Calibrate tools and instruments accurately and correctly
Promptly re-calibrate tools out of calibration
Re-qualify tools and instruments sent out for recalibration or repairs
Label tools and equipment that have been calibrated
Document all calibration activities

Learning Objectives
Examine different types of precision measurement instruments and their uses
Define calibration and how it is performed
Compare and contrast accuracy versus precision
Explain tolerance
Describe how tolerances and precisions are developed for a piece/product
Explain how calibration precision and schedules are determined
Describe the proper use of selected precision measurement tools
Explain how to determine and control potential sources of measurement error
Discuss how to apply calibration methods to control product and process characteristics

Comments:
Unit 10: Maintenance, Installation, and Repair Pathway  
Industrial Equipment- Advanced

Competency

2. Set up and fabricate metal

Performance Standard Condition

Competence will be demonstrated at the worksite

Performance Standard Criteria

Performance will be successful when learners:

GENERAL SET UP
- Layout and plan work
- Perform safety checks
  - Place parts and assemblies into fixtures
  - Set up equipment for fabrication

FIXTURE SET UP
- Locate parts or subassemblies needed
- Determine the order for the part or subassembly placement
- Position, align, and bolt jigs, holding fixtures, guides, and stops onto machines
- Position, align and/or clamp work pieces into jigs and/or holding fixtures
- Tighten all holding and positioning clamps
- Inspect assembly

FABRICATE METAL
- Prepare base metal
- Add or adjust safety guards
- Verify machine or equipment settings for fabrication of metal material
- Verify blades, shears, dies, etc., appropriate for metal fabrication to be completed
- Perform equipment pre-check
- Adjust holding devices, blade speeds, and metal positions safely as needed

Operate tools and equipment safely
- Process metal according to specifications
  - Use hand tools such as brakes and hammers
  - Use equipment such as such as grinders, saws, drills, drill presses, or brakes
- Inspect, measure, or test completed metal pieces
- Shut down and secure equipment
- Clean up
- Report any discrepancies or equipment concerns to worksite professional immediately
- Document fabrication process if required

Learning Objectives

- Distinguish between common cutting, drilling and welding processes
- Describe equipment components and safety features
- Describe how to cut, drill, and/or weld metal to tolerances
- Interpret cutting, forming, drilling, and welding symbols on schematics
- Identify variables that impact cutting and welding equipment settings
List the types of labeling used on tools and equipment at your facility to indicate whether a tool or piece of equipment is functional and safe to use
Compare basic holding devices

Comments:
Unit 10: Maintenance, Installation, and Repair Pathway
Industrial Equipment- Advanced

Competency

3. Mount a bearing

Performance Standard Condition

Competence will be demonstrated
at the worksite

Performance Standard Criteria

Performance will be successful when learners:
- Follow preventive maintenance and repair of equipment steps
  - Perform safety checks
    - Check running machine for signs (e.g., heat, noise, vibration, etc.) of malfunctioning bearings
    - Find the correct reference for bearing numbering
    - Verify the correct bearing for the application
    - Inspect bearing for condition and lubrication
    - Verify mounting clearances according to specification
- Handle bearings properly to avoid contamination and damage
- Assist worksite professional to remove used bearings carefully and correctly
- Assist worksite professional to prepare all appropriate surfaces (the shaft and bore) as required
- Assist worksite professional to mount bearing according to specifications
- Assist worksite professional to analyze reason bearing failed
- Document bearing installation

Learning Objectives
- Identify bearing types and use
- Explain how to match bearing number nomenclature to bearing type
- Explain how to analyze bearings as to type and application
- Discuss the need to prevent contamination of fluids and bearings
- Describe proper function of bearings and couplings and their reliability issues including functioning of transmission equipment, and bearings, shafts, and couplings function

Comments:
Unit 10: Maintenance, Installation, and Repair Pathway
Industrial Equipment- Advanced

Competency

4. **Install mechanical fasteners**

Performance Standard Condition
- **Competence will be demonstrated**
  - at the worksite

Performance Standard Criteria
- **Performance will be successful when learners:**
  - Follow preventive maintenance and repair of equipment steps
  - **Perform safety checks**
  - Select the appropriate fastener for the application
  - Install various fasteners according to specifications
  - Use the correct tools to install mechanical fastener
  - Document fastener installation

Learning Objectives
- Distinguish between screw thread types and sizes
- Examine and identify different fasteners and their uses

Comments:
Unit 10: Maintenance, Installation, and Repair Pathway
Industrial Equipment- Advanced

Competency
5. Assist with electrical circuit problem identification and diagnosis

Performance Standard Condition
Competence will be demonstrated
at the worksite
while assisting a worksite professional

