Appendix L

MANUFACTURING
YOUTH APPRENTICESHIP

PRODUCTION PATHWAY
MANUFACTURING PROCESSES (UNIT 5)
Unit 5: Production Pathway
Manufacturing Processes

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 symbols and procedures

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 5: Production Pathway
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Competency

2. Interpret 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 production process 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:
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Competency
3. Identify set up

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 production processing
- Plan sequencing, tools, and equipment needed for procedure
- Identify set up needed
- Consult with worksite professional to verify production schedule, deadlines, and timeframes

Learning Objectives
- Describe how a processing plan is developed from a technical drawing for process, equipment, tools, and holders
- Explain how product design and production are related
- Identify terminology related to production
- List characteristics of major types of production systems
- Compare and contrast conventional production processes with automated production processes to produce a piece

Comments:
Unit 5: Production Pathway
Manufacturing Processes

Competency
4. Select tools and materials

Performance Standard Condition
  Competence will be demonstrated
  at the worksite

Performance Standard Criteria
  Performance will be successful when learners:
  - Select tools and production equipment to be used
  - Select appropriate work holding devices for work piece and equipment
  - Check raw materials needed against work order
  - Verify raw material(s) meet specifications
  - Gather all resources needed at the workstation
  - Notify worksite professional of any discrepancies

Learning Objectives
  - List the various tools and equipment used in production at your worksite
  - Outline applications of each tool and equipment
  - Describe and demonstrate the safety requirements and safeguards for each tool and equipment
  - Explain the importance of materials meeting specifications prior to processing
  - Identify, name, and explain the function of each specific control on equipment you operate
  - List typical work holding devices for each equipment type you use
  - Compare and contrast the different methods used in your process. For example, the different methods of casting

Comments:
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Competency

5. Perform safety checks

Performance Standard Condition

Competence will be demonstrated
at the worksite

Performance Standard Criteria

Performance will be successful when learners:

- Review production procedure to be used
- Review safety requirements of procedure
- Verify safety equipment and any Personal Protective Equipment (PPE) needed for production process
- Inspect tools and work area for safety considerations
- Examine equipment labeling and safeguarding

Learning Objectives

- 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
- List the situations which require you to obtain help to resolve problems with equipment or production
- List the safety rule for the equipment you will be operating

Comments:
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Competency

6. Assist to perform set up

Performance Standard Condition

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

Performance Standard Criteria

Performance will be successful when learners:
Assemble and adjust tools and production equipment as required
Verify production equipment is available for use and in working order
Verify production equipment is current for preventative maintenance and/or calibration
Calculate any control settings needed
Check equipment fluid, air, pressure levels as required
Set production equipment parameters as required for the procedure
Install work holding devices so they are secure
Stage pieces and raw materials for production

Learning Objectives
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
Explain the purpose and importance of preventative maintenance and calibration
List the situations which require you to obtain help to resolve problems with equipment or production
Identify the major components of equipment used in your production process and their functions
Identify variables that impact equipment settings

Comments:
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Competency

7. Verify set up

Performance Standard Condition

Competence will be demonstrated

at the worksite

Performance Standard Criteria

Performance will be successful when learners:

- Verify set up meets process requirements and product specifications
- Examine first piece/product or production run for visual and/or dimensional specification
- Make adjustments to ensure piece/product meets specification if needed
- Verify repeatability of set up if applicable
- Document set up procedure for repeatability if applicable
- Document set up procedure if required

Learning Objectives

- Define repeatability
- Describe the importance of repeatability in manufacturing

Comments:
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Competency

8. Perform start up

Performance Standard Condition

Competence will be demonstrated at the worksite

Performance Standard Criteria

Performance will be successful when learners:

Verify correct set up of equipment adjustments
Inspect piece/product
Document start up procedure

Learning Objectives

Describe the production process procedure to be completed
List the situations which require you to obtain help to resolve problems with equipment or production

Comments:
Unit 5: Production Pathway  
Manufacturing Processes

Competency  
9. Operate equipment

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

Performance Standard Criteria  
**Performance will be successful when learners:**
- Wear the required Personal Protective Equipment (PPE) at all times as required for the operation of the equipment
- Cycle equipment
- Operate equipment safely in the manner required for the job task
- Operate equipment according to machine requirements
  - *Monitor equipment for correct operation* while operating

Learning Objectives  
- Describe advantages and limitations of automated production
- List the safety rules associated with automated production systems
- List the situations which require you to obtain help to resolve problems with equipment or production
- Identify how your production process is used to make pieces and products
- Describe the techniques required to produce the piece to specified tolerance

Comments:
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Competency
10. Monitor product and process specifications

Performance Standard Condition
Competence will be demonstrated at the worksite

Performance Standard Criteria
Performance will be successful when learners:
- Monitor piece/product produced for specification
- Monitor the process and equipment for performance
- Adjust the process for quality and/or productivity as needed
- Take corrective actions to resolve problems as they occur
- Replenish processing materials as needed
- Test piece/product for function
- Label pieces/products for compliance or non-compliance
- Document quality control checks
- Pieces are produced to specification

Learning Objectives
- List the quality checks performed as part of the production process
- Explain why products are tested for quality and function
- List the situations which require you to obtain help to resolve problems with equipment or production
- Explain why labeling and documentation are part of the quality check

Comments:
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Competency

11. Process production documents

Performance Standard Condition

Competence will be demonstrated at the worksite

Performance Standard Criteria

Performance will be successful when learners:
- Document processing data on items such as labor, quality, quantity, and time
- Verify fabrication and production documentation is completed
- Documentation is legible
- Documentation is complete
- Documentation is in appropriate format
- Documentation is stored or forwarded as required
- Pieces are correctly stored or staged

