COMPETENCY-BASED OCCUPATIONAL FRAMEWORK FOR REGISTERED APPRENTICESHIP

Mechatronics Technician/ Engineer (Intermediate, installer-focus)

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Competency-Based Occupational Frameworks

The Urban Institute, under contract by the U.S. Department of Labor, has worked with employers, subject matter experts, labor unions, trade associations, credentialing organizations and academics to develop Competency-Based Occupational Frameworks (CBOF) for Registered Apprenticeship programs. These frameworks defined the **purpose** of an occupation, the **job functions** that are carried out to fulfill that purpose, the **competencies** that enable the apprentice to execute those job functions well, and the **performance criteria** that define the specific knowledge, skills and personal attributes associated with high performance in the workplace. This organizational hierarchy – Job Purpose – Job Functions – Competencies – Performance Criteria – is designed to illustrate that performing work well requires more than just acquiring discrete knowledge elements or developing a series of manual skills. To perform a job well, the employee must be able to assimilate knowledge and skills learned in various settings, recall and apply that information to the present situation, and carry out work activities using sound professional judgement, demonstrating an appropriate attitude or disposition, and achieving a level of speed and accuracy necessary to meet the employer's business need.

The table below compares the terminology of Functional Analysis with that of traditional Occupational Task Analysis to illustrate the important similarities and differences. While both identify the key technical elements of an occupation, Functional Analysis includes the identification of behaviors, attributes and characteristics of workers necessary to meet an employer's expectations.

Framework Terminology	Traditional Task Analysis Terminology
Job Function – the work activities that are carried out to fulfill the job purpose	Job Duties – roles and responsibilities associated with an occupation
Competency – the actions an individual takes and the attitudes he/she displays to complete those activities	Task – a unit of work or set of activities needed to produce some result
Performance Criteria – the specific knowledge, skills, dispositions, attributes, speed and accuracy associated with meeting the employer's expectations	Sub Task – the independent actions taken to perform a unit of work or a work activity

Although designed for use in competency-based apprenticeship, these Competency-Based Occupational Frameworks also support time-based apprenticeship by defining more clearly and precisely what an apprentice is expected to learn and do during the allocated time-period.

CBOFs are comprehensive to encompass the full range of jobs that may be performed by individuals in the same occupation. As employers or sponsors develop their individual apprenticeship programs, they can extract from or add to the framework to meet their unique organizational needs.

Components of the Competency-Based Occupational Framework

Occupational Overview: This section of the framework provides a description of the occupation including its purpose, the setting in which the job is performed and unique features of the occupation.

Work Process Schedule: This section includes the job functions and competencies that would likely be included in an apprenticeship sponsor's application for registration. These frameworks provide a point of reference that has already been vetted by industry leaders so sponsors can develop new programs knowing that they will meet or exceed the consensus expectations of peers. Sponsors maintain the ability to customize their programs to meet their unique needs, but omission of a significant number of job functions or competencies should raise questions about whether or not the program has correctly identified the occupation of interest.

Cross-cutting Competencies: These competencies are common among all workers, and focus on the underlying knowledge, attitudes, personal attributes and interpersonal skills that are important regardless of the occupation. That said, while these competencies are important to all occupations, the relative importance of some versus others may change from one occupation to the next. These relative differences are illustrated in this part of the CBOF and can be used to design pre-apprenticeship programs or design effective screening tools when recruiting apprentices to the program.

Detailed Job Function Analysis: This portion of the framework includes considerable detail and is designed to support curriculum designers and trainers in developing and administering the program. There is considerable detail in this section, which may be confusing to those seeking a more succinct, higher-level view of the program. For this reason, we recommend that the Work Process Schedule be the focus of program planning activities, leaving the detailed job function analysis sections to instructional designers as they engage in their development work.

a. Related Technical Instruction: Under each job function appears a list of foundational knowledge, skills, tools and technologies that would likely be taught in the classroom to enable the apprentice's on-the-job training safety and success.

b. Performance Criteria: Under each competency, we provide recommended performance criteria that could be used to differentiate between minimally, moderately and highly competent apprentices. These performance criteria are generally skills-based rather than knowledge-based, but may also include dispositional and behavioral competencies.

Using the Competency-Based Occupational Framework to Develop a Registered Apprenticeship Program

When developing a registered apprenticeship program, the Work Process Schedule included in this CBOF provides an overview of the job functions and competencies an expert peer group deemed to be important to this occupation. The Work Process Schedule in this document can be used directly, or modified and used to describe your program content and design as part of your registration application.

When designing the curriculum to support the apprenticeship program – including on the job training and related technical instruction – the more detailed information in Section 5 could be helpful. These more detailed job function documents include recommendations for the key knowledge and skill elements that might be included in the classroom instruction designed to support a given job function, and the performance criteria provided under each competency could be helpful to trainers and mentors in evaluating apprentice performance and insuring inter-rater reliability when multiple mentors are involved.

Mechatronics Technician/Engineer (Intermediate, Installer-focus) Occupational Overview

Occupational Purpose and Context

Mechatronics Technician/ Engineers (Intermediate, installer-focus) work with mechanical machinery supported by information technology in dynamic environments using a variety of measurement and computer equipment and tools. They manage complex machines, adjust, find errors, and eliminate them; know the principles of operation of hydraulic, electrical and other devices; and carry out the measurements and interference with the fabrication processes. They know how to use computer programs and control the steering of various processes. Mechatronics Technician/ Engineers (Intermediate, installer-focus) are able to maintain, listen, observe, perform screenings, and carry a sense of professionalism with staff and any outside parties.

Mechatronics Technician/ Engineers (Intermediate, installer-focus) work in the installation and maintenance of mechatronics components and systems for manufacturers in the plant construction and engineering sectors, for system operators and in service sectors, and for service providers in a wide range of branches of trade and industry. Mechatronics Technician/ Engineers (Intermediate, installer-focus) carry out their work at various places, mainly at plant assembly sites, in workshops and in connection with service operations. They are qualified to work autonomously on the basis of technical documents and instructions and carry out their work in compliance with the relevant provisions and safety regulations. They often work in teams. They coordinate their activities with upstream and downstream operations.

Mechatronics Technician/ Engineers (Intermediate, installer-focus) work to combine electronic, mechanical, computer and control skills at the workplace. They will work with complex high-performance manufacturing systems and are able to analyze, troubleshoot and repair systems to maintain process efficiency. They must understand and analyze the technical specifications of mechatronic systems, subsystems, modules and components; perform scheduled and preventive maintenance to detect and prevent problems; use troubleshooting skills to identify and prevent

possible problems and failures, and to systematically and intelligently make repairs; incorporate relevant technical literature into the understanding of system operation and coordinate efforts with other technicians involved in installing or maintaining equipment or components; install, repair, adjust, and test equipment and components to ensure that systems function properly; communicate with machine operators; and operate equipment to detect equipment problems, analyze malfunctions, and verify system problems; and observe and incorporate safety standards and regulations required for safe operation of the system.

Mechatronics Technician/ Engineer (Intermediate, installer-focus) apprentices will receive a more comprehensive education than mechatronics technicians. While having similar training with computers and PLCs, they have more extensive baseline skills training. Specifically, installers will have a more comprehensive education requiring benchwork, measurements, and basic installation skills. As a result, this framework is more comprehensive than the technician framework and should be used by those wishing to provide a more extensive initiation to the work of mechatronics to apprentices.

Potential Job Titles

Electrical and Electronics Repairers, Commercial and Industrial Equipment; Maintenance and Repair Worker; Maintenance Workers, Machinery; Electro-Mechanical Technicians; Robotics Technicians; Electrical and Electronic Equipment Assemblers; Automation Technicians; Industrial Foreman

Attitudes and Behaviors

Mechatronics Technician/ Engineers (Intermediate, installer-focus) should have well developed critical thinking skills to solve problems quickly, be able to identify errors or inconsistencies in product quality, be able to stay focused and observe the work process despite distractions, be able to combine pieces of information to form general rules or conclusions which they should communicate clearly, and be able to arrange objects or actions in an order or pattern related to a specific rule or set of rules.

Apprenticeship Prerequisites

A high school diploma and the ability to pass a drug or background screening test are often necessary.

