

Appendix M

MANUFACTURING YOUTH APPRENTICESHIP

PRODUCTION PATHWAY MACHINING (UNIT 6)

Unit 6: Production Pathway Machining

Competency

1. Read machining technical drawings & 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 machining instructions and specifications
- Interpret machining symbols & 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:

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Competency

2. Interpret machining symbols & 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 machining tasks
- 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 machining plan from a technical drawing which includes tools, equipment, speeds, feeds, fixtures & 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, & 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 machining process

Plan sequencing, tools, and equipment needed for machining process

Identify set up needed

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

Learning Objectives

Describe how a machining 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 machining

Compare and contrast conventional machining to automated machining

List characteristics of major types of machining systems

GRINDERS

- Describe conventional machining process characteristics, major components, advantages and limitations of grinding machines
- Describe automated machining process characteristics, major components, advantages and limitations of grinding machines
- Identify chip cutting theory and machineability
- Evaluate surface finish requirements and machineability of materials used at your facility
- Determine the importance of cutting fluids
- Identify types of cutting fluids and application methods
- Describe how to calculate pre-grinding tolerances

LATHES

- Describe automated machining process characteristics, major components, advantages and limitations of lathes and turning machines
- Identify chip cutting theory and machineability
- Evaluate surface finish requirements and machineability of materials used at your facility
- Determine the importance of cutting fluids
- Identify types of cutting fluids and application methods
- Describe different thread forms
- Identify and calculate general dimensions of a thread

MACHINE/MILLING CENTERS

- Describe automated machining process characteristics, major components, advantages and limitations of sawing, drilling, and milling machines
- Identify chip cutting theory and machineability

- Evaluate surface finish requirements and machineability of materials used at your facility
- Determine the importance of cutting fluids
- Identify types of cutting fluids and application methods

Comments:

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Competency

4. Select tools & materials

Performance Standard Condition

Competence will be demonstrated
at the worksite

Performance Standard Criteria

Performance will be successful when learners:

- Select tools and machining 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 common machining tools and equipment
- Identify, name and explain the function of common machining equipment
- List typical work holding devices for each machine type
- List advantages and disadvantages for various work holding devices
- Outline applications of each tool and equipment
- Describe and demonstrate the safety requirements and safeguards for common machining tools and equipment
- Explain the importance of materials meeting specifications prior to processing

GRINDERS

- Identify various types of grinders and their applications
- Describe the advantages and limitations of grinders
- Identify types of grinding wheels and their applications
- Compare bond and grit characteristics
- Interpret wheel marking systems
- Describe dust hazards

LATHES

- Identify the major types of lathes and turning machines and their applications
- Describe the advantages and limitations of lathes
- Compare various lathe tool bits and their functions
- Identify various styles of boring bars
- List typical work holding devices for each machine type
- List advantages and disadvantages for various work holding devices

MACHINE/MILLING CENTERS

- Identify major types of sawing machines, drill presses, and milling machines and their applications
- Describe advantages and limitations of sawing machines, drill presses and milling machines
- List typical work holding devices for each machine type
- List advantages and disadvantages for various work holding devices

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 machining procedure to be used
- Review safety requirements of procedure
- Verify safety equipment and any Personal Protective Equipment (PPE) needed for machining 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 rules for grinders, lathes and milling machines

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 machining equipment as required

Verify machining equipment is available for use and in working order

Verify machining equipment is current for preventative maintenance and/or calibration

Calculate any control settings needed

Check fluid, oil, air, pressure levels

Set machining equipment parameters, such as speed and feed rates, as required for the procedure

Install work holding devices so they are secure, aligned, and do not interfere with the machining

GRINDERS

- Mount, dress, and balance selected grinding wheel for the operation

LATHES

- Select appropriate tool bit and holder for lathe process (turning, facing, tapering, boring, etc)

Sharpen punches, drill bits, and chisels

Stage pieces and raw materials for machining

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

GRINDERS

- Identify the major components of grinders and their functions
- Explain the importance of why a grinding wheel must be dressed, rung and balanced
- Identify variables for grinder speeds and feeds
- Identify set ups and adjustments for grinders

LATHES

- Identify the major components of lathes and their functions
- Identify variables for speeds and feeds

MACHINE/MILLING CENTERS

- Identify the major components of sawing machines, drill presses, and milling machines and their functions
- Identify variables for speeds and feeds

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 machining 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 grinding, lathe, and milling processes

List the situations which require you to obtain help to resolve problems with equipment or production

Comments:

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Competency

9. Operate machining 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 machining 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 machining processes are used to make parts and products

Describe conventional machining processes

GRINDERS

- Describe the motions between pieces and grinders
- Describe the techniques required to grind a piece to specified tolerance

LATHES

- Describe the motions between pieces, drills and lathes
- Explain techniques required to product a piece to specification

MACHINE/MILLING CENTERS

- Describe the motions between pieces and saws, drills, and milling machines

Comments:

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Competency

10. Monitor machining product & process specifications

Performance Standard Condition

Competence will be demonstrated
at the worksite

Performance Standard Criteria

Performance will be successful when learners:

- Monitor piece/product machined for specification
- Monitor the machining 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
 - Pieces are ground to specified tolerances
 - Pieces show no sign of burn marks
 - Pieces are smooth and free of burrs

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 & 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 machining process

Comments:

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Competency

12. Shutdown machining 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 machining 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 reports 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. Use hand tools

Performance Standard Condition

Competence will be demonstrated
at the worksite

Performance Standard Criteria

Performance will be successful when learners:

Fabricate metal as needed using hand tools

- 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

Identify cutting and non-cutting hand tools

Compare basic tools and tool-holding devices

Distinguish between common hand tools including hammers, wrenches, pliers, punches, taps and dies, etc.

Comments:

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Competency

15. Use CNC 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:

Review plan sheet/work order for work holding devices, cutting tools, reference points, and machining sequence

Develop a CNC set-up plan with appropriate program codes and coordinates

Select a part holding method

Select a reference point from a technical drawing

Calculate appropriate speed and feed

Select cutting tools with correct speeds and feed

Identify program codes

Write &/or test CNC program

Set machine parameters

Edit program as needed

Monitor and adjust tool wear offset

Machine a piece utilizing CNC methods

Pieces meet specification

Learning Objectives

Compare the difference between manual and CNC machines

Explain the features of CNC machining and turning centers

Interpret the Cartesian coordinate system

Identify program codes

Compare and contrast characteristics, advantages and limitations of computerized machining vs. conventional and automatic machining processes including conventional EDM, wire EDM, CNC milling, and CNC turning machines

Identify CNC tooling and types of tool changes

Explain the use of 3 axis coordinate systems and the reference point for identification

Contrast open and closed loop systems

Describe G & M codes

Describe how part geometry is analyzed to select appropriate cutting tools and fixturing devices

Compare efficiency of machining for large production runs

Comments:

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Competency

16. 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 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 & 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

17. Document equipment use &/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: