MANUFACTURING SKILL STANDARDS COUNCIL

"Certifying the Industrial Athlete of the Future"

Production Standards

2020 "Industry 4.0" Edition

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Background

The Manufacturing Skill Standards Council (MSSC) was officially recognized by the federal National Skill Standards Board (NSSB) in 1998 as the "Voluntary Partnership" for Manufacturing under the bipartisan National Skill Standards Act of 1994. MSSC was mandated to establish the industry-defined core skill standards and certifications needed for production technicians within all sectors of manufacturing.

For this purpose, MSSC assembled in 1998-2001 one of the largest coalitions in U.S. workforce education history: 234 leading corporations and trade associations, 378 Career-Tech Ed (CTE) schools and the leading industrial unions collaborated in developing the standards, which were then validated nationwide with representative cross section of companies. an additional 300 companies and 4,000 frontline workers. The NSSB formally approved the MSSC Production Standards, which formed the substantive foundation for the MSSC's signature Certified Production Technician (CPT) training and certification system.

To ensure that its standards remain current with industry best practice and technological change, MSSC updates them every 2-3 years with industry subject matter experts. In the 2019 review of these standards for this 2020 Edition, MSSC formed a Select Committee (SC) on Emerging Manufacturing Process Technologies to choose and define a set of newly emerging "Industry 4.0" technologies for inclusion in the standards. Those technologies are 5G, Artificial Intelligence (AI), Autonomous Robots, Additive (3D), Data Analytics, Industrial Internet of Things (IIOT), Augmented Reality, Nanomanufacturing, Advanced Materials.

MSSC's Work Standards are those used for CPT Assessments since they define the Key Activities and related Performance Indicators in which MSSC CPT Certificants need to demonstrate competency. The Production Standards are organized around five key activity areas.

- ***Safety***
- ***Quality Practices and Measurement***
- ***Manufacturing Processes and Production***
- ***Maintenance Awareness***
- ***Green Production****

*Green Production is not required for full-CPT® certification.

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MSSC WORK STANDARDS

Safety

Key Activities and Performance Indicators

1. Work in a Safe and Productive Manufacturing Workplace

a. Recognize systems of safety used by high-performance manufacturers and integrate in safety systems in all work
b. Explain responsibilities of a frontline production worker in a high-performance, safety-conscious work organization
c. Define OSHA and other health and safety requirements as applied to the workplace
d. Identify the role of production workers in helping to ensure competitive levels of cost, quality and delivery in a safe work environment
e. Identify external and internal customers
f. Identify common safety practices and systems
g. Explain workplace codes of conduct and responsibilities for ethical and responsible behavior in all work activities
h. Recognize ways in which industry 4.0 technologies impact manufacturing

2. Perform safety and environmental assessments

a. Identify, report and monitor potential hazards in the workplace
b. Take corrective action to eliminate potential hazards
c. Review health, safety and environmental documentation and policies
d. Locate and use Safety Data Sheets (SDS)
e. Ensure that inspections meet all relevant health, safety and environmental laws and regulations
f. Develop safety checklists
g. Perform inspections according to company schedule and procedures
h. Document inspections
i. Store inspection records correctly

3. Perform emergency drills and participate in emergency teams

a. Ensure that training and certification on relevant emergency and first aid procedures are complete and up to date
b. Follow company and regulatory procedures for responding to fire, medical, and electrical emergencies
c. Ensure that emergency response complies with company and regulatory policies and procedures
d. Document emergency drills and incidents according to company and regulatory procedures

4. Identify unsafe conditions and take corrective action

a. Identify, report and document conditions that present a threat to health, safety and the environment
b. Describe ergonomic impact of work techniques
c. Identify corrective actions
d. Consult appropriate parties about corrective actions
e. Take corrective actions according to company procedures
f. Track and report ongoing safety concerns until corrective action is taken

5. Participate in safety training

a. Follow orientation that covers all topics and procedures needed to facilitate employee safety
b. Define health and safety education requirements
c. Follow orientation that identifies needs and processes to raise safety concerns, ask questions and receive additional training
d. Receive orientation on use of personal protective equipment
e. Describe lock out/tag out requirements
f. Document orientation according to company requirements
g. Follow safety orientation for relevant laws, policies and regulations
h. Participate in regular safety training

6. Participate in equipment safety training

a. Receive complete orientation to equipment and guidelines for ergonomic safety
b. Communicate all important information regarding equipment safety, including material handling equipment
c. Make suggestions regarding training materials and content to the correct parties
d. Provide evaluations and feedback to improve training materials and methods
e. Ensure trainee has the correct tools to do the job during training
f. Ensure that workers can operate equipment safely through post-training evaluation
g. Ensure that training and facilitation techniques used are appropriate for trainees
h. Document quality and effectiveness of training
i. Describe robot safety guidelines
j. Describe types and use of automation safety devices

7. Suggest processes and procedures that support safety of work environment

a. Consult health and safety representatives in the development of suggestions
b. Provide operator feedback to create a safer, more effective work environment
c. Make suggestions to correct parties, according to company procedure
d. Communicate customer needs effectively to others including shift-to-shift, co-workers and managers, including needs that impact safety
e. Describe what appropriate cross-training benefits
f. Ensure that content of suggestions responds to safety, quality and productivity issues

8. Fulfill safety and health requirements for maintenance, installation and repair

a. Participate in regular safety communications
b. Participate in job safety analyses regularly according to company policy
c. Follow hazardous materials procedures and policies, such as Safety Data Sheets (SDS) and right-to-know
d. Perform environmental testing of workplace on a regular basis as required by company policy and regulation
e. Audit equipment to ensure there are no by-passes of safety guards
f. Follow all regulatory and company safety procedures, including those related to lock-out/tag-out, confined space, arc flash awareness, and ergonomics
g. Follow good housekeeping procedures

9. Monitor safe equipment and operator performance

a. Perform regular monitoring
b. Report out-of-compliance or unsafe conditions immediately
c. Take corrective action on out-of-compliance or unsafe conditions
d. Check equipment to ensure it is operating according to safety specifications
e. Check tools to ensure they are in compliance with safety specifications
f. Forward accident and injury data to appropriate personnel for inclusion in OSHA recordables
g. Gather information on equipment use from operators to reveal existing or potential safety problems
h. Document all safety monitoring data

10. Utilize effective, safety-enhancing workplace practices

a. Communicate clearly
b. Describe ways to improve reading, listening and writing skills
c. Explain different forms of communication, such as e-mail, fax and phone
d. Participate in work teams
e. Make production job assignments
f. Run training programs efficiently
g. Follows company code of good conduct

MSSC Worker Standards

SAFETY

Basic Technical Core Competencies

1. Safe and Productive Workplace

1. Recognize ways in which manufacturing affects the national economy and standard of living
2. Define ways in which the global economy affects manufacturers
3. Define major sub-industries within manufacturing
4. Identify common safety practices and systems
5. Explain responsibilities of a frontline production worker in a high-performance, safety-conscious work organization
6. Recognize different and common needs of internal and external customers
7. Maintain customer contact about product specifications and printed specs to ensure understanding of needs, including those related to safety

2. Safety procedures

1. Locate and use Safety Data Sheets (SDS)
2. Identify company first aid or first response procedures
3. Describe material handling techniques to safely move materials
4. Respond proactively to a safety concern and document occurrences
5. Locate emergency exits
6. Describe various emergency alarms and procedures
7. Explain clean-up procedures for spills
8. Describe lock out/tag out requirements
9. Inspect work area and report possible safety risks
10. Define machinery and equipment safety functions to determine if all safeguards are operational
11. Explain safety procedures in case of smoke or chemical inhalation
12. Follow procedures for handling hazardous material
13. Develop safety checklists
14. Follow equipment shutdown procedures
15. Perform leak checks to determine if toxic or hazardous material is escaping from a piece of equipment
16. Explain proper and safe installation techniques as described in manuals, checklists and regulations
17. Define an electrically safe work condition

3. Personal Safety Practices

1. Identify and report unsafe conditions
2. Select and use proper personal protective equipment
3. Describe ergonomic impact of work techniques
4. Use proper techniques for lifting loads
5. Describe safety requirements for platforms, man lifts and ladders
6. Define safety requirements for material handling equipment such as forklifts, cranes, rigging and pry trucks
7. Define safety requirements for manual, electrical-powered and pneumatic tools
8. Define safety requirements for operation of automated machines/processes

4. Safety Policies and Regulations

1. Follow basic filing procedures to properly store inspection records
2. Describe safety requirements and environmental regulations related to performing inspections
3. Define policies and procedures needed to perform audits and train employees about hazardous conditions
4. Explain company safety standards for handling potential hazards
5. Store, identify and use hazardous materials and pressurized vessels safely
6. Define OSHA and other health and safety requirements as applied to the workplace
7. Describe government policies, procedures and regulations governing the safe use of equipment
8. Follow procedures to prevent or reduce emissions and spills
9. Define Hazardous Materials (HAZMAT) procedure information
10. Describe the Globally Harmonized System of Classification and Labelling of Chemicals (GHS)
11. Define Safety Data Sheets (SDS)
12. Define applicable safety standards
13. Identify which tools and equipment require safety certification
14. Explain what the law requires companies to post or publish in order to keep employees abreast of OSHA and other government regulations
15. Define EPA required documentation for disposal of hazardous waste generated during maintenance or transportation of contaminated items
16. Explain accident documentation procedures

5. Safety-related Maintenance Procedures

1. Explain equipment operation and design parameters to determine if machine is operating safely
2. Review environmental data systems in the factory
3. Make adjustments to equipment to ensure that it is operating within established safety and environmental parameters
4. Monitor equipment for unsafe conditions

6. Safety Training

1. Develop and/or deliver safety training per guidelines
2. Define health and safety education requirements
3. Identify safety training courses
4. Use equipment manuals and standard practice manuals to repair equipment safely
5. Explain certifications needed for regulatory compliance (i.e., Cardio Pulmonary Resuscitation (CPR), fire extinguisher, and blood-borne pathogens)
6. Conduct equipment safety demonstrations
7. Train other workers in proper safety procedures during maintenance process
8. Use the tools and materials needed to operate equipment to train others
9. Use monthly safety meetings to improve the safety environment and communicate changes in regulations

7. Communication Skills that Enhance Safety

1. Describe ways to improve reading, listening and writing skills
2. Define techniques for making effective presentations to internal and external customers, including safety orientations
3. Use different forms of communication, such as e-mail, fax and phone
4. Provide effective feedback and make suggestions

5. Communicate customer needs effectively to others including shift-to-shift, co-workers and managers, including needs that impact safety.

8. Teamwork skills that Enhance Safety

1. Describe the characteristics of a high-performance team
2. Describe roles and responsibilities of production team members
3. Use teamwork to deal with customer requests
4. Align team goals to customer and business production needs
5. Ensure that team goals are specific, documented, measurable and achievable
6. Communicate production information to team members
7. Use team problem-solving and conflict resolution processes
8. Explain workplace codes of conduct and responsibilities for ethical and responsible behavior in all work activities

9. Training skills that Enhance Safety

1. Explain how training needs are assessed regularly to identify new requirements and training issues
2. Conduct training in an effective and appropriate manner to achieve training goals
3. Ensure training materials are documented and available
4. Ensure training is relevant to equipment, tools, materials and processes at the workstation
5. Provide appropriate cross-training
6. Ensure that training documentation is accurate and current and meets all company and regulatory requirements

MSSC Work Standards

QUALITY PRACTICES & MEASUREMENT

Key Activities and Performance Indicators

1. Participate in periodic or statistically based internal quality audit activities

a. Describe the use and benefits of Statistical Process Control (SPC), Six Sigma, Total Quality Management (TQM), Lean Management, "Plan-Do-Check-Act" and the requirements of the International Organization of Standardization standards, especially ISO 9001 for manufacturers
b. Describe documentation process and requirements to ensure verifiable evidence of product quality
c. Ensure audit data are relevant and correct
d. Complete all relevant audit forms and forward to proper parties in a timely manner
e. Assess and document conformances to quality standards
f. Include observation of operation in audit to ensure process and product meet specifications, when appropriate
g. Participate in audits in accordance with company and other required schedules and procedures
h. Participate in ongoing audits to optimize the outcomes of corrective actions

2. Check and document calibration of gauges and other data collection equipment

a. Describe inspection equipment calibration standards and requirements
b. Follow calibration schedule according to specifications
c. Check instrument certification by reviewing documentation and observing during use
d. Recalibrate instruments out of calibration or refer to appropriate parties for recalibration repairs

3. Suggest continuous improvements

a. Explain concepts of Lean Manufacturing
b. Describe Total Quality Management (TQM)
c. Recognize potential improvements through observation and data analysis
d. Include measurable and data-driven benefits to the company, customers and employees in suggestions
e. Describe roles and responsibilities for quality in an organization
f. Make suggestions according to proper procedures and documentation
g. Review all relevant data before making suggestions

4. Inspect materials and product/process at all stages to ensure they meet specifications

a. Perform sampling and inspection according to schedule and procedures
b. Select and use correct inspection tools and procedures
c. Verify calibration of testing equipment
d. Inspect materials against specifications
e. Identify products, processes and materials that do not meet specifications
f. Verify implementation of corrective actions through spot-checks
g. Document and report inspection results to correct parties

5. Document the results of quality tests

a. Check data forms to ensure that they are complete and accurate
b. Evaluate and interpret information
c. Identify and report inaccuracies in quality data and develop responses to correct them
d. Forward data to correct parties
e. Select and use correct analytical tools, including statistical process controls (SPC)
f. Store reports for the specified time frames

6. Communicate quality problems

a. Explain the importance of knowing when to stop process to prevent production of defective product
b. Review quality problems with production operators and supervisors
c. Communicate quality problems to appropriate parties
d. Document quality problems according to established processes
e. Summarize and report defect trends to appropriate parties
f. Explain follow-up and reporting documentation procedures to ensure proper communications

7. Take corrective actions to restore or maintain quality

a. Identify appropriate corrective actions and obtain approvals when needed
b. Make clear, concise, data-supported recommendations for action
c. Make recommendations to the appropriate parties
d. Make adjustments in a timely manner to eliminate deviations and bring process back into control
e. Document adjustments and follow-up product quality checks in correct format
f. Implement corrective action/quality improvements in standardized manner

8. Record process outcomes and trends

a. Describe the use of statistical quality tools (e.g., Root Cause Failure Analyses and Pareto charts) to reach accurate decisions about quality data
b. Maintain records on quality processes
c. Chart outcomes of quality processes according to appropriate methods and standards
d. Report quality process performance data to appropriate parties in a timely manner
e. Examine previous documentation on similar process issues to identify possible solutions

9. Identify fundamentals of blueprint reading

a. Identify product features from a multi-view drawing
b. Identify dimensions and tolerances of an object from a multi-view drawing
c. Visualize objects from a multi-view drawing
d. Read and interpret dimensions of an object in a technical drawing
e. Identify geometric dimensioning and assembly tolerances on a drawing
f. Recognize functions of sectional drawings
g. Interpret assembly drawings

10. Use common measurement systems and precision measurement tools

a. Use and convert U.S. measurement and standard international metric systems
b. Measure parts using a machinist's rule and tape measure

c. Measure parts using a dial and digital calipers
d. Measure parts using a digital or Vernier micrometer
e. Measure parts using a dial indicator
f. Measure data from a digital gauge using a computer

MSSC Worker Standards

QUALITY PRACTICES AND MEASURMENT

Basic Technical Core Competencies

1. Overall Quality Process

1. Describe quality standards and how they apply to products to make effective decisions about quality problems
2. Explain quality procedures and product specifications to identify nonconformance
3. Describe roles and responsibilities for quality in an organization
4. Identify product defects and defect patterns
5. Check and test good products and non-conforming products
6. Describe corrective action methods for dealing with non-conformances to avoid future occurrences
7. Follow procedures for rejecting substandard products
8. Develop and document quality procedures, check lists and methods
9. Identify and report inaccuracies in quality data and develop responses to correct them
10. Define quality terminology
11. Explain company quality assurance procedures

2. Quality Systems and Inspection Tools

1. Define quality systems such as Statistical Process Control (SPC), Six Sigma, Total Quality Management (TQM), Lean Management, "Plan-Do-Check-Act" and the requirements of the International Organization of Standardization standards, especially ISO 9001 for manufacturers
2. Select and use quality systems to identify problems and record quality issues
3. Use statistical quality tools (e.g., Root Cause Failure Analyses and Pareto charts) to reach accurate decisions about quality data
4. Accurately troubleshoot and categorize defect types to determine root cause
5. Create control charts (e.g., variables and attributes)
6. Record and analyze quality issues in the production process, using tools such as Root Cause Failure Analyses (RCFA)
7. Use Pareto analysis to identify priorities for solving multiple sub –standard product problems
8. Determine accuracy and precision when using measuring equipment
9. Use performance indicators that can be readily understood by operators
10. Use inspection tools, equipment and procedures
11. Describe inspection equipment calibration standards and requirements
12. Verify calibration of inspection equipment
13. Use appropriate automated inspection system
14. Use hand-held inspection devices to examine materials
15. Properly maintain and store inspection tools

3. Corrective Action

1. Determine appropriate corrective action
2. Follow corrective action procedures to follow up on quality problems and corrective measures
3. Describe health and safety standards to ensure quality problems are addressed correctly without impairing health and safety
4. Conduct follow-up activities to validate that corrective action has been taken
5. Review historical documents to help develop solutions
6. Know when to stop process to prevent production of defective product
7. Tag and segregate non-conforming material
8. Investigate non-conformances (e.g., rejection tags) to determine root cause and recommend corrective action

4. Quality Documentation

1. Complete proper forms to document problems and corrective actions
2. Use computer systems to document and track substandard and scrapped parts, materials and assemblies as required by quality processes
3. Describe documentation process and requirements to ensure verifiable evidence of product quality
4. Follow quality system protocol for performing an audit
5. Follow procedure for reviewing quality problems with operators to provide feedback
6. Follow correct approval procedures to document inspection results
7. Follow procedures for recording and storing product history and maintaining records
8. Use route sheets and statistical method charts to document process
9. Explain follow-up and reporting documentation procedures to ensure proper communications

5. Blueprint Reading Fundamentals

1. Visualize objects from a multi-view drawing
2. Identify product features from a multi-view drawing
3. Identify dimensions and tolerances of an object from a multi-view drawing
4. Interpret geometric dimensioning and assembly tolerances on a drawing
5. Interpret of title or legend blocks
6. Interpret assembly drawings

6. Basic Measurement

1. Convert measurements in U.S. measurement and standard international metrics systems
2. Use a machinist's rule to measure parts
3. Use a tape measure to measure parts
4. Use dial and digital calipers to measure parts
5. Use a digital or Vernier micrometer to measure parts
6. Use a dial indicator to measure parts
7. Collect measurement data from a digital gauge using a computer

MSSC Work Standards

MANUFACTURING PROCESSES & PRODUCTION

Key Activities and Performance Indicators

1. Identify customer needs

a. Recognize the different and common needs of internal and external customers
b. Maintain customer contact about product aspects and printed specifications to ensure understanding of needs
c. Ensure customer specifications are up to date
d. Communicate customer needs to others including shift-to-shift, co-workers and managers
e. Address issues preventing customer needs from being met
f. Define principles and practice of Just-in-time (JIT) inventory control

2. Production Equipment Operation

a. Explain machinery operation, set up and testing
b. Describe emergency shutdown of production machines
c. Describe common types of mechanisms used in machines
d. Describe ways in which force and torque are used in machine operations
e. Explain impact of friction on machine operation and methods
f. Explain use of cams
g. Define ways in which machines use pulley and gear drives
h. Define basic machine tooling
i. Describe basic casting, molding and stamping processes
j. Describe computer numerically controlled (CNC) equipment
k. Describe Programable Logic Controllers (PLC)
l. Describe Human Machine Interface (HMI)
m. Describe lasers in relationship to production equipment

3. Determine resources available for the production process

a. Check raw materials against work orders
b. Check tools and equipment against work orders
c. Communicate discrepancies to the proper parties
d. Describe equipment capabilities to maximize productivity
e. Ensure that necessary resources are available at workstation
f. Schedule workers with appropriate skills according to production needs
g. Describe the basic operations of industrial robots
h. Describe Artificial Intelligence (AI)
i. Describe the use of Autonomous Robots
j. Describe Additive Manufacturing (AM) or 3D Printing
k. Describe Nanomanufacturing
l. Explain Mechatronics

4. Set up and verify equipment for the production process

a. Make proper repairs and adjustments to production equipment prior to putting into service
b. Ensure set-up meets process requirements and product specifications
c. Describe lubricants and coolants to make the proper selection
d. Set up, program and operate a computerized control process
e. Ensure first piece or production run meets specifications
f. Document set-up procedures to ensure repeatability
g. Ensure set-up meets ergonomic and other relevant health, safety and environmental standards
h. Ensure set up meets equipment specifications
i. Describe the operation of automation equipment
j. Describe Augmented Reality (AR)

5. Set team production goals

a. Describe principles of Lean Manufacturing and High-Performance Work Organizations
b. Set team goals that are specific, measurable, achievable, relevant and time-bound
c. Align team goals with customer and business needs
d. Ensure team goals focus the team in order to meet team objectives
e. Document team goals and communicate them to all parties

6. Make job assignments

a. Ensure job assignments match skills with the production work to be done
b. Ensure job assignments maximize the use of available skills
c. Ensure workers are notified of job assignments effectively

7. Coordinate workflow with team members and other work groups

a. Describe lead-time required for a production plan
b. Meet production schedules
c. Notify team members of schedule requirements in a timely manner
d. Ensure production workflow runs efficiently
e. Describe types of automated material handling equipment
f. Minimize downtime
g. Work with others to facilitate effective workflow
h. Participate in meetings and problem-solving groups

8. Communicate production and material requirements and product specifications

a. Ensure communication reflects knowledge of production requirements, levels and product specifications
b. Ensure communication reflects knowledge of material specifications and delivery issues and schedules
c. Ensure communication demonstrates knowledge of customer and business production needs
d. Describe various materials used in production
e. Describe Advanced Materials
f. Ensure communication is clear and relevant to production and products
g. Track and document communications, as appropriate

9. Perform, monitor and document the process to make the product

a. Describe Data Analytics

b. Monitor process control data to ensure that the manufacturing process is meeting product specifications
c. Ensure manufacturing process cycle time meets customer and business needs
d. Ensure product meets customer specifications
e. Label products appropriately for compliance **onion**-compliance
f. Perform production operations in a manner that fully complies with all health, safety, and environmental policies and practices
g. Describe the Industrial Internet of Things (IIOT)

10. Document product and process compliance with customer requirements

a. Complete documentation of compliance legibly
b. Write documentation of compliance in the appropriate format and store correctly
c. Forward documentation of compliance to the proper parties
d. Complete documentation and obtain "sign off"
e. Label products appropriately for compliance onion-compliance

11. Prepare final product for shipping or distribution

a. Ensure packaging materials meet packaging and shipping specifications, including proper labeling and safety requirements
b. Describe barcodes and their use
c. Ensure completed documentation of customer packaging and shipping instructions accompany product to next destination
d. Communicate product availability to the proper parties in a timely manner
e. Check product and all relevant information, such as quantity, destination and packaging instruction, against the work order
f. Store or stage product for shipping
g. Follow all laws and regulations with regard to labeling, packaging and transport
h. Follow material handling procedures to prevent product damage

MSSC Worker Standards

MANUFACTURING PROCESSES AND PRODUCTION

Basic Technical Core Competencies

1. Work Flow Planning and Control

1. Describe principles of Lean Manufacturing and High Performance Work Organizations
2. Make job assignments and coordinate workflow
3. Ensure appropriate resources are available to meet customer specifications
4. Ensure set-up and operation procedures are available and up-to-date
5. Read and interpret a production schedule and manufacturing work order
6. Explain production process, including flow and bottlenecks
7. Describe lead-time required for a production plan
8. Read and interpret bills of materials and routing sheets
9. Explain methods of productivity measurement and improvement
10. Define principles and practice of Just-in-time (JIT) inventory control
11. Perform a physical inventory