Performance Standard Criteria
Performance will be successful when learners:
Assist worksite profession to identify and diagnose equipment problem
Interpret electrical schematics
Perform safety checks
Assist with electrical circuit testing
  o Measure current draw
  o Test circuit for specified readings to isolate possible causes of fault
  o Test for voltage, resistance, open circuits and shorted elements if required
Utilize electrical tests logically in process of elimination
Assist worksite professional to identify specific cause of the problem in electrical circuits
Document electrical circuit testing completed

Learning Objectives
Compare sources of electricity
Compare AC and DC circuits
List units of measure for electrical quantities
Define voltage, current, and power (wattage)
Explain how to test voltage, current, and power (wattage)
Define/apply theory of Ohm’s law
Calculate electrical quantities such as voltage, current, resistance, power and conductance
Determine how resistance affects an electrical circuit
Compare resistive series circuits, parallel circuits, and combination circuits
Compare conductors and insulators
Describe features, symbols and notations used on electrical schematics
Describe electrical circuit components and functions
Describe electrical systems reliability issues including power supply connections, operations, series and parallel circuit function, circuit breaker function, electric motor control, and power overload

Comments:
6. Assist with motor control problem identification and diagnosis

Performance Standard Condition

Competence will be demonstrated
- at the worksite
- while assisting a worksite professional

Performance Standard Criteria

Performance will be successful when learners:
- Assist worksite profession to identify and diagnose equipment problem
- Interpret single electric motor control diagrams
- Perform safety checks
  - Assist worksite professional to take appropriate readings on motor control system using meters and testing instruments
  - Assist worksite professional in locating and determining the cause of problems in motor control system
  - Document motor control testing completed

Learning Objectives

- Explain how motor action relates to the operation of electrical devices
- Compare DC, 3-phase and single phase motors
- Describe motor control circuit components, functions and reliability issues
- Describe proper functioning of belts and chains and their reliability issues including belt drive, chain drive and roller chain drive functions
- Describe features, symbols and notations used on motor control circuit diagrams
- Describe automated machine reliability issues including computerized control processes, logic control circuits, solenoid-operated fluid power valves, electromechanical limit switches, time delay devices, manual controls, and interlock circuits

Comments:
Unit 10: Maintenance, Installation, and Repair Pathway
Industrial Equipment- Advanced

Competency

7. Assist with hydraulic and/or pneumatic problem identification and diagnosis

Performance Standard Condition

Competence will be demonstrated
at the worksite
while assisting a worksite professional

Performance Standard Criteria

Performance will be successful when learners:
Assist worksite profession to identify and diagnose equipment problem
Interpret schematics for basic hydraulic system or pneumatic circuit
Perform safety checks
Assist in taking appropriate readings using meters and testing instruments
Check pressure in a hydraulic OR pneumatic system at the appropriate location
Assist worksite professional to locate and determine the cause of problems in a hydraulic or pneumatic systems
Document hydraulic and/or pneumatic system testing completed

Learning Objectives

Define the principles of hydraulics
Explain the purpose and function of hydraulic components
Describe hydraulic system reliability issues including seals, gaskets, packing, and hydraulic fluids
Define the principles of pneumatics
Demonstrate how and where to measure pressure in a pneumatic system
Describe pneumatic system reliability issues including pressure gage readings, conductors, connectors, seals, gaskets, packing, quick-connect fittings, pneumatic cylinder and motor operations, air muffler operations, actuator power output, and pressure regulator operations

Comments:
Unit 10: Maintenance, Installation, and Repair Pathway
Industrial Equipment- Advanced

Competency
8. Maintain and repair mechanical drive system components

Performance Standard Condition
Competence will be demonstrated at the worksite

Performance Standard Criteria
Performance will be successful when learners:

- Assist worksite profession to identify and diagnose equipment problem
- Interpret schematics for mechanical drive systems

Perform safety checks
- Maintain and repair mechanical drives systems
  - Check pulley and belts for tension, wear and damage
  - Mount new pulleys to shafts if required
  - Maintain, install, align, and adjust tension on a belt drive
  - Clean, install, and align gear drives
  - Maintain, install, align, and adjust tension a chain and sprocket drive
  - Install and align couplings
  - Check and corrects motor mounting for soft foot condition, angular and groove alignment
  - Apply lubrication to mechanical drive system according to specifications
  - Remove foreign debris from cooling towers
  - Replace air filters

Document mechanical drive system maintenance

Learning Objectives
- Locate the major components of a mechanical drive system including v-belts, pulleys and chain drives
- Distinguish between various kinds of mechanical power transmissions
- Recognize reliability issues for belt and chain drives
- Determine proper belt deflection force required for tension

Comments:
Unit 10: Maintenance, Installation, and Repair Pathway
Industrial Equipment- Advanced

Competency
9. Maintain and repair electrical control system components

Performance Standard Condition
Competence will be demonstrated
at the worksite

Performance Standard Criteria
Performance will be successful when learners:
Assist worksite profession to identify and diagnose equipment problem
Interpret schematics for electrical control systems