Occupational Pathways

Mechatronics Technician/ Engineers (Intermediate, installer-focus) may move from entry-level employees to certified machine operators to qualified apprenticeship candidates to mechatronics technician apprentices. Installers can also move to installing programmable logic controllers (PLCs). Unlike other mechatronics technicians, installers have a more comprehensive occupational overview, including work with more advanced machinery.

Certifications, Licensure and Other Credential Requirements

CREDENTIAL	Offered By	Before, During or After Apprenticeship
Mechanical Components I and II	PMMI	During
Industrial Electricity I and II	PMMI	During
Programmable Logic Controllers I and II	PMMI	During
Fluid Power I and II	PMMI	During
Motors and Motor Control	PMMI	During
Robotics and Motion Control	PMMI	During
Machining Certifications (optional)	PMMI	During
Welding Certifications (optional)	PMMI	During
Competent and Proficient Mechatronics Technicians	PMMI	During
Mechatronics Engineering Technology Degrees	PMMI	During

Job Functions

JOB FUNCTIONS		Core or Optional	Level
1.	Maintain safety and health at work while contributing to the avoidance of instances of environmental pollution caused by the company	Core	
2.	Follow company and technical communication guidelines	Core	
3.	Plan and control work processes and check and evaluate the quality of work	Core	
4.	Check, mark off, and label workpieces to assure quality assurance	Core	
5.	Cut, separate, and reform manually or by machine and then join equipment	Core	
6.	Install electrical subassemblies and components	Core	
7.	Measure and test electrical values and install and test hardware and software components	Core	
8.	Build and test control systems and program mechatronic systems	Core	
9.	Assemble subassemblies and components into machines and systems	Core	
10.	Test and adjust the functioning of mechatronic systems	Core	
11.	Commission, operate, and maintain mechatronic systems	Core	

Stackable Programs

This occupational framework is designed to link to the following additional framework(s) as part of a career laddering pathway.

Stackable Programs		Base or Higher Level	Stacks on top of
1.		Base Program	
2.			
3.			
4.			

Options and Specializations

The following options and specializations have been identified for this occupation. The Work Process Schedule and individual job function outlines indicate which job functions and competencies were deemed by industry advisors to be optional. Work Process Schedules for Specializations are included at the end of this document.

Options and Specializations	Option	Specialization
Electrical and Electronics Repairers, Commercial and Industrial Equipment		
Maintenance and Repair Worker		
Maintenance Workers, Machinery		
Electro-mechanical Technicians		
Robotics Technicians		
Electrical and Electronic Equipment Assemblers		
Automation Technicians		
Industrial Foreman		

Work Process Schedule

WORK PROCESS SCHEDULE[1]	O*NET-SOC Code: 49-2094.00
Mechatronics Technician (Intermediate, installer-focus) (Alternate Title: Electrical and Electronics Repairers, Commercial and Industrial Equipment (Intermediate, installer-focus))	RAPIDS Code: 2014CB

Job Title:		
Level:	**Specialization:**	
Stackable Program ___yes ___no **Base Occupation Name:**		
Company Contact:		
Address:	**Phone:**	**Email:**
Apprenticeship Type: **_____Competency-Based** **_____Time-Based _____Hybrid**	**Prerequisites:**	

JOB FUNCTION 1: Maintain safety and health at work while contributing to the avoidance of instances of environmental pollution caused by the company

Competencies	Core or Optional	OJT	RTI
A. Ascertain health and safety risk in the workplace and adopt measures for the avoidance of hazards	Core		
B. Deploy occupationally related health and safety and accident prevention measures	Core		
C. Describe behaviors when accidents occur and institute initial	Core		

[1] See full framework for certifications and occupational pathways, cross-cutting competencies, and detailed job functions at https://www.dol.gov/cgi-bin/leave-dol.asp?exiturl=https://www.urban.org/policy-centers/center-labor-human-services-and-population/projects/competency-based-occupational-frameworks-registered-apprenticeships&exitTitle=www.urban.org.

measures			
D. Deploy regulations for preventative fire protection; describe behaviors in the event of a fire and initiate firefighting measures	Core		
E. Explain possible instances of environmental pollution caused by the company providing training and its contribution to environmental protection using examples	Core		
JOB FUNCTION 2: Follow company and technical communication guidelines			
Competencies	Core or Optional	OJT	RTI
A. Procure and evaluate information	Core		
B. Conduct discussions with line managers, colleagues, and within the team in a manner appropriate to the situation; present facts and circumstances	Core		
C. Use opportunities to resolve conflicts	Core		
D. Handle IT systems and, in particular, deploy software and connect and use peripheral devices	Core		
E. Protect and secure data	Core		
F. Prepare protocols and reports using standard software	Core		
G. Read and use partial, group, and overall drawings	Core		
H. Read and use circuit documentation on sub-assemblies and devices used in fluid power	Core		
I. Read and use electrical, block, function, assembly, and connection plans	Core		
J. Utilize technical regulations, operating instructions, work directives, and other information	Core		
K. Explain products and work results on handover and provide initial instructions on function	Core		
L. Use company information and communication systems	Core		
JOB FUNCTION 3: Plan and control work processes and check and evaluate the quality of work			
Competencies	Core or Optional	OJT	RTI
A. Stipulate stages of work in accordance with functional, technical production and business criteria	Core		
B. Stipulate and secure work processes in accordance with organizational and information criteria	Core		
C. Plan work in a team; assign tasks	Core		
D. Plan and set up the workplace	Core		
E. Request and provide materials, tools, and equipment in an order-related manner	Core		

F. Prepare processing machines for the work process	Core		
G. Calibrate tools, machine tools, testing and measuring equipment, and technical equipment ready for operational use; check and maintain such tools and equipment and initiate measures for the rectification of errors	Core		
H. Monitor, evaluate, and check own work and work done by others	Core		
I. Document materials, spare parts, work time, and technical checks	Core		
J. Observe standards and specifications for quality assurance of the products and secure quality in completing the order with due consideration for upstream and downstream divisions	Core		
JOB FUNCTION 4: Check, mark off, and label workpieces to ensure quality assurance			
Competencies	Core or Optional	OJT	RTI
A. Measure lengths, observe tolerances, and check matching	Core		
B. Check areas for evenness, angularity, and precision of form, and evaluate the quality of surface areas	Core		
C. Monitor form of surface areas and characteristics of joining surfaces in accordance with technical requirements	Core		
D. Mark off and label workpieces	Core		
E. Measure angles and check them using angle gauges	Core		
JOB FUNCTION 5: Cut, separate, and reform manually or by machine and then join equipment			
Competencies	Core or Optional	OJT	RTI
A. Select and use measuring instruments for the measurement and checking of lengths, angles, and areas	Core		
B. Saw sheet metals, boards, and metal and plastic profiles as marked out	Core		
C. File and chamfer areas and forms on workpieces so they are flat, angled, and parallel to measure	Core		
D. Create and deburr drill holes	Core		
E. Create internal and external screw threads	Core		
F. Process workpieces by turning	Optional		
G. Process workpieces by milling	Optional		
H. Cut metal and acrylic sheets profiles as marked out	Core		
I. Select and install fasteners according to torque specifications	Core		

J. Install dowels and pins	Optional		
K. Join pipe connections	Core		
L. Weld, cut, deburr, and thread metal pipes	Optional		
JOB FUNCTION 6: Install electrical subassemblies and components			
Competencies	Core or Optional	OJT	RTI
A. Assemble, connect, and wire electrical components, housings, and circuit unit combinations	Core		
B. Select, install, connect, and label components for electrical auxiliary and circuit units	Core		
C. Install and label components for open- and closed- loop control; measure, test, and debug	Core		
D. Select, prepare, lay, and connect cables according to electrical load, routing, and purpose	Optional		
E. Wire up sub-assemblies and devices using various methods according to documentation and prints	Core		
F. Correct errors and document changes to electrical prints	Optional		
JOB FUNCTION 7: Measure and test electrical values and install and test hardware and software components			
Competencies	Core or Optional	OJT	RTI
A. Specify measuring procedures and devices; assess measurement errors, and set up measuring equipment	Core		
B. Measure voltages, current; then select correct size of cables and/or conductors	Core		
C. Measure and test analog and digital signals	Core		
D. Check electrical parameters of sub-assemblies and components	Core		
E. Build electrical circuits and test function	Core		
F. Test hardware and software interfaces, compatibility of hardware components, and system requirements with software	Core		
G. Assemble and connect system components	Core		
H. Configure hardware; install and test software	Core		
I. Install and configure network systems	Core		
J. Test signals at interfaces, interpret protocols, and test systems	Core		
K. Carry out version changes of software	Core		
L. Document changes in hardware and software	Core		

JOB FUNCTION 8: Build and test control systems and program mechatronic systems			
Competencies	Core or Optional	OJT	RTI
A. Install, connect, and test electrical and fluid power circuits	Core		
B. Build and connect electrical and fluid power circuits; test and adjust systems for the provision of electrical, pneumatic, or hydraulic pressure	Core		
C. Measure and adjust pressure in fluid power systems	Core		
D. Analyze assignment, in particular sequences and reciprocal effect, at interfaces of the system to be controlled	Core		
E. Align control concepts and select control equipment	Core		
F. Install sensors, actuators, and valving	Core		
G. Check and adjust the interaction of connected functions; consider interfaces in localizing errors	Core		
H. Evaluate control systems of different designs	Core		
I. Prepare, enter, and test application programs for control systems	Core		
J. Monitor program process in mechatronic systems; identify and rectify errors	Core		
JOB FUNCTION 9: Assemble subassemblies and components into machines and systems			
Competencies	Core or Optional	OJT	RTI
A. Identify and troubleshoot sub-assemblies and components and check that characteristics are error-free	Core		
B. Carry out preliminary installations	Core		
C. Install lubricating and cooling systems	Core		
D. Install fluid power component, in particular cylinders and valves	Core		
E. Prepare, lay, and connect up pipes and hoses; check for leaks	Core		
F. Match sub-assemblies and components, adjust to the correct functionality, and secure position	Core		
G. Install mechanical drive systems, drives, gears, and coupling systems, and verify the functionality of movable parts	Core		
H. Install and connect circuit devices	Core		
I. Install, adjust, and connect sensors	Core		
J. Check functions during the installation process	Core		
JOB FUNCTION 10: Test and adjust the functioning of mechatronic systems			

Competencies	Core or Optional	OJT	RTI
A. Install/troubleshoot signal processing sub-assemblies and check incoming and outgoing signals	Core		
B. Calibrate measuring equipment for the recording of pressure and temperature	Core		
C. Adjust sensing distance of sensors	Core		
D. Install and adjust actuators in accordance with technical specifications	Core		
E. Locate symptoms and faults for mechanical, fluidic, and electrical equipment through visual checks, testing, and measurement	Core		
F. Install and troubleshoot Variable Frequency Drives (VFD)	Core		
G. Install, test, and debug automated manufacturing equipment	Core		
JOB FUNCTION 11: Commission, operate, and maintain mechatronic systems			
Competencies	Core or Optional	OJT	RTI
A. Check guarding against direct contact	Core		
B. Check effectiveness of protective measures, in particular, fault current protective equipment, measure insulation, and short circuits	Core		
C. Check the effectiveness of mechanical and electrical safety fixtures, in particular, emergency off switches and alarm systems	Core		
D. Test and commission auxiliary and control current circuits including the relevant signal and command transmitters for open and closed loop control and monitoring systems	Core		
E. Check main circuits and gradually commission, measure operational values, and adjust target values	Core		
F. Commission fluid power equipment	Core		
G. Check and secure fixing, energy supply, lubrication, cooling, and disposal systems	Core		
H. Load and secure programs and data; check and adjust program process	Core		
I. Check protective measures for electromagnetic compatibility	Core		
J. Identify system parameters at the time when commissioning takes place; compare with stipulated values and adjust	Core		
K. Inspect mechatronic systems, check function of safety systems and protocol checks	Core		
L. Dismantle devices and sub-assemblies, noting their function, and label parts with regard to position and functional alignment	Core		
M. Correct malfunctions by conducting remedial procedures and exchanging parts and sub-assemblies	Core		
N. Correct software errors	Core		

O.	Compare system parameters with stipulated values and make adjustments	Core		
P.	Repair mechatronic systems with due consideration for company processes	Core		

Specialization

Type of Specialization: _____

JOB FUNCTION 1:		**Level**
Competencies	RTI	OJT
JOB FUNCTION 2:		**Level**
Competencies	OJT	RTI
JOB FUNCTION 3:		Level
Competencies	OJT	RTI

JOB FUNCTION 4:		**Level**
Competencies	OJT	RTI
JOB FUNCTION 5:		**Level**
Competencies	OJT	RTI

Related Technical Instruction Plan

COURSE NAME	Course Number
	Hours
LEARNING OBJECTIVES	
COURSE NAME	Course Number
	Hours
LEARNING OBJECTIVES	
COURSE NAME	Course Number
	Hours
LEARNING OBJECTIVES	
COURSE NAME	Course Number
	Hours

LEARNING OBJECTIVES	
COURSE NAME	Course Number
	Hours
LEARNING OBJECTIVES	

Cross-Cutting Competencies

	COMPETENCY**	0	1	2	3	4	5	6	7	8
Personal Effectiveness	Interpersonal Skills									
	Integrity									
	Professionalism									
	Initiative									
	Dependability and Reliability									
	Adaptability and Flexibility									
	Lifelong Learning									
Academic	Reading									
	Writing									
	Mathematics									
	Science & Technology									
	Communication									
	Critical and Analytical Thinking									
	Basic Computer Skills									
Workplace	Teamwork									
	Customer Focus									
	Planning and Organization									
	Creative Thinking									
	Problem Solving & Decision Making									
	Working with Tools & Technology									
	Checking, Examining & Recording									
	Business Fundamentals									
	Sustainable									
	Health & Safety									

**Cross-cutting competencies are defined in the Competency Model Clearinghouse:

https://www.careeronestop.org/CompetencyModel/competency-models/buidling-blocks-model.aspx

Cross-Cutting Competencies identify transferable skills – sometimes called "soft skills" or "employability skills" – that are important for workplace success, regardless of a person's occupation. Still, the relative importance of specific cross-cutting competencies differs from occupation to occupation. The Cross-Cutting Competencies table, above, provides information about which of these competencies is most important to be successful in a particular occupation. This information can be useful to employers or intermediaries in screening and selecting candidates for apprenticeship programs, or to pre-apprenticeship providers that seek to prepare individuals for successful entry into an apprenticeship program.

The names of the cross-cutting competencies come from the U.S. Department of Labor's Competency Model Clearinghouse and definitions for each can be viewed at https://www.careeronestop.org/CompetencyModel/competency-models/building-blocks-model.aspx

The scoring system utilized to evaluate the level of competency required in each cross cutting skill aligns with the recommendations of the Lumina Foundation's Connecting Credentials Framework. The framework can be found at: http://connectingcredentials.org/wp-content/uploads/2015/05/ConnectingCredentials-4-29-30.pdf.

Detailed Job Functions

JOB FUNCTION 1: Maintain safety and health at work while contributing to the avoidance of instances of environmental pollution caused by the company

Related Technical Instruction		
KNOWLEDGE	**SKILLS**	**TOOLS & TECHNOLOGIES**
• Risk assessment techniques and protocols • Equipment effectiveness • OSHA health standards	• Using proper procedures in conducting work • Maintaining situational awareness • Performing risk assessment and risk mitigation activities • Clear thinking • Identifying problems and correcting them	• None

Competency A: Ascertain health and safety risk in the workplace and adopt measures for the avoidance of hazards	**Core or Optional**
PERFORMANCE CRITERIA	
1. Adheres to OSHA, NIOSH, EPA, and other federal and state safety requirements for the workplace	Core
2. Identifies and recognizes common industrial hazards, per OSHA standards (including, ergonomics, laser safety, NFPA arc flash, confined space, gases and combustibles, steam, and compressed air)	Core
3. Uses at all times appropriate personal protective equipment (eyes, head, breathing air apparatus, body, feet, hands, ears)	Core
4. Reviews material safety data sheets and follows appropriate use, storage, disposal, and accidental exposure directions	Core
5. Uses proper fall protection strategies when working at heights and using ladders, scaffolding, and lifts	Core
Competency B: Deploy occupationally related health and safety and accident prevention measures	**Core or Optional**
PERFORMANCE CRITERIA	

1. Employs preventive methods to prevent or remedy hazardous situations (includes following guidelines to prevent spread of blood borne pathogens, spill control, proper storage, handling, protection of equipment, first aid)	Core
Competency C: Describe behaviors when accidents occur and institute initial measures	**Core or Optional**
PERFORMANCE CRITERIA	
1. Manually or orally notes the response to accidents and begins to institute measures to prevent from reoccurrence	Core
Competency D: Deploy regulations for preventative fire protection; describe behaviors in the event of fire and initiate firefighting measures	**Core or Optional**
PERFORMANCE CRITERIA	
1. Selects, installs, and inspects fire extinguishers ensuring that grade aligns with materials in use	Core
Competency E: Explain possible instances of environmental pollution caused by the company providing training and its contribution to environmental protection using examples	**Core or Optional**
PERFORMANCE CRITERIA	
1. Properly disposes environmental waste and identifies roles and responsibilities for environmental disposal	Core

JOB FUNCTION 2: Follow company and technical communication guidelines

Related Technical Instruction		
KNOWLEDGE	**SKILLS**	**TOOLS & TECHNOLOGIES**
• Risk assessment techniques and protocols • Mathematical calculations and measurements • Equipment effectiveness • Software and coding • Computers and software • Technical drawings and plans	• Selecting proper tools and procedures • Using proper procedures in conducting work • Maintaining situational awareness • Performing risk assessment and risk mitigation activities • Clear thinking and speaking • Identifying problems and correcting them	• Hardware • Software • Electrical circuits

Competency A: Procure and evaluate information	**Core or Optional**
PERFORMANCE CRITERIA	
1. Obtains the proper information from relevant coworkers to evaluate company policies and procedures	Core
Competency B: Conduct discussions with line managers, colleagues, and within the team in a manner appropriate to the situation, present facts and circumstances	**Core or Optional**
PERFORMANCE CRITERIA	
1. Has appropriate interpersonal skills involving a supervisor or team leader and other team members to ensure work is smoothly continued from one shift to the next	Core
Competency C: Use opportunities to resolve conflicts	**Core or Optional**
PERFORMANCE CRITERIA	
1. Analyzes the problem(s), proposes a remedy(ies), having been given authorization to carry it out and discusses it with coworkers	Core

Competency D: Handle IT systems, and in particular deploy software and connect and use peripheral devices	Core or Optional
PERFORMANCE CRITERIA	
1. Describes how to open a processor file using software	Core
2. Opens a processor file using software and identify software components	Core
3. Describes how to download and run a program	Core
4. Downloads and runs a program using programming software	Core
Competency E: Protect and secure data	**Core or Optional**
PERFORMANCE CRITERIA	
1. Installs proper anti-virus software to protect against computer or tablet viruses and follows proper company security policy to ensure data is handled properly	Core
Competency F: Prepare protocols and reports using standard software	**Core or Optional**
PERFORMANCE CRITERIA	
1. Develops protocols and reports using the proper software available throughout the company	Core
Competency G: Read and use partial, group, and overall drawings	**Core or Optional**
PERFORMANCE CRITERIA	
1. Describes six rules of drawing a ladder diagram	Core
2. Draws a ladder diagram of a control circuit	Core
Competency H: Read and use circuit documentation on sub-assemblies and devices used in fluid power	**Core or Optional**
PERFORMANCE CRITERIA	
1. Solders and inspects a connection on a printed Circuit Board	Core
2. Unsolders a connection using a Solder Wick	Core
3. Unsolders a connection using a Solder Sucker Pump	Core
4. Solders a DB9 Connector to a Multi-Conductor Cable	Core
5. Solders wires to the terminals of an electrical component	Core
Competency I: Read and use electrical, block, function, assembly, and connection plans	**Core or Optional**
PERFORMANCE CRITERIA	
1. Reads and uses the various technical plans	Core

Competency J: Utilize technical regulations, operating instructions, work directives, and other information	Core or Optional
PERFORMANCE CRITERIA	
1. Follows the instructions of supervisors and technical directives and offers constructive feedback to ensure proper completion of tasks	Core
Competency K: Explain products and work results on handover and provide initial instructions as to function	**Core or Optional**
PERFORMANCE CRITERIA	
1. Has appropriate interpersonal skills involving a supervisor or team leader and other team members to ensure work is smoothly continued from one shift to the next	Core
Competency L: Use company information and communication systems	**Core or Optional**
PERFORMANCE CRITERIA	
1. Follows and uses the information provided by the company and uses the communication system to process this information	Core

JOB FUNCTION 3: Plan and control work processes and check and evaluate the quality of work

Related Technical Instruction		
KNOWLEDGE	**SKILLS**	**TOOLS & TECHNOLOGIES**
• Measurement principles • Risk assessment techniques and protocols • Mathematical calculations and measurements • Equipment effectiveness	• Selecting proper tools and procedures • Using proper procedures in conducting work • Maintaining situational awareness • Performing risk assessment and risk mitigation activities • Clear thinking • Identifying problems and correcting them • Establishing a plan of action and following through	• Machine tools

Competency A: Stipulate stages of work in accordance with functional, technical production, and business criteria	**Core or Optional**
PERFORMANCE CRITERIA	
1. Helps calculate production time, quality, and quantity; conducts SWOT analyses	Core
2. Helps determine the impact of these activities on competitive advantage and the global economy	Core
3. Looks at methods of continuous improvement to increase production time, quantity, and quality	Core
4. Gauges the cost of repair and rework	Core
Competency B: Stipulate and secure work processes in accordance with organizational and information criteria	**Core or Optional**
PERFORMANCE CRITERIA	
1. Selects and assembles tooling, fixtures, and equipment according to the operational method sheet	Core
Competency C: Plan work in a team, assign tasks	**Core or Optional**
PERFORMANCE CRITERIA	
1. Works together with coworkers and supervisors to outline work and tasks that will be done	Core
2. If necessary, assigns work to coworkers to assist in tasks	Core

Competency D: Plan and set up the workplace	Core or Optional
PERFORMANCE CRITERIA	
1. Outlines the key functions and tasks to be conducted through the work at hand	Core
2. Prepares materials and equipment for smooth operation of work	Core
Competency E: Request and provide materials, tools, and equipment in an order-related manner	**Core or Optional**
PERFORMANCE CRITERIA	
1. Catalogues the materials, tools, and equipment that are needed for work and procures them properly	Core
Competency F: Prepare processing machines for the work process	**Core or Optional**
PERFORMANCE CRITERIA	
1. Visually inspects tooling, fixtures, and equipment are properly assembled, installed, and in working order	Core
2. Adjusts equipment and tooling to maintain product specifications	Core
3. Observes equipment for unusual sounds, vibrations, or smells	Core
4. Documents issues or potential problems	Core
5. Notifies supervisor or appropriate individual of need for repairs	Core
Competency G: Calibrate tools, machine tools, testing and measuring equipment, and technical equipment ready for operational use, check and maintain such tools and equipment and initiate measures for the rectification of errors	**Core or Optional**
PERFORMANCE CRITERIA	
1. Checks calibration of a measurement tool	Core
2. Verifies calibrations and sizes of all measuring devices	Core
Competency H: Monitor, evaluate, and check own work and work done by others	**Core or Optional**
PERFORMANCE CRITERIA	
1. Visually and orally discusses and checks the work done by the team and measure against initial specifications that had been decided	Core
Competency I: Document materials, spare parts, work time, and technical checks	**Core or Optional**
PERFORMANCE CRITERIA	
1. Writes or types the materials, spare parts, work time, and technical checks of the work that had been completed	Core

Competency J: Observe standards and specifications for quality assurance of the products and secure quality in completing the order according due consideration to upstream and downstream divisions	Core or Optional
PERFORMANCE CRITERIA	
1. Identifies lean manufacturing and six sigma goals that can be used to improve the manufacturing process	Core
2. Looks at the potential implications of using upstream versus downstream processes in acquiring materials	Core
3. Helps to manage individual or team expectations	Core
4. Applies appropriate corrections based on team input	Core

JOB FUNCTION 4: Check, mark off, and label workpieces to assure quality assurance

Related Technical Instruction		
KNOWLEDGE	**SKILLS**	**TOOLS & TECHNOLOGIES**
• Measurement principles • Risk assessment techniques and protocols • Mathematical calculations and measurements	• Selecting proper tools and procedures • Using proper procedures in conducting work • Maintaining situational awareness • Performing risk assessment and risk mitigation activities • Clear thinking • Identifying problems and correcting them	• Workpieces

Competency A: Measure lengths, observe tolerances, and check matching	**Core or Optional**
PERFORMANCE CRITERIA	
1. Conducts dimensional, visual, and mechanical inspection according to employer documentation and procedures	Core
2. Uses appropriate measuring devices to measure component specifications	Core
3. Compares measured parameters with protocol/specifications to ensure accuracy	Core
4. Adjusts program or materials to correct production errors	Core
5. Notifies supervisor if specifications and error tolerance limits cannot be reached	Core
Competency B: Check areas for evenness, angularity, and precision of form and evaluate the quality of surface areas	**Core or Optional**
PERFORMANCE CRITERIA	
1. Given the necessary job process sheet for a part and verbal instructions, identifies and selects the required measuring instruments, and conducts the required inspection procedures	Core
2. Verifies calibrations and sizes of all measuring devices	Core
3. Takes measurements to an accuracy of 1/64 for fractions, .002 for decimals and ½ degree for angles	Core
4. Reads standard orthographic prints and understands types of lines, title block information, revision levels, abbreviations, symbols, and tolerances	Core

Competency C: Monitor form of surface areas and characteristics of joining surfaces in accordance with technical requirements	Core or Optional
PERFORMANCE CRITERIA	
1. Identifies surface defects, burrs, and any adverse conditions such as flat or torn threads, out of round conditions, eccentricity, etc.	Core
Competency D: Mark off and label workpieces	**Core or Optional**
PERFORMANCE CRITERIA	
1. Marks and labels workpiece with proper utensil	Core
Competency E: Measure angles and check using angle gauges	**Core or Optional**
PERFORMANCE CRITERIA	
1. Takes measurements to an accuracy of 1/64 for fractions, .002 for decimals and ½ degree for angles	Core

JOB FUNCTION 5: Cut, separate, and reform manually or by machine and then join equipment

Related Technical Instruction		
KNOWLEDGE	**SKILLS**	**TOOLS & TECHNOLOGIES**
• Measurement principles • Risk assessment techniques and protocols • Mathematical calculations and measurements • Equipment effectiveness • Milling and turning • Using hand tools properly	• Selecting proper tools and procedures • Using proper procedures in conducting work • Maintaining situational awareness • Performing risk assessment and risk mitigation activities • Clear thinking • Identifying problems and correcting them	• Metals and plastics • Piping • Hand equipment •

Competency A: Select and use measuring instruments for the measurement and checking of lengths, angles, and areas	**Core or Optional**
PERFORMANCE CRITERIA	
1. Given the necessary job process sheet for a part and verbal instructions, identifies and selects the required measuring instruments and conducts the required inspection procedures	Core
2. Takes measurements to an accuracy of 1/64 for fractions, .002 for decimals and ½ degree for angles	Core
Competency B: Saw sheet metals, boards, and metal and plastic profiles as marked out	**Core or Optional**
PERFORMANCE CRITERIA	
1. Chooses and mounts appropriate blades; welds, breaks, and re-welds blades as necessary	Core
2. Completes sawing parts to fit the layout	Core
Competency C: File and chamfer areas and forms on workpieces flat, angled, and parallel to measure	**Core or Optional**
PERFORMANCE CRITERIA	
1. Sets the cutting edge of the tool bit to the desired angle of chamfer and feeding it against the shoulder, or by setting the compound rest to the desired angle	Core
Competency D: Create and deburr drill holes	**Core or Optional**
PERFORMANCE CRITERIA	

1. Deburrs the part, hand drills and taps the holes, presses in the bushing, and installs the stud	Core
Competency E: Create internal and external screw threads	**Core or Optional**
PERFORMANCE CRITERIA	
1. Turns the handle of the wrench to widen the jaws, fit the threading tap with single groove to start	Core
2. Uses a center punch mark to center the drill point	Core
3. Drills a hole smaller than the measure needed for the tap	Core
4. Puts some Rocol cutting compound on the end of the tap	Core
5. Holding the level and square to the material turns the tap wrench until the first cut into the material has been made	Core
6. Repeats the process using the tap with two grooves and then finally again using the tap with no grooves	Core
7. Checks the threading using the appropriate sized bolt	Core
Competency F: Process workpieces by turning	**Core or Optional**
PERFORMANCE CRITERIA	
1. Sets up and carries out, between centers and with chucks, turning operations	Optional
2. Uses the principles of Cartesian coordinates to develop a program for the manufacture of a simple part	Optional
3. Operates a CNC lathe or turning center	Optional
4. Writes sophisticated programs	Optional
5. Creates programs using a manufacturing modeling software package	Optional
Competency G: Process workpieces by milling	**Core or Optional**
PERFORMANCE CRITERIA	
1. Using the principles of Cartesian coordinates, develops a program for the manufacture of a simple part	Optional
2. Creates a qualified CNC program, sets up and operates the mill, changes tool values as necessary, and replaces and qualifies tooling as necessary	Optional
3. Sets up and operates a CNC mill or CNC milling center	Optional
4. Writes sophisticated RS-274-D programs	Optional
5. Creates programs using a manufacturing modeling software package	Optional
Competency H: Cut metal and acrylic sheets profiles as marked out	**Core or Optional**
PERFORMANCE CRITERIA	
1. Sets up a torch and tanks for operation	Core
2. Selects correct tips for thickness of metal	Core
3. Cares for torch tips	Core
4. Selects/chooses proper PPE	Core
5. Uses a torch to perform a straight cut on various thickness of metals up to ½" thick	Core
6. Properly transports and stores regulators, pressure adjustments, and tanks	Core

Competency I: Select and install fasteners according to torque specifications	Core or Optional
PERFORMANCE CRITERIA	
1. Identifies and adheres to threaded and non-threaded fastener specifications	Core
2. Properly identifies and locates new fasteners based on a sample fastener	Core
3. Identifies and selects a fastener for a given application	Core
Competency J: Install dowels and pins	**Core or Optional**
PERFORMANCE CRITERIA	
1. Performs calculations of size of dowels and pins needed	Optional
2. Installs dowels and pins	Optional
Competency K: Join pipe connections	**Core or Optional**
PERFORMANCE CRITERIA	
1. Interprets or details the appropriate measurement of materials for cutting or bending	Core
2. Calculates pipe length required for installation or repair	Core
3. Uses threading machines, tubing benders, and cutting devices to prepare pipe and tubing	Core
4. Performs surface preparation for all types of connections	Core
5. Measures, cuts, and prepares pipe for installation or replacement	Core
6. Measures, cuts, and prepares pipe for installation	Core
7. Joins the pipe connection	Core
Competency L: Weld, cut, deburr, and thread metal pipes	**Core or Optional**
PERFORMANCE CRITERIA	
1. Welds, cuts, deburrs, and threads the metal pipes to complete task	Optional

JOB FUNCTION 6: Install electrical subassemblies and components

Related Technical Instruction		
KNOWLEDGE	**SKILLS**	**TOOLS & TECHNOLOGIES**
• Measurement principles • Assembly, connection, and wiring • Risk assessment techniques and protocols • Mathematical calculations and measurements • Equipment effectiveness	• Selecting proper tools and procedures • Using proper procedures in conducting work • Maintaining situational awareness • Performing risk assessment and risk mitigation activities • Clear thinking • Identifying problems and correcting them	• Cabling routes • Sub-assemblies • Electrical circuits

Competency A: Assemble, connect, and wire electrical components, housings, and circuit unit combinations	**Core or Optional**
PERFORMANCE CRITERIA	
1. Identifies and selects electro-mechanical tools	Core
2. Identifies solid and stranded conductors	Core
3. Identifies American Wire Gauge (AWG) sizes	Core
4. Connects a three-wire 120 VAC plug to an electric cord	Core
Competency B: Select, install, connect, and label components for electrical auxiliary and circuit units	**Core or Optional**
PERFORMANCE CRITERIA	
1. Connects and operates a reversing motor circuit with mechanical and auxiliary contact interlocking	Core
Competency C: Install, label components for open and closed loop control, measure, test, and debug	**Core or Optional**
PERFORMANCE CRITERIA	
1. Designs a robot program that uses looping, speed, and delay commands to move an object	Core
2. Troubleshoots program if issues arise	Core

Competency D: Select, prepare, lay, and connect cables according to electrical load, routing, and purpose	Core or Optional
PERFORMANCE CRITERIA	
1. Identifies, cuts, strips, splices, and connects non-metallic cable	Optional
2. Installs cable connectors in an electrical box	Optional
Competency E: Wire up sub-assemblies and devices using various methods according to documentation and prints	**Core or Optional**
PERFORMANCE CRITERIA	
1. Solders and inspects a connection on a printed circuit board	Core
2. Unsolders a connection using a solder wick	Core
3. Unsolders a connection using a solder sucker pump	Core
4. Solders a DB9 connector to a multi-conductor cable	Core
5. Solders wires to the terminals of an electrical component	Core
Competency F: Correct errors and document changes to electrical prints	**Core or Optional**
PERFORMANCE CRITERIA	
1. Correctly identifies any electrical errors and writes or types up changes to prints	Optional

JOB FUNCTION 7: Measure and test electrical values and install and test hardware and software components

Related Technical Instruction		
KNOWLEDGE	**SKILLS**	**TOOLS & TECHNOLOGIES**
• Measurement principles • Risk assessment techniques and protocols • Mathematical calculations and measurements • Equipment effectiveness • Software and coding • Computers and software	• Selecting proper tools and procedures • Using proper procedures in conducting work • Maintaining situational awareness • Performing risk assessment and risk mitigation activities • Clear thinking • Identifying problems and correcting them	• Hardware • Software • Electrical circuits •

Competency A: Specify measuring procedures, measuring devices, assess measurement errors, and set up measuring equipment	**Core or Optional**
PERFORMANCE CRITERIA	
1. Uses a machinist's rule graduated in common fractions of an inch to measure a dimension	Core
2. Uses a tape measure to measure a shaft length	Core
3. Converts between common fraction inches and decimal inches	Core
4. Converts between U.S. customary units and S.I. metric units	Core
Competency B: Measure voltages, current, then select correct size cables and/or conductors	**Core or Optional**
PERFORMANCE CRITERIA	
1. Uses a dial caliper to measure an outside dimension of a part	Core
2. Uses a dial caliper to measure an inside dimension of a part	Core
3. Uses an outside micrometer graduated in English units to measure the outside dimension of a part	Core
4. Measures a dimension using a dial indicator	Core
Competency C: Measure and test analog and digital signals	**Core or Optional**
PERFORMANCE CRITERIA	
1. Uses an analog and a digital multi-meter to measure voltage, amperage, and resistance	Core
2. Uses and cares for analog and digital meters	Core
3. Performs a continuity test	Core

Competency D: Check electrical parameters of sub-assemblies and components	Core or Optional
PERFORMANCE CRITERIA	
1. Checks electrical components for UL and CSA approval	Core
Competency E: Build electrical circuits and test function	**Core or Optional**
PERFORMANCE CRITERIA	
1. Builds and tests a series circuit	Core
2. Builds and tests a parallel circuit	Core
3. Builds and tests a series/parallel circuit	Core
4. Troubleshoots series and parallel circuits	Core
5. Calculates voltage, current, and resistance	Core
6. Measures voltage, current, and resistance	Core
Competency F: Test hardware and software interfaces, compatibility of hardware components, and system requirements with software	**Core or Optional**
PERFORMANCE CRITERIA	
1. Develops an interface wiring diagram to interface a MicroLogix 1000 PLC to a machine controller	Core
Competency G: Assemble and connect system components	**Core or Optional**
PERFORMANCE CRITERIA	
1. Connects and tests a limit switch to a discrete MicroLogix 1000 input	Core
2. Connects and tests the operation of a solenoid valve to a MicroLogix 1000 PLC output	Core
3. Connects and tests the operation of a motor starter to a MicroLogix 1000 PLC output	Core
4. Connects and tests the operation of an electronic sensor to a MicroLogix 1000 PLC input module	Core
5. Develops an interface wiring diagram to interface a MicroLogix 1000 PLC to a machine controller	Core
6. Connects and operates a conveyor system using discrete MicroLogix 1000 PLC inputs and outputs	Core

Competency H: Configure hardware, install, and test software	Core or Optional
PERFORMANCE CRITERIA	
1. Configures a serial communications driver using RS Linux software	Core
2. Monitors PLC operation using the using RS Logix software's system communications dialog	Core
3. Runs a PLC processor file using RS Logix PLC programming software	Core
4. Stops a PLC processor file using RS Logix PLC programming software	Core
5. Operates PLC inputs and outputs using RS Logix software	Core
6. Operates input and output instructions using RS Logix software	Core
7. Operates basic PLC Logic elements using RS Logix software	Core
Competency I: Install and configure network systems	**Core or Optional**
PERFORMANCE CRITERIA	
1. Explains where PLC networks may be used in the manufacturing process	Core
2. Installs and configures system	Core
Competency J: Test signals at interfaces, interpret protocols, test systems	**Core or Optional**
PERFORMANCE CRITERIA	
1. Performs and analyzes circuit signal tests in a motor control circuit	Core
Competency K: Carry out version changes of software	**Core or Optional**
PERFORMANCE CRITERIA	
1. Downloads a PLC processor file using RS Logix PLC programming software	Core
2. Configures a serial communications driver using RS Linux software	Core
3. Monitors PLC operation using the RS Logix software's system communications dialog	Core
4. Runs a PLC processor file using RS Logix PLC programming software	Core
5. Stops a PLC processor file using RS Logix PLC programming software	Core
6. Operates of PLC inputs and outputs using RS Logix software	Core
7. Operates input and output instructions using RS Logix software	Core
8. Operates basic PLC logic elements using RS Logix software	Core
Competency L: Document changes in hardware and software	**Core or Optional**
PERFORMANCE CRITERIA	
1. Writes, types, and records the information critical for the proper functioning of the job	Core

JOB FUNCTION 8: Build and test control systems and program mechatronic systems

Related Technical Instruction		
KNOWLEDGE	**SKILLS**	**TOOLS & TECHNOLOGIES**
• Measurement principles • Risk assessment techniques and protocols • Mathematical calculations and measurements • Equipment effectiveness • Software and coding • Computers and software	• Selecting proper tools and procedures • Using proper procedures in conducting work • Maintaining situational awareness • Performing risk assessment and risk mitigation activities • Clear thinking • Identifying problems and correcting them	• Electrical and fluid power circuits • Sensors, actuators and valving • Mechatronic systems

Competency A: Install, connect, and test electrical and fluid power circuits	**Core or Optional**
PERFORMANCE CRITERIA	
1. Identifies electrical symbols and schematics for hydraulic systems	Core
2. Describes electric and electronic control circuits, devices, and feedback as they relate to hydraulics	Core
3. Identifies the fundamentals of hydraulics	Core
4. Examines characteristics of hydraulic pumps	Core
5. Explains the transmission and conditioning of hydraulic fluid	Core
6. Measures oil flow and oil pressure	Core
7. Identifies the operation of manual and pilot directional control valves	Core
Competency B: Build and connect electrical and fluid power circuits, test and adjust systems for the provision of electrical, pneumatic, or hydraulic pressure	**Core or Optional**
PERFORMANCE CRITERIA	
1. Identifies electrical symbols and schematics for hydraulic systems	Core
2. Describes electric and electronic control circuits, devices, and feedback as they relate to hydraulics	Core
3. Identifies the fundamentals of hydraulics	Core
4. Examines characteristics of hydraulic pumps	Core
5. Explains the transmission and conditioning of hydraulic fluid	Core
6. Measures oil flow and oil pressure	Core
7. Identifies the operation of manual and pilot directional control valves	Core
8. Describes and explains hydraulic actuators	Core

9. Operates hydraulic actuator circuits	Core
10. Constructs, tests, and troubleshoots hydraulic control circuits	Core
11. Applies knowledge of basic electricity in analyzing hydraulic circuits	Core
12. Explains where electronic switches and sensors may be found in hydraulic systems	Core
13. Identifies and use proper size hydraulic lines	Core
14. Describes the relationship between hydraulic pressure and flow	Core
Competency C: Measure and adjust pressure in fluid power systems	**Core or Optional**
PERFORMANCE CRITERIA	
1. Describes the characteristics of air compressors	Core
2. Explains systems used for the distribution and conditioning of air	Core
3. Measures and controls air flow and air pressure	Core
Competency D: Analyze assignment, sequences, and reciprocal effect at interfaces of the system to be controlled	**Core or Optional**
PERFORMANCE CRITERIA	
1. Enters a robot program that uses the pmove command	Core
2. Enters a robot program that uses the grasp and release commands	Core
3. Designs a robot program to perform a basic material handling task	Core
4. Enters a robot program that uses the label and branch commands	Core
5. Enters a robot program that uses the speed and delay commands	Core
6. Designs a robot program that uses looping, speed, and delay commands to move an object	Core
Competency E: Align control concepts and select control equipment	**Core or Optional**
PERFORMANCE CRITERIA	
1. Identifies control system component types	Core
2. Powers up an automated machine	Core
3. Operates a pick and place inventory station	Core
Competency F: Install sensors, actuators, and valving	**Core or Optional**
PERFORMANCE CRITERIA	
1. Connects and operates an inductive proximity sensor	Core
2. Designs a drill motor control circuit which uses an inductive proximity sensor	Core
3. Connects and operates a capacitive proximity sensor	Core
4. Designs a level sensing control circuit which uses a capacitive proximity sensor	Core
5. Connects and operates a photoelectric sensor	Core
6. Connects and operates a motor control circuit with a photoelectric sensor	Core

Competency G: Check and adjust the interaction of connected functions, consider interfaces in localizing errors	Core or Optional
PERFORMANCE CRITERIA	
1. Describes how to interface a PLC to a robot using discrete I/O	Core
2. Designs a mechatronics PLC to robot workstation interface wiring diagram using discrete I/O	Core
Competency H: Evaluate control systems of different designs	**Core or Optional**
PERFORMANCE CRITERIA	
1. Identifies control system component types and evaluate differences	Core
Competency I: Prepare, enter, and test application programs for control systems	**Core or Optional**
PERFORMANCE CRITERIA	
1. Ensures the input data is complete, accurate and valid	Core
2. Ensures the internal processing produces the expected results	Core
3. Ensures the processing accomplishes the desired tasks	Core
4. Ensures output reports are protected from disclosure	Core
Competency J: Monitor program process in mechatronic systems, identify, and rectify errors	**Core or Optional**
PERFORMANCE CRITERIA	
1. Observes equipment for unusual sounds, vibrations, or smells	Core
2. Documents issues or potential problems	Core
3. Notifies supervisor or appropriate individual of need for repairs	Core

JOB FUNCTION 9: Assemble subassemblies and components into machines and systems

Related Technical Instruction		
KNOWLEDGE	**SKILLS**	**TOOLS & TECHNOLOGIES**
• Measurement principles • Risk assessment techniques and protocols • Mathematical calculations and measurements • Equipment effectiveness • Software and coding • Computers and software • Computer installation	• Selecting proper tools and procedures • Using proper procedures in conducting work • Maintaining situational awareness • Performing risk assessment and risk mitigation activities • Clear thinking • Identifying problems and correcting them	• Lubricating and cooling systems • Cylinders and valves • Sensors

Competency A: Identify and troubleshoot sub-assemblies and components and check characteristics are error-free	**Core or Optional**
PERFORMANCE CRITERIA	
1. Informs supervisor of equipment malfunctions	Core
2. Informs proper maintenance personnel of equipment malfunctions	Core
3. Records equipment malfunctions in log book	Core
Competency B: Carry out preliminary installations	**Core or Optional**
PERFORMANCE CRITERIA	
1. Selects a fastener size and type for a motor mount	Core
2. Mounts an electric motor and corrects for a soft foot condition	Core
Competency C: Install lubricating and cooling systems	**Core or Optional**
PERFORMANCE CRITERIA	
1. Installs lubricate and cooling equipment using correct lubricants and coolants as recommended by manufacturer's guidance	Core
Competency D: Install fluid power component, in particular cylinders and valves	**Core or Optional**
PERFORMANCE CRITERIA	
1. Adheres to OSHA, NIOSH, EPA, and other federal and state safety requirements for the workplace	Core
2. Troubleshoots and replaces hydraulic lines	Core

3. Troubleshoots and replaces hydraulic pumps	Core
4. Troubleshoots and replaces hydraulic gauges	Core
5. Troubleshoots and replaces hydraulic filters	Core
6. Troubleshoots and replaces hydraulic directional control valves	Core
7. Troubleshoots and replaces hydraulic pressure control valves	Core
8. Performs adjustments to control oil temperature and pressure	Core
Competency E: Prepare, lay, and connect up pipes and hoses, check for leaks	**Core or Optional**
PERFORMANCE CRITERIA	
1. Starts up and shuts down a hydraulic system and adjust hydraulic pressure control valves in a system that uses a fixed displacement pump	Core
2. Safely starts up a hydraulic power system including pre-start inspection	Core
3. Safely shuts down a hydraulic power system	Core
4. Uses manufacturer's documentation per specific application to determine correct operating pressure	Core
5. Reads a pressure gauge	Core
6. Adjusts the system operating pressure using a relief valve	Core
7. Operates manual valves to direct system flow	Core
8. Adjusts the pressure of a pressure reducing valve	Core
9. Adjusts the system operating pressure	Core
10. Properly selects, aligns, and adjusts types of relief valves, direct and pilot operated	Core
11. Identifies correct pressure-flow characteristics of fixed and variable displacement pumps	Core
Competency F: Match sub-assemblies and components, adjust to the correct functionality, and secure position	**Core or Optional**
PERFORMANCE CRITERIA	
1. Solders and inspects a connection on a printed circuit board	Core
2. Unsolders a connection using a solder wick	Core
3. Unsolders a connection using a solder sucker pump	Core
4. Solders a DB9 connector to a multi-conductor cable	Core
5. Solders wires to the terminals of an electrical component	Core
Competency G: Install mechanical drive systems, drives, gears, and coupling systems and verify the functionality of movable parts	**Core or Optional**
PERFORMANCE CRITERIA	
1. Identifies mechanical power transmission safety	Core
2. Performs a lockout/tagout of a disconnect	Core
3. Uses a spirit level to determine orientation of a surface	Core
4. Selects a fastener size and type for a motor mount	Core
5. Mounts an electric motor and corrects for a soft foot condition	Core
6. Levels an electric motor	Core
7. Uses a digital tachometer to measure motor speed	Core

Competency H: Install and connect circuit devices	Core or Optional
PERFORMANCE CRITERIA	
1. Selects the proper size raceway for same size/type conductors using tables in the NEC	Core
2. Determines conduit size when conductors are of different size and/or types using tables in the NEC	Core
3. Determines electrical box size when conductors are the same size	Core
4. Determines electrical box size when conductors are the different size	Core
Competency I: Install, adjust, and connect sensors	**Core or Optional**
PERFORMANCE CRITERIA	
1. Connects and operates an inductive proximity sensor	Core
2. Designs a drill motor control circuit which uses an inductive proximity sensor	Core
3. Connects and operates a capacitive proximity sensor	Core
4. Designs a level sensing control circuit which uses a capacitive proximity sensor	Core
5. Connects and operates a photoelectric sensor	Core
6. Connects and operates a motor control circuit with a photoelectric sensor	Core
Competency J: Check functions during the installation process	**Core or Optional**
PERFORMANCE CRITERIA	
1. Powers up the machine and checks proper installation	Core

JOB FUNCTION 10: Test and adjust the functioning of mechatronic systems

Related Technical Instruction		
KNOWLEDGE	**SKILLS**	**TOOLS & TECHNOLOGIES**
• Measurement principles • Risk assessment techniques and protocols • Mathematical calculations and measurements • Equipment effectiveness • Software and coding • Computers and software • Computer installation	• Selecting proper tools and procedures • Using proper procedures in conducting work • Maintaining situational awareness • Performing risk assessment and risk mitigation activities • Clear thinking • Identifying problems and correcting them	• Measuring equipment • Sensors • Process valves • Actuators • Variable frequency drives

Competency A: Install/troubleshoot signal processing sub-assemblies and check incoming and outgoing signals	**Core or Optional**
PERFORMANCE CRITERIA	
1. Solders and inspects a connection on a printed circuit board	Core
2. Unsolders a connection using a solder wick	Core
3. Unsolders a connection using a solder sucker pump	Core
4. Solders a DB9 connector to a multi-conductor cable	Core
5. Solders wires to the terminals of an electrical component	Core
6. Troubleshoots sub-assemblies	Core
Competency B: Calibrate measuring equipment for the recording of pressure and temperature	**Core or Optional**
PERFORMANCE CRITERIA	
1. Checks how measuring equipment reads the temperature of two physical constants: the temperature at which ice melts and the boiling point of water	Core
Competency C: Adjust sensing distance of sensors	**Core or Optional**
PERFORMANCE CRITERIA	
1. Designs a level sensing control circuit which uses a capacitive proximity sensor	Core

Competency D: Install and adjust actuators in accordance with technical specifications	Core or Optional
PERFORMANCE CRITERIA	
1. Installs hydraulic actuators	Core
2. Operates hydraulic actuator circuits	Core
Competency E: Locate symptoms and faults for mechanical, fluidic, and electrical equipment through visual checks, testing, and measurement	**Core or Optional**
PERFORMANCE CRITERIA	
1. Determines faults based on the fault display of equipment	Core
2. Troubleshoots the parameter settings of equipment	Core
3. Troubleshoots a circuit in the equipment	Core
4. Manually clears a fault on equipment	Core
Competency F: Install and troubleshoot Variable Frequency Drives (VFD)	**Core or Optional**
PERFORMANCE CRITERIA	
1. Programs and connects a Variable Frequency AC Drive for three-wire control	Core
2. Operates a three-wire control circuit using a Variable Frequency AC Drive	Core
3. Programs and operates a two-wire control circuit using a Variable Frequency Drive	Core
4. Programs, connects and operates a Variable Frequency AC Drive for Motor Jogging	Core
5. Controls motor speed using the keypad of a Variable Frequency AC Drive	Core
6. Troubleshoots the parameter settings of a Variable Frequency AC Drive	Core
7. Troubleshoots a circuit that includes a Variable Frequency AC Drive	Core
Competency G: Install, test, and debug automated manufacturing equipment	**Core or Optional**
PERFORMANCE CRITERIA	
1. Designs a robot program that uses looping, speed, and delay commands to move an object	Core
2. Troubleshoots program if issues arise	Core

JOB FUNCTION 11: Commission, operate, and maintain mechatronic systems

Related Technical Instruction		
KNOWLEDGE	**SKILLS**	**TOOLS & TECHNOLOGIES**
• Measurement principles • Risk assessment techniques and protocols • Mathematical calculations and measurements • Equipment effectiveness • Software and coding • Computers and software	• Selecting proper tools and procedures • Using proper procedures in conducting work • Maintaining situational awareness • Performing risk assessment and risk mitigation activities • Clear thinking • Identifying problems and correcting them	• Mechanical and electrical safety fixtures • Mechatronic equipment • Fluid power equipment • Power transmission equipment

Competency A: Check guarding against direct contact	**Core or Optional**
PERFORMANCE CRITERIA	
1. Guards jobsite extension cords with heavy-duty cord covers	Core
Competency B: Check effectiveness of protective measures, in particular, fault current protective equipment, measure insulation, and short circuits	**Core or Optional**
PERFORMANCE CRITERIA	
1. Selects wire size and insulation type for an application using tables in the NEC	Core
2. Select a disconnect for an application	Core
Competency C: Check the effectiveness of mechanical and electrical safety fixtures, in particular emergency off switches and alarm systems	**Core or Optional**
PERFORMANCE CRITERIA	
1. Designs a RS Logix PLC program that uses subroutines to control a motor application with an alarm	Core

Competency D: Test and commission auxiliary and control current circuits including the relevant signal and command transmitters for open and closed loop control and monitoring systems	Core or Optional
PERFORMANCE CRITERIA	
1. Connects and operates a reversing motor circuit with mechanical and auxiliary contact interlocking	Core
Competency E: Check main circuits and gradually commission, measure operational values, adjust target values	**Core or Optional**
PERFORMANCE CRITERIA	
1. Connects and operates a control circuit with an on-delay timer relay	Core
2. Designs a time-driven traffic light circuit using an on-delay timer relay	Core
3. Connects and operates an on-delay timer to control circuit to perform an unloaded start of a motor	Core
4. Designs a control circuit using an on-delay timer to perform a cylinder dwell	Core
5. Designs a control circuit to perform time-driven sequencing using an on-delay timer	Core
6. Connects and operates a control circuit with an on-delay timer relay	Core
Competency F: Commission fluid power equipment	**Core or Optional**
PERFORMANCE CRITERIA	
1. Connects and operates a relay to energize a fluid power solenoid	Core
Competency G: Check and secure fixing, energy supply, lubrication, cooling, and disposal systems	**Core or Optional**
PERFORMANCE CRITERIA	
1. Checks and secures fixtures to the machine	Core
2. Lubricates equipment using correct lubricants and as recommended by manufacturer's guidance	Core
3. Performs a preventive maintenance procedure for a given machine to extend machine life and minimize downtime	Core
Competency H: Load and secure programs and data, check and adjust program process	**Core or Optional**
PERFORMANCE CRITERIA	
1. Uploads a robotics program to equipment	Core
2. Downloads a robotic program to equipment	Core
3. Saves a robotic program to equipment	Core
4. Runs a robotic program on equipment	Core

Competency I: Check protective measures for electromagnetic compatibility	Core or Optional
PERFORMANCE CRITERIA	
1. Tests an electromagnetic field and connects a relay	Core
Competency J: Identify system parameters at the time when commissioning takes place, compare with stipulated values, and adjust	**Core or Optional**
PERFORMANCE CRITERIA	
1. Checks and identifies the systems parameters	Core
2. Troubleshoots the parameter settings of the mechatronic system	Core
Competency K: Inspect mechatronic systems, check function of safety systems, and protocol checks	**Core or Optional**
PERFORMANCE CRITERIA	
1. Properly inspects dimensions of shafts and other components	Core
2. Correctly uses safety checklist to make sure equipment is ready to come online, that safety devices are operation, and that machine interlocks are functioning properly	Core
Competency L: Dismantle devices and sub-assemblies noting their function and label parts with regard to position and functional alignment	**Core or Optional**
PERFORMANCE CRITERIA	
1. Dismantles devices and sub-assemblies noting their function and label parts with regard to position and functional alignment	Core
Competency M: Correct malfunctions by conducting remedial procedures and exchanging parts and sub-assemblies	**Core or Optional**
PERFORMANCE CRITERIA	
1. Corrects malfunctions by conducting remedial procedures and exchanging parts and sub-assemblies	Core
Competency N: Correct software errors	**Core or Optional**
PERFORMANCE CRITERIA	
1. Correctly identifies any software errors and writes or types up changes to prints	Core
Competency O: Compare system parameters with stipulated values and make adjustments	**Core or Optional**
PERFORMANCE CRITERIA	
1. Views and edits parameters in an AC VFD using an onboard HMI	Core

Competency P: Repair mechatronic systems according due consideration to company processes	Core or Optional
PERFORMANCE CRITERIA	
1. Properly starts-up, operates, and shutdowns the system	Core
2. Disassembles and reassembles mechanical unit	Core
3. Uses company manual for repair and ordering of spare parts	Core
4. Performs preventive maintenance procedures on the system	Core
5. Calibrates system with calibration fixtures	Core

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