2. Production equipment operations

1. Start and operate production machines
2. Perform emergency shutdown of production machines
3. Recognize and address machine malfunctions
4. Describe common types of mechanisms used in machines
5. Describe ways in which force and torque are used in machine operations
6. Explain impact of friction on machine operation and methods
7. Explain use of cams
8. Define ways in which machines use pulley and gear drives
9. Describe which manufacturing processes are used to make and finish parts
10. Use basic types of manual machine tools, such as drill press and cutoff saw
11. Define basic machine tooling
12. Describe basic casting, molding and stamping processes
13. Describe basic direct digital and additive manufacturing
14. Define and use injury prevention safety devices on machines

3. Production Materials, Tools and Equipment

1. Describe various materials used in production
2. Explain machinery operation, set up and testing
3. Read and interpret gauges (i.e., analog, digital and vernier)
4. Determine whether additional tools need to be purchased
5. Describe lubricants and coolants to make the proper selection
6. Set up, program and operate computerized control process
7. Describe equipment capabilities to maximize productivity
8. Make machine adjustments
9. Order tools and materials

4. Work Orders and Documentation

1. Interpret work orders to meet customer needs
2. Review order sheets to determine if on-site adjustments are needed
3. Use diagrams and technical drawings
4. Interpret route sheets and operation sheets to set-up and operate machine
5. Complete compliance tag to indicate that the sub-assembly meets the customer requirements
6. Determine packing requirements based upon customer specifications
7. Determine packing requirements based upon available packing materials
8. Determine the safest method of shipping the product based upon available packing materials

MSSC Work Standards

MAINTENANCE AWARENESS

Key Activities and Performance Indicators

1. Perform preventive maintenance and routine repair

a. Explain principles of Total Productive Maintenance (TPM)
b. Monitor preventive maintenance schedule
c. Follow preventive maintenance schedule
d. Document preventive maintenance in a timely manner
e. Communicate repair needs to the correct parties using correct procedures and forms
f. Explain the most common causes of failure of equipment to diagnose problem quickly
g. Check any necessary repair work through follow up
h. Ensure necessary supplies are available to perform preventive maintenance
i. Communicate preventive maintenance schedules, documentation, equipment needs and outstanding repairs from shift-to-shift, to team members, to managers and to others as required
j. Follow all safety procedures when performing repairs
k. Recognize potential maintenance issues with robotics and machine automation systems, including vision, inputs/outputs, end-of-arm tool, sensors, cabling, conveyance

2. Monitor indicators to ensure correct operations

a. Compare current equipment performance to optimal equipment operations regularly
b. Explain what equipment alarms mean
c. Investigate abnormal equipment conditions
d. Correct abnormal equipment conditions in a timely manner
e. Monitor equipment to ensure that corrective action solved the problem
f. Describe the use of sensors with production equipment
g. Document equipment repair history
h. Explain the use of PC Ethernet

3. Perform all housekeeping to maintain production schedule

a. Store tools in proper locations and integrate a system for organizing spaces so work can be performed efficiently, effectively and safely (such as 5S or 6S)
b. Store materials in a safe manner
c. Identify and promptly report unsafe conditions
d. Take corrective action to address unsafe conditions
e. Ensure workstation is clean and clear of safety hazards
f. Pass scheduled housekeeping inspections
g. Organize workstation to maximize efficiency

4. Recognize potential maintenance issues with basic production systems, including knowledge of when to inform maintenance personnel about problems with:

a. Electrical systems
b. Pneumatic and vacuum systems

c. Hydraulic systems
d. Machine automation systems
e. Lubrication processes
f. Bearings and couplings
g. Belts and chain drives
h. Explain proper adjustment of chain sag, including knowledge of when to inform maintenance personnel
i. Variable Frequency Drives (VFD)
j. High vacuum systems
k. Laser systems

MSSC Worker Standards

MAINTENANCE AWARENESS

Basic Technical Core Competencies

1. Overall Maintenance Process

1. Explain principles of Total Productive Maintenance (TPM)
2. Describe what equipment is to be maintained and monitored
3. Troubleshoot to identify a problem with equipment
4. Follow preventive maintenance schedules
5. Define job specific guidelines or collective bargaining agreement that affect maintenance
6. Recognize significant wear and tear on equipment components
7. Follow procedures for logging repairs and work order requests
8. Explain the most common causes of failure of equipment to diagnose problem quickly
9. Explain what equipment alarms mean
10. Make on-process adjustments during production

2. Maintenance of Tools and Equipment

1. Describe materials management to know what is recyclable and what is not
2. Use appropriate maintenance tools to maintain machines
3. Use monitoring or diagnostic devices to find out when equipment is operating correctly

3. Documentation of Maintenance

1. Ensure that equipment is producing a quality product using statistical methods charts
2. Explain which forms and procedures to use for correctly documenting needs
3. Repair equipment using diagrams, schematics, manuals and specifications
4. Document repairs, replacement parts, problems and corrective actions to maintain log to determine patterns of operation
5. Review maintenance log/checklist to ensure that recommended preventative procedures are followed

4. Maintenance-related Safety

1. Verify machine safety through proper set-up
2. Explain safety procedures to prevent accidents
3. Know the certification/license requirements to operate specific equipment
4. Use and store hazardous materials and chemicals (e.g., compliance with SDS, EPA and DOT regulations)
5. Describe Lock out/Tag out policies and procedures
6. Visually inspect equipment to ensure safety compliance before operating
7. Identify and report unsafe work conditions
8. Define materials management to know what is recyclable and what is not

5. Potential maintenance issues with basic production systems

1. Define electrical systems reliability issues, including knowledge of when to inform maintenance personnel
2. Define pneumatic systems reliability issues, including knowledge of when to inform maintenance personnel
3. Define hydraulic systems reliability issues, including knowledge of when to inform maintenance personnel
4. Define machine automation systems reliability issues, including knowledge of when to inform maintenance personnel

6. Proper lubrication procedures

1. Take and analyze oil samples
2. Use correct lubricants for various types of equipment
3. Operate grease guns correctly for various types of lubrication
4. Store and dispose of lubricants safely
5. Monitor machine for coolant level and correct mixture

7. Bearings and coupling reliability

1. Explain proper functioning of mechanical power transmission equipment, including knowledge of when to inform maintenance personnel
2. Describe proper functioning of bearings and shafts, including knowledge of when to inform maintenance personnel
3. Explain proper functioning of couplings, including knowledge of when to inform maintenance personnel

8. Belt and chain drive reliability

1. Describe proper functioning of belt drive systems, including knowledge of when to inform maintenance personnel
2. Explain proper functioning of roller chain drive systems, including knowledge of when to inform maintenance personnel
3. Explain proper adjustment of chain sag, including knowledge of when to inform maintenance personnel

MSSC Work Standards

GREEN PRODUCTION

Key Activities and Performance Indicators

1. Train workers in environmental issues

a. Include basic characteristics of a "green" manufacturing environment, including new trends and their impact on production workers, the company and society in workforce training
b. Include the benefits of workplace environmental assurance programs to the worker, the company and society in workforce training
c. Participate in environmental training for employees both at time of hire and on a recurrent basis
d. Document required environmental training
e. Participate in environmental training courses regarding the latest technology advancements
f. Incorporate input from instructors and the results of course evaluations into routine updates of environmental training courses

2. Implement and promote environmental programs, projects, policies or procedures

a. Document regulatory compliance
b. Ensure company, local, state and federal environmental policies and procedures are communicated and posted as required
c. Identify and report practices inconsistent with established environmental policies and procedures
d. Report violations
e. Ensure materials supporting environmental assurance programs are written consistent with needs of the intended audience
f. Keep environmental assurance materials on file and readily accessible

3. Conduct environmental incident and hazard investigations

a. Investigate environmental incidents and hazards, including near misses
b. Document environmental investigation findings
c. Review all environmental investigations and audits and assign corrective actions
d. Check and implement prescribed actions to correct environmental problems

4. Conduct preventive environmental inspections

a. Identify, report and document conditions that present a threat to the environment
b. Identify, report and monitor potential environmental hazards in the work area
c. Take corrective action to eliminate potential hazards
d. Gather environmental documentation required from workers and ensure policies are followed
e. Ensure inspections and audits include all relevant and required environmental laws and regulations

5. Monitor environmental aspects at each stage of production

a. Environmental issues involved in production processes are recognized
b. Identify and monitor relevant environmentally significant aspects in the production process for each stage of production to determine whether practical environmental improvements can be made
c. Program equipment to control and monitor the environmental impact of production processes at each stage

d. Monitor environmental indicators and gauges according to established procedures and use computers and/or other instruments to inspect and analyze results
e. Monitor consumption and conservation of resources throughout the production process
f. Monitor environmentally impactful agents in the production process are to reduce environmental impact
g. Monitor and evaluate energy use, areas of energy waste and emissions leakage in industrial facilities and production processes
h. Identify and evaluate opportunities for enhancing energy-efficiency and reducing energy-related carbon emissions

6. Implement continuous improvement in environmental assurance practices

a. Prioritize and inspect root causes or problems according to established hierarchy
b. Maintain worker knowledge of policies and procedures for environmental issues
c. Participate in meetings with all relevant groups about environmental assurance programs and developments
d. Make suggestions to management for improvement in environmentally related practices

7. Use advanced materials in production to reduce weight and increase life

a. Use designated equipment to monitor, measure and handle advanced materials
b. Take and document measures to ensure cost-effective production line energy efficiency
c. Read and interpret instruments to ensure required controls, including Personal Protective Equipment (PPE)
d. Use environmental controls/levels required for production with advanced materials
e. Adhere to environmental and quality requirements of advanced materials
f. Handle advanced materials, surplus and waste according to established requirements to minimize waste
g. Identify opportunities to reduce materials and volume of waste