Perform safety checks
Maintain and repair electrical control systems
  o Replace faulty lighting components
  o Replace blown fuse or tripped circuit breaker
  o Construct common control circuits using switches and relays
  o Assist to adjust, repair or replace faulty circuit components
  o Assist to install conduit and wiring
Document electrical control system maintenance

Learning Objectives
Describe special safety precautions needed when working with electrical components
Explain ground requirements
Compare lamp wattage, lumens, size and types of lighting and fixtures
Compare wire size and types
Compare conduit size and types
Determine bend radius and location
Describe how to assemble a wire bundle
Explain how to connect wires to termination points

Comments:
Unit 10: Maintenance, Installation, and Repair Pathway
Industrial Equipment- Advanced

Competency

10. Maintain and repair hydraulic and/or pneumatic system components

Performance Standard Condition

**Competence will be demonstrated**
at the worksite

Performance Standard Criteria

**Performance will be successful when learners:**

- Assist worksite profession to *identify and diagnose equipment problem*
- Interpret schematics for hydraulic and/or pneumatic systems

**Perform safety checks**

- Maintain and repair hydraulic and/or pneumatic systems
  - Measure and adjust relief, unloading, and pressure control valves for proper pressure
  - Measure and adjust flow controls for proper rates
  - Check for system leaks

**HYDRALICS**

  - Draw sample of hydraulic fluid for analysis
  - Test hydraulic fluids for contamination and viscosity
  - Drain hydraulic fluids if required
  - Fill reservoir with correct hydraulic fluid
  - Use procedures to avoid fluid contamination
  - Clean inlet strainer and filters if required
  - Check hydraulic power unit for proper performance
  - Inspect and replaces seals and gaskets if required
  - Inspect and replaces hoses, tubing and fittings if required
  - Check operation of control valves and cylinders and replace if required

**PNEUMATICS**

  - Measure and adjust pressure regulators and in-line filters and replace if required
  - Check and repair lines for air leaks
  - Check and manually operate all safety valves
  - Check air dryer for proper operation
  - Check operation of control valves and cylinders and replaces if required
  - Align piston (rod) of pneumatic cylinder
  - Check operation of water separator/drain as necessary
  - Drain receiver tanks
  - Drain and blow out mains and header pipes
  - Inspect and fill air lubricators

- Document hydraulic and/or pneumatic system maintenance

Learning Objectives

- Interpret hydraulic schematics
- Interpret pneumatic schematics
Differentiate between seals, packings, and gaskets on hydraulic systems
Identify hydraulic components, fittings (threads and types) and lines
Describe the use of different types of pneumatic conductors and connectors for a given system

Comments:
Unit 10: Maintenance, Installation, and Repair Pathway
Industrial Equipment- Advanced

Competency
11. Assist to install and qualify equipment

Performance Standard Condition
Competence will be demonstrated
at the worksite
while assisting a worksite professional

Performance Standard Criteria
Performance will be successful when learners:
- Identify and evaluate required technical, environmental, safety and performance features of equipment needed
- Verify final selection of equipment from qualified vendor
- Obtain manufacturer's recommendations for installation site requirements
- Check the equipment operation site for the fulfillment of the manufacturer's recommendations
  - Utilities such as electricity, water and gases
  - Environmental conditions such as humidity, temperature, vibration level and dust
  - Space for the equipment, related SOPs, operating manuals, logbooks and any software
- Receive equipment and check for damage
- Install equipment according to manufacturer recommendations
  - Level and fasten installed equipment as required
  - Test and validate the equipment operationally for all types of applications, stresses, and routine operation
  - If equipment is customized or adjusted, test and validate for specific changes made
- Determine performance start up qualification (criteria, procedures, critical parameters, test intervals) and sample analysis for each run or use
- Determine cleaning, preventive maintenance (PM), routine servicing and authorized repair engineers
- Update maintenance schedules with new equipment PM and servicing
- Document qualification and installation such as initial calibration, initial operational testing, quality control procedures and parameters, customization and testing, determination of maintenance and servicing, list of authorized service engineers, etc.

Learning Objectives
- Define the following components of equipment qualification: design qualification, installation qualification, operational qualification, performance qualification, maintenance qualification
- Explain the role of the vendor and the role of the user in all phases of equipment qualification
- List examples of technical, environmental and safety factors that need to be considered when purchasing industrial equipment
- Describe the vendor qualification process
- Distinguish between initial operational qualification of equipment and routine performance qualification
Describe the impact of Total Quality Management (TQM) principles and ISO9000 certification on equipment qualification

Explain the purpose of data collection and analysis to qualify equipment

Identify statistical tools used in performance qualification

Identify methods of inspecting materials, processes, and final products in qualifying equipment

Explain the purpose of documentation and record keeping for equipment qualification

Explain the importance of testing and documenting customized or adjusted equipment

Comments: