

MANUFACTURING SKILL STANDARDS COUNCIL

"Certifying the Industrial Athlete of the Future"



Standards Certified Automation Technician (CAT)

In collaboration with

Material Handling Industry - MHI



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Background

These Standards are the foundation for a Manufacturing Skill Standards Council (MSSC) certification and instructional program for Certified Automaton Technician (CAT). This industry standards-based certification for this new occupation is based upon a definition of "supply chain technician" developed by the National Center for Supply Chain Technology Education: *A person who installs, operates, supports, upgrades or maintains the automated material handling equipment and systems which support the supply chain.*

The certification system based on these Standards includes assessment development, assessments conducted at MSSC-authorized assessment centers, credentials, and registry. Instructional activities based on these Standards include eLearning, instructor authorization training, and an instructor's manual developed primarily by Amatrol.

Principal Participants:

- Manufacturing Skill Standards Council (MSSC) The national leader in developing the first-ever national certification for front-line material handling and distribution work through its MSSC-Certified Logistics Associate/Certified Logistics Technician (CLA/CLT) program. MSSC is also the only national certification body accredited by the American National Standards Institute (ANSI) under ISO quality standard 17025 (Personnel Certification) for both manufacturing and logistics.
- Material Handling Industry (MHI) The leading national, non-profit association representing the suppliers of material handling and logistics solutions.
- National Center for Supply Chain Technology Education (NCSCTE) Funded under a grant from the Advanced Technician Education program of the National Science Foundation, the National Center identifies and develops skills-based educational pathways, facilitates professional development, and disseminates educational materials to increase the number of skilled supply chain technicians.

CAT Work Standards are organized around three Critical Work Functions.

- 1. Maintaining Equipment/Systems
- 2. Installing, Modifying, Troubleshooting and Repairing Equipment/Systems
- 3. Installing, Modifying, Troubleshooting, and Repairing Basic Controllers and Networks

MSSC will issue an industry-recognized, nationally portable certification to individuals who achieve success by assessment in each of these three critical work functions and, in early 2020, a certification plus (CAT+) for those who also pass a hands-on assessment using a new training and assessment device being invented by Amatrol.

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CAT WORK Standards #1

MAINTAINING EQUIPMENT/SYSTEMS

Key Activities and Performance Indicators

1. Implement and Remove Equipment/System Safety Protocols

- a. Review policy and procedures for job assignment (i.e. safety manual)
- b. Implement communication with all affected parties (i.e. operator, floor supervisor)
- c. Acquire Personal Protective Equipment (PPE) and tools according to safety protocol
- d. Identify and secure energy sources, install lockout protective devices, and verify secure
- e. Comply with safety requirements/regulations and environmental regulations
- f. Identify, report and take corrective action on unsafe and out-of-compliance safety conditions
- g. If work is verified complete by observation, remove all safety equipment and communicate to all parties that machine can be brought back in to service
- h. Restore energy source (air, fluids, electricity, etc.), test machine, and then return to service
- i. Perform housekeeping.

2. Identify and operate major automated equipment/systems

- a. Identify and operate automated conveyer systems
- b. Identify and operate automated storage and retrieval systems
- c. Identify and operate automated packaging equipment
- d. Identify and operate control systems
- e. Identify and operate automated order fulfillment systems
- f. Identify and operate various types of scanning equipment

3. Monitor machine/system operation

- a. Establish a baseline of normal machine / system operating parameters
- b. Compare new data with established baseline
- c. Research manufacturers' recommended specifications (i.e. manual)
- d. Test drive system, control system, and energy source
- e. Compare theoretical output to actual application
- f. Apply data from comparison and apply to maintenance plan.

4. Ensure key parts and components are available in inventory

- a. Check parts inventory / stock
- b. Order parts as needed per diagnosis
- c. Participate in periodic inventory audits
- d. Enter part numbers into electronic tracking system, where applicable
- e. Search approved web sites for parts or tools as needed.

5. Implement preventive maintenance

- a. Receive work order from management
- b. Review instructions for maintenance of machine on work order
- c. Gather necessary support, tools, supplies, and PPE equipment
- d. Ensure test equipment and tools are properly calibrated and certified when applicable.

6. Perform preventive maintenance

a. Evaluate and inspect drive system (i.e. test for over current)

- b. Evaluate and inspect the air and lubrication system (i.e. replace air filter)
- c. Evaluate and inspect control system (i.e. visually inspect contactors)
- d. Replace necessary components according to protocol
- e. Reclaim, recycle or dispose of fluids, refrigerants, materials and waste
- f. Perform housekeeping
- g. Make basic adjustments to equipment to maintain performance
- h. Add fluids to maintain proper levels
- i. Test for functionality and safety; compare test results to baseline operating data.
- j. Complete all necessary paperwork / data entry to certify completion and maintain accountability

7. Establish monitoring and maintenance schedule for equipment/lubricant condition

- a. Establish and enter new maintenance protocol scheduling as needed
- b. Assist engineering staff with projects pertinent to the maintenance program
- c. Provide suggestions regarding maintenance steps and schedule for continuous improvements
- d. Modify specifications as needed to improve maintenance process

8. Safely use hand tools to maintain equipment

- a. Safely use hand tools to maintain equipment
- b. Select proper hand tool for given task
- c. Inspect hand tools
- d. Maintain hand tools

9. Communicate with co-workers to promote productivity

- a. Fill out maintenance and repair logs
- b. Communicate job-specific needs
- c. Suggest ways to improve equipment performance or prevent future equipment malfunction
- d. Promote teamwork and continuous improvement.

10. Perform technical and administrative duties

- a. Maintain manual and electronic records, databases and reports
- b. Obtain and maintain proficiency in current and new technologies
- c. Acquire and maintain industry certifications.

CAT WORKER Standards #1

MAINTAINING EQUIPMENT/SYSTEMS

Technical Knowledge and Skills

1. Implement and Remove Equipment/System Safety Protocols

- 1. Knowledge of machine energy sources
- 2. Knowledge of safety protocols and environmental regulations
- 3. Knowledge of machine housekeeping
- 4. Knowledge of Personal Protective Equipment (PPE) and its applications
- 5. Skill in reading and interpreting company safety manuals
- 6. Skill in selecting and using Personal Protective Equipment
- 7. Skill in performing lockout/tagout

2. Automated Supply Chain Equipment/Systems

- 1. Knowledge of conveyers: automated conveyers, automated conveyer systems components
- 2. Knowledge of storage and retrieval: automated storage & retrieval systems, automatic guided vehicles, robotics, pick-to-light systems, pick-to-voice systems
- 3. Knowledge of packaging: packaging equipment
- 4. Knowledge of control systems: programmable logic controllers (PLCs), real-time embedded microprocessor-based data acquisition and control systems, equipment network systems
- 5. Knowledge of ordering: automated order fulfillment systems
- 6. Knowledge of scanning: scanners, optics, encoders, radio frequency identification (RFID)

3. Machine Operation

- 1. Knowledge of hydraulic and pneumatic safety and PPE
- 2. Knowledge of mechanical safety and PPE
- 3. Knowledge of electrical safety and PPE
- 4. Knowledge of types of machine stop categories
- 5. Knowledge of types of safety interlocks
- 6. Knowledge of machine operation safety
- 7. Skill in starting up and shutting down an air compressor
- 8. Skill in starting up and shutting down a hydraulic power unit
- 9. Skill in starting up and shutting down an automated machine
- 10. Skill in operating and monitoring an automated machine
- 11. Skill in recognizing signs of machine malfunction

4. Machine Operation Measurement

- 1. Skill in converting dimensional measurements between Imperial and SI International system
- 2. Skill in calibrating and using dial and digital calipers to measure parts
- 3. Skill in calibrating and using a micrometer to measure parts
- 4. Skill in calibrating and using a dial indicator to measure parts
- 5. Skill in transferring measurement data from a digital gage to a computer

5. Machine Monitoring

- 1. Skill in using a pressure gage to take pressure readings
- 2. Skill in using a vacuum gage to take vacuum readings
- 3. Skill in using a flow meter to measure volumetric flow rate
- 4. Skill in using a tachometer to measure shaft speed
- 5. Skill in using a temperature gage to measure temperature
- 6. Skill in using an infrared thermometer to measure temperature
- 7. Skill in converting temperature measurements in between Fahrenheit and Celsius
- 8. Skill in converting pressure measurements in between psi and kPa

9. Skill in converting flow measurements in between lpm and gpm

6. Preventive Maintenance-Adjustments

- 1. Skill in using a relief valve to adjust system pressure in a hydraulic circuit
- 2. Skill in using a pressure reducing valve to adjust pressure in a hydraulic circuit
- 3. Skill in using a flow control valve to adjust actuator speed in a hydraulic circuit
- 4. Skill in using a flow control valve to adjust actuator speed in a pneumatic circuit
- 5. Skill in using a pressure regulator to adjust pressure in a pneumatic circuit
- 6. Skill in checking alignment of flexible couplings and shafts
- 7. Skill in checking alignment and tension single v-belt drives
- 8. Skill in checking alignment and tension single chain drives
- 9. Skill in checking adjustment and alignment of pillow block and flange bearings
- 10. Skill in checking motor and for soft foot
- 11. Skill in replacing, cleaning and adjusting barcode and RFID scanners
- 12. Skill in replacing adjusting barcode and RFID scanners
- 13. Skill in inspecting barcode labels
- 14. Skill in replacing and adjusting RFID components and tags
- 15. Skill in using a multimeter to take measurements of continuity, resistance, voltage, and current
- 16. Knowledge of basic hydraulic principles including flow, displacement, pressure, fluid power, Pascal's law, fluid friction, and vacuum.
- 17. Knowledge of operation of basic hydraulic components, including fixed displacement pumps, manual valves, relief valves, directional control valves, flow control valves, check valves, cylinders, motors, pressure gages, filters, pressure reducing valves.
- 18. Knowledge of basic pneumatic principles including Ideal gas law, pressurized air flow, Bernoulli's theorem, pressure, compressed air power, Pascal's law, fluid friction, and vacuum.
- 19. Knowledge of operation of basic pneumatic components, including air compressors, dryers, manual valves, directional control valves, flow control valves, check valves, cylinders, motors, rotary actuators, pressure gages, air pilot valves, filters, pressure regulator valves, vacuum cups, vacuum generators, and air reservoirs.
- 20. Knowledge of basic electrical principles including AC/DC electricity, Ohm's law, Kirchoff's law, power, voltage, current, resistance, capacitance, inductance, series and parallel circuits.
- 21. Knowledge of operation of basic electrical components, including fuses, circuit breakers, transformers, Ground fault circuit interrupters, switches, resistors, capacitors, inductors, batteries, single phase AC motors, DC motors, and 3-phase motors
- 22. Knowledge of operation of limit switches, pressure switches, liquid level switches
- 23. Knowledge of operation of electronic sensors: capacitive, inductive, photoelectric, Hall Effect, fiber optic, magnetic
- 24. Knowledge of operation of solenoid operated fluid power valves, electric brakes, reversing motor starters, overloads, and manual motor starters
- 25. Skill in using a potentiometer to adjust motor speed
- 26. Skill in adjusting the trip position of a limit switch, liquid level switch, and electronic sensor
- 27. Skill in using an HMI to make adjustments to process flow rate, speed, pressure, and temperature

7. Preventive Maintenance-Machine Service

- 1. Skill in inspecting and replacing pneumatic filters
- 2. Skill in inspecting and replacing hydraulic filters
- 3. Skill in inspecting oil levels and adding hydraulic oil to a reservoir
- 4. Skill in inspecting and draining condensate from a pneumatic system
- 5. Skill in inspecting and cleaning/ tightening an automated machine
- 6. Skill in using manufacturer's documentation to determine proper oil for a hydraulic system

8. Preventive Maintenance-Lubrication Systems

- 1. Knowledge of types of lubricants (greases and oils), their characteristics and applications
- 2. Skill in using manufacturer's documentation to determine proper lubricant for a machine
- 3. Skill in using locating grease points on a machine
- 4. Skill in using a grease gun to add lubricant to a bearing
- 5. Skill in determining when to refill grease and oil lubrication systems through visual inspection and manufacturer's documentation
- 6. Skill in operating and adjusting automatic lubricators
- 7. Skill in handling and storing lubricants

9. Hand Tools

- 1. Knowledge of OSHA hand tool safety
- 2. Knowledge of fastener types, use, selection, operational concepts
- 3. Skill in disassembling, assembling and tightening fasteners
- 4. Skill in using screwdrivers, fixed wrenches, hex wrenches, ratchet wrenches, pullers, pliers, and mallets
- 5. Skill in using torque wrenches, click type and pneumatic
- 6. Skill in using electric-powered hand tools: drills, screwdrivers
- 7. Skill in assembling parts with bolt patterns
- 8. Skill in assembling parts with pins, clips, snap rings and wire wraps

CAT WORK Standards #2

INSTALLING, MODIFYING, TROUBLESHOOTING AND REPAIRING EQUIPMENT/SYSTEMS

Key Activities and Performance Indicators

1. Troubleshoot machine / mechanical system / electrical system failure

- a. Respond to notification of machine failure (i.e. work order)
- b. Perform diagnostic testing and root cause analysis
- c. Consult blueprints and schematics as necessary
- d. Consult manufacturer's performance specifications as necessary
- e. Interview operator(s)
- f. Observe machine failure(s)
- g. Diagnose specific machine failure(s) (i.e. obstructions).

2. Prepare for repair

- a. Obtain all necessary parts for repair
- b. Gather necessary support, tools, supplies, and Personal Protective Equipment (PPE)
- c. Ensure test equipment and tools are properly calibrated and certified when applicable.

3. Repair machine / mechanical system / electrical system failure

- a. Indicate wires and IO
- b. Remove broken part(s)
- c. Install / connect replacement part(s) and/or sub-program components (e.g. photo eyes, frequency drives, controllers)
- d. Reclaim, recycle or dispose of fluids, refrigerants, materials and waste
- e. Document completion of work order

4. Install, Move, or Remove equipment

- a. Prepare to lead the team that will install a piece of equipment
- b. Use safe rigging techniques Move/ Remove Equipment
- c. Test machine to ensure functionality after installation or move/removal
- d. Modify and update existing documents and procedures pertinent to installation

CAT WORKER Standards #2

INSTALLING, MODIFYING, TROUBLESHOOTING AND REPAIRING EQUIPMENT/SYSTEMS

Technical Knowledge and Skills

1. Troubleshooting Machines-Mechanical System

- 1. Knowledge of Mechanical Systems Safety and PPE
- 2. Skill in checking backlash and alignment of spur gears and gearboxes
- 3. Skill in interpreting specifications of mechanical power transmission components
- 4. Skill in troubleshooting wear and failure of mechanical power transmission components and systems
- 5. Skill in using dial indicator alignment
- 6. Knowledge of power transmission principles, including gear/sprocket ratios, power-torque-speed, efficiency

2. Troubleshooting Machines-Electrical Systems

- 1. Knowledge of Electrical Systems Safety and PPE
- 2. Skill in reading and interpreting electrical power and control schematics
- 3. Skill in interpreting electrical ladder diagrams schematics and component symbols
- 4. Knowledge of machine grounds and grounding techniques
- 5. Skill in troubleshooting basic electrical components and series/parallel circuits
- 6. Skill in troubleshooting electric motor control circuits
- 7. Skill in troubleshooting electric-relay controlled fluid power circuits
- 8. Skill in troubleshooting electric brakes
- 9. Skill in testing for proper machine grounding

3. Troubleshooting Machines-Hydraulic Systems

- 1. Knowledge of Hydraulic Systems Safety and PPE
- 2. Skill in reading and interpreting hydraulic schematics and component symbols
- 3. Skill in flushing a hydraulic system
- 4. Skill in bleeding air from a hydraulic system
- 5. Skill in replacing hydraulic oil
- 6. Skill in troubleshooting electro-hydraulic systems

4. Troubleshooting Machines-Pneumatic Systems

- 1. Knowledge of Pneumatic Systems Safety and PPE
- 2. Skill in reading and interpreting pneumatic schematics and component symbols
- 3. Skill in troubleshooting electro-pneumatic systems

5. Repair Machine-Mechanical System

- 1. Skill in replacing and leveling a motor and correcting for soft foot
- 2. Skill in replacing and aligning flexible couplings and shafts
- 3. Skill in replacing, aligning, and tensioning single and double v-belt drives
- 4. Skill in replacing, aligning, and tensioning single and double chain drives
- 5. Skill in replacing and adjusting pillow block and flange bearings
- 6. Skill in replacing and adjusting spur gears and gearboxes
- 7. Skill in interpreting specifications of mechanical power transmission components

6. Repair Machine-Electrical Systems

- 1. Skill in sizing fuses and circuit breakers
- 2. Skill in replacing and connecting basic electrical components
- 3. Skill in interpreting specifications and nameplate data of common electrical components
- 4. Skill in replacing and connecting electric relays, sensors, switches, solenoid valves and motor starters
- 5. Skill in replacing electrical wiring in a machine
- 6. Skill in sizing and selecting replacement wire for a machine control systems
- 7. Skill in adjusting and replacing electric brakes
- 8. Skill in repairing machine grounding

7. Repair Machine-Hydraulic Systems

- 1. Skill in replacing hydraulic flexible and rigid conductors and fittings
- 2. Skill in sizing hydraulic filters for suction, pressure and return applications
- 3. Skill in replacing and connecting hydraulic components
- 4. Skill in interpreting specifications and nameplate data of common hydraulic components and conductors

8. Repair Machine-Pneumatic Systems

- 1. Skill in replacing pneumatic flexible and rigid conductors and fittings
- 2. Skill in replacing and connecting basic pneumatic components
- 3. Skill in interpreting specifications and nameplate data of common pneumatic components and conductors

9. Interpret Part and Assembly Technical Drawings

- 1. Knowledge of Machining Safety and PPE
- 2. Knowledge of visualizing objects from a multi-view drawing
- 3. Knowledge of identifying product features from a multi-view drawing
- 4. Knowledge of identifying dimensions and tolerances of an object from a multi-view drawing
- 5. Knowledge of interpreting geometric dimensioning and assembly tolerances on a drawing
- 6. Knowledge of interpretation of title blocks
- 7. Skill in interpreting assembly drawings

10. Equipment Movement-Rigging

- 1. Knowledge of rigging safety
- 2. Knowledge of slings, hoists, rigging hardware, sling and lifting techniques
- 3. Knowledge of pry bars, hydraulic jacks, dollies, and come-alongs
- 4. Skill in lifting a load using a manual or electric hoist
- 5. Skill in selecting and sizing slings for lifting loads
- 6. Skill in calculating center of gravity, lift loads
- 7. Skill in using crush force tables
- 8. Skill in inspecting hoists for safe operation

CAT WORK Standards #3

INSTALLING, MODIFYING, TROUBLESHOOTING, AND REPAIRING BASIC CONTROLLERS AND NETWORKS

Key Activities and Performance Indicators

1. Install and maintain PLCs and PLC modules

- a. Install PLCs, PLC modules and external discrete I/O wiring given a diagram
- b. Change battery
- c. Clean control cabinet
- d. Inspect wires and all connections
- e. Monitor PLC controls and equipment via remote connection

2. Troubleshoot and repair PLCs with discrete I/O PLC modules

- a. Interpret PLC diagram to facilitate troubleshooting of equipment input/output signals
- b. Use a multimeter to troubleshoot PLC I/O
- c. Use PLC diagnostics to troubleshoot PLC systems and components
- d. Replace failed PLC components
- e. Test PLC system after component replacement

3. Modify, troubleshoot or manipulate standard PLC operating programs and test/verify them for correct operation

- a. Program PLC timers and counters
- b. Edit PLC program instructions which use discrete I/O
- c. Use PLC history files to troubleshoot a machine
- d. Interpret PLC documentation