8. Reprocess materials by recycling and reuse throughout product life cycle to optimize waste reduction

a. Sort waste and used or rejected materials to determine which should go to re-cycling and which can be reused or repurposed inside the company
b. Place waste designated for recycling into prescribed containers
c. Coordinate recycling activities with contractors or other third-party representatives
d. Code and label materials designated for reuse or repurpose
e. Assess rejected products to determine whether the product should be repaired, reused or recycled
f. Break down rejected products when necessary for reuse, repurpose or recycling

MSSC Worker Standards

GREEN PRODUCTION

Basic Technical Core Competencies

1. Workforce Training

1. Describe costs and impact of environmental incidents and the value of training
2. Provide input into scheduling and conducting environmental training for frontline production workers and ensuring that evaluations, test results and certifications reflect training effectiveness
3. Document environmental training, including attendance records and job training profiles

2. Implementation and Promotion of Environmental Policies, Programs, Projects or Procedures

1. Define basic EPA, OSHA and other federal, state and local government regulations, reporting requirements and permit conditions related to manufacturing production and processes
2. Define company policies, programs and procedures related to environmental performance improvement including environment management systems (EMS)
3. Define company policies and procedures to ensure timely compliance, accurate, accessible and complete documentation
4. Communicate and advocate company environmental policies and procedures using multiple methods as provided, including visible posters, worker notifications and meetings
5. Prepare for environmental emergencies, including participating with emergency plan development team, ensuring compliance with those plans during an emergency, keeping emergency equipment in good order and participating in emergency drills on a regular basis

3. Environmental Incident and Hazard Investigations

1. Provide input into documenting findings to ensure that they are timely, accurate and include recommended corrective actions, including visual inspections
2. Conduct sensory (e.g., visual, auditory, olfactory, etc.) inspections of environmental incident hazard issues
3. Provide input to auditors to ensure that recommended corrective actions have been taken

4. Preventive Environmental Incident and Hazard Investigations

1. Identify and communicate conditions that could present an environmental threat
2. Define company policies and procedures for auditing compliance and non-compliance issues related to prevention
3. Explain EPA compliance assistance information for relevant manufacturing processes
4. Provide input into preventive investigations to ensure that they are timely, accurate and include recommended corrective actions

5. Monitoring of Environmental Aspects at Each Stage of Production

1. Describe production-related environmental impact, such as acids, batteries, chemicals, compressed gas, fluorescent lighting, paints & coatings, liquid waste streams, petroleum & oils, solvents, packaging, plastics, metallic wastes and rubber-based products
2. Analyze role of production-related environmental impact at each stage of production

3. Define resources used in production processes and the concepts of life-cycle assessment and gate-to- gate processes
4. Describe energy-efficient production processes such as the tradeoffs and energy use differences between Just-In-Time operations, lean manufacturing processes, batch processing and continuous vs. single shift operations
5. Explain energy auditing procedures and techniques and apply them to identify energy use, waste and emissions leakage
6. Define resources, methods and tools for reducing energy waste and emissions leakage and enhancing energy-efficiency in industrial facilities and in production processes, systems and equipment (in particular, motors, compressed air systems, data centers, steam systems, fan systems, process heating and pumping systems)
7. Explain carbon footprint concept and how it can be used to evaluate environmental impacts
8. Describe environmentally impactful agents
9. Describe fundamentals of "green" chemistry and its implications on current Safety Data Sheets (SDS)
10. Use proper environmental labeling

6. Continuous Improvement in Environmental Assurance Practices

1. Describe techniques for tracking resource use, environmental compliance and identifying environmental improvements
2. Participate in meetings with all relevant groups about company environmental assurance program
3. Form useful recommendations to management for continuous improvement
4. Explain worker responsibilities (including cost implications for the company) in effective implementation of environmental assurance programs
5. Define how ISO 14000 and Leadership in Energy and Environmental Design (LEED) outcomes impact environmental quality and energy use at both plant-wide and worker levels.

7. Energy Efficient Materials in Manufacturing Production Processes

1. Describe benefits of using advanced materials
2. Describe processes and equipment required to manufacture products out of advanced materials
3. Operate exposure control technology and Personal Protective Equipment (PPE) required to work with advanced materials
4. Contain unique environmental hazards associated with advanced materials
5. Define when to reuse, repurpose and/or recycle advanced materials in the production process
6. Describe traditional energy use and energy-efficiency measures in production processes
7. Explain impact of equipment usage during peak demand and its effects on energy use and production schedules

8. Material Re-processing

1. Use 4R's to organize: Refuse – Reduce – Reuse – Recycle
2. Describe origins of waste in production processes and the differences between energy/material optimization and waste minimization
3. Explain the goal of "zero landfill"
4. Describe different types of reprocessing
5. Follow procedures for sorting materials for recycling or reuse
6. Follow procedures for reusing materials within the company
7. Explain processes for determining whether the production workforce or an outside contractor should break down a given defective product for recycling or reuse