Learning Objectives
- Describe the uses of production data
- Describe the importance of documenting the production process

Comments:
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Competency

12. Shutdown process

Performance Standard Condition

Competence will be demonstrated at the worksite

Performance Standard Criteria

Performance will be successful when learners:
- Review procedure to be used
- Stop production process
- Verify all equipment is shut down safely as required
- Identify any process or equipment maintenance concerns with the production run
- Take corrective action to report and correct maintenance concerns

Learning Objectives
- Describe the shutdown procedures used for the specific production equipment you operate

Comments:
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Competency
13. Clean up

Performance Standard Condition
Competence will be demonstrated
at the worksite

Performance Standard Criteria
Performance will be successful when learners:
- Select appropriate cleaning tools and equipment
- Clean production tools/equipment as required
- Clean work area as required
- Store tools safely in proper location
- Store materials in safe manner
- Identify unsafe conditions and report them promptly
- Take corrective action to correct unsafe conditions
- Ensure that workstation is clean and clear of safety hazards
- Ensure workstation is organized for efficiency
- Dispose of waste appropriately as required

Learning Objectives
Describe the cleaning procedures and materials used for the specific processes you perform

Comments:
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Competency

14. 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
- Ensure that equipment is properly labeled and pulled from production use if inoperative
- Assist worksite professional to investigate abnormal equipment conditions in a timely manner
- Assist worksite professional to follow up on repaired equipment to ensure that corrective action solved the problem
- Document all monitoring activities

Learning Objectives

- Explain the meaning of common alarms on equipment at your facility
- Explain how to read and review repair history records
- Describe how trends for malfunctioning equipment might appear in production records
- List the tools and equipment at your facility that must be monitored and maintained
- Define Total Productive Maintenance (TPM)
- Describe common electrical systems reliability issues including power supply connections, operations, series and parallel circuit function, circuit breaker function, electric motor control, and power overload
- Describe common 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
- Describe common hydraulic system reliability issues including seals, gaskets, packing, and hydraulic fluids
- Describe common 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:
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Competency

15. Document equipment use and/or operational problems

Performance Standard Condition

Competence will be demonstrated
at the worksite

Performance Standard Criteria

Performance will be successful when learners:
- Verify all internal and external communication with appropriate parties in a timely manner
- Communicate maintenance and repair needs clearly
- Use the correct reporting formats for communication
- Document use, maintenance, and repair activities accurately
- Report back and document any maintenance and repair issues in a timely manner
- Maintenance communication is timely and accurate
- Maintenance communication is documented

Learning Objectives

- Explain the uses of equipment data
- 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

Comments:
ADDITIONAL Learning Objectives for Specific Production Processes

Casting
- Describe the casting process
- Compare the functions, advantages, disadvantages, and amorphous materials used for various mold components
- Differentiate between sand, metal, and plaster/ceramic mold casting processes
- Identify the function of the casting components
- Identify common terminology used in casting
- Interpret casting specifications on technical drawings
- Compare hot and cold chamber processes
- Determine the function of a die cast trim die
- Identify standard mold bases and brushing sets
- Identify runners, gates, and water lines that cool the mold

Conditioning
- Compare the functions, advantages, disadvantages, and materials used for different conditioning processes such as hardening, tempering, and annealing
- Explain the procedure for hardness testing
- Describe characteristics, advantages and limitations of furnaces and hardness testing equipment
- Identify common terminology used in conditioning
- Interpret conditioning specifications on technical drawings

Filling
- Compare the functions, advantages, disadvantages, and materials used for different filling processes

Finishing
- Compare different finishing (coating) techniques such as spraying, powder, roll, electro-coating, and dipping, and their applications
- Interpret finishing specifications on technical drawings
- Explain how finishes are used to improve the look and performance of engineering materials

Forming
- Compare the functions, components, advantages, disadvantages, and materials used with different metal forming and die sets
- Identify pierce, form, draw, and progressive dies
- Compare shears, brake presses, and roll formers
- Calculate clearance and tonnage parameters
- Describe various stripping methods
- Distinguish between open die forging and closed die forging
- Describe die construction
- Compare casting and forging processes
- Identify common terminology used in forming and forging
- Interpret forming specifications on technical drawings
Joining/Combining
- Compare different joining methods such as sewing, gluing, nailing and welding
- Compare characteristics, advantages and limitations of welding, brazing, and soldering
- Compare functions, advantages, disadvantages, and materials used for different welding types
- Define how variables of such as current, voltage, polarity, arc length, speed, flux, flow rates, material, piece thickness, etc affect a weld
- Compare the functions, advantages, disadvantages, and materials used for different brazing/soldering types
- Interpret joining specifications on technical drawings

Molding
- Compare the functions, advantages, disadvantages, and materials used for various mold components
- Compare different molding techniques such as blown, injected, rotated, and vacuum-formed
- Consult mold setup information that accompanies installed mold
- Describe how set temperatures, pressures, position and timers affect the mold
- Identify common terminology used in molding
- Evaluate the characteristics, advantages and limitations of different types of thermo-plastics
- Interpret molding specifications on technical drawings
- Explain the importance of a parting line
- Define the functions of cavities and cores
- Describe the runner system
- Identify how a part is released from a mold
- Identify potential problems during the molding process

Separating
- Compare the functions, advantages, disadvantages, and materials used for different separating processes
- Interpret separating specifications on technical drawings