4. Install, maintain, and troubleshoot PLC systems with variable frequency AC drives

- a. Install and configure parameters of an AC variable frequency drive (VFD)
- b. Wire devices to a VFD
- c. Interface a VFD to a PLC via a network
- d. Interpret PLC programs that communicate data to and from a VFD
- e. Monitor and maintain PLC that controls a VFD
- f. Use a multimeter and diagnostics to troubleshoot a VFD

5. Operate and test equipment network system, scanners, and run system applications

- a. Configure Ethernet addresses
- b. Configure scanners for operation on Ethernet network
- c. Test/ ping network components
- d. Configure devices, scanners and software to communicate on serial networks

CAT WORKER Standards #3

INSTALLING, MODIFYING, TROUBLESHOOTING, AND REPAIRING BASIC CONTROLLERS AND NETWORKS

Technical Knowledge and Skills

1. Basic Programmable Controller Systems

- 1. Knowledge of the principles of operation of a programmable controller with discrete I/O
- 2. Skill in interpreting basic ladder logic programmable controller programs with basic instructions: output coils, internal coils, timers, counters, and contacts
- 3. Skill in configuring a PLC with discrete I/O
- 4. Skill in replacing PLC components and wiring
- 5. Skill in transferring programs between PC and PLC
- 6. Skill in using a Human Machine Interface (HMI) to operate a PLC-controlled machine
- 7. Skill in testing the operation of a PLC-controlled machine
- 8. Skill in interpreting a PLC I/O diagram
- 9. Skill in troubleshooting a PLC with basic program commands
- 10. Skill in using a Human Machine Interface (HMI) to troubleshoot a PLC-controlled machine
- 11. Skill in documenting PLC programs
- 12. Skill in modifying PLC programs

2. AC Variable Frequency Drives

- 1. Knowledge of principles of operation of key VFD components such as IGBTs and FET transistors
- 2. Knowledge of operation of variable frequency AC drives (VFDs)
- 3. Knowledge of VFD parameters and their use
- 4. Skill in configuring basic parameters of a VFD using onboard HMI and PC software
- 5. Skill in operating an VFD
- 6. Knowledge of types of basic VFD diagnostics and alarms
- 7. Skill in troubleshooting and replacing a VFD

3. Network/ Communication Systems

- 1. Knowledge of operation of Ethernet TCP/IP
- 2. Knowledge of Ethernet network topologies and applications
- 3. Knowledge of Ethernet addressing schemes, masks, and sub-masks
- 4. Knowledge of Ethernet device addressing methods, dynamic and static
- 5. Knowledge of operation of Ethernet subnets and routing between them
- 6. Knowledge of operation of Ethernet network layers, managed switches, unmanaged switches
- 7. Knowledge of Ethernet cabling and hardware
- 8. Skill in configure subnet addresses and access devices on different subnets
- 9. Skill in replacing Ethernet network components

4. PLC Communications

- 1. Knowledge of PLC Ethernet topology operation and applications
- 2. Knowledge of Profinet, Ethernet IP, and Modbus TCP operation

- 3. Knowledge of PLC Ethernet addressing schemes
- 4. Skill in configuring a PLC to use Ethernet network to send and receive data
- 5. Knowledge of types of serial communications (RS-232, RS-422, and RS-485)
- 6. Knowledge of serial communication protocols such as Modbus
- 7. Knowledge of operation of PLC serial communications
- 8. Skill in connecting serial communications devices to a PLC or serial network
- 9. Skill in configuring a PLC and PLC program to communicate with serial devices
- 10. Skill in configuring an HMI to communicate to PLCs and other devices via an Ethernet network

5. Barcode and RFID Identification Systems

- 1. Knowledge of types of barcode standards and their applications
- 2. Knowledge of operation of types of barcode readers (1D, 2D) and their applications
- 3. Skill in configuring barcode readers to transfer data using serial and Ethernet communications
- 4. Skill in printing and applying barcode labels
- 5. Skill in replacing barcode scanners
- 6. Knowledge of types of RFID systems (high/low frequency, passive/active, etc) and their applications
- 7. Knowledge of types of RFID tags and their applications
- 8. Knowledge of operation of RFID readers/tags and their applications
- 9. Skill in replacing RFID scanners
- 10. Skill in configuring RFID readers to transfer data using serial and Ethernet communications