



INDUSTRIAL INSTRUMENTATION & CONTROLS TECHNOLOGY ALLIANCE
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October 2, 2008

The Industrial Instrumentation and Controls Technology Alliance has reviewed and adopted the skills standards for Industrial Instrumentation and Controls Technicians in this booklet. In addition, the organization has endorsed eight core courses which our membership believes that, upon successful completion, provides the necessary fundamentals for entry level employment.

We invite you to review these standards and courses and align your curriculum with them, thereby aligning with our national effort to provide standards for Instrumentation and Controls education.

The IICTA also invites you to join our organization and assist us in our efforts to increase the numbers of students that are pursuing this course of study. For educators, partnering with the IICTA provides your students the opportunity to apply for industry-sponsored scholarships from our non-profit corporation. Industry partners are able to substantially influence the national educational system by helping us provide a real “industry voice,” enabling the system to understand and meet the national needs of industry.

For additional information, please refer to our website at www.iicta.org or email our General Manager at generalmanager@iicta.org.

Thank you for your interest in Instrumentation and Controls and in the IICTA.

Johnny H. Payne
President

Occupational Title: Industrial Instrumentation and Controls Technician

Key Purpose: The Industrial Instrumentation and Controls Technician troubleshoots, maintains, repairs and installs process control and related equipment to produce quality products and ensure safe, cost-effective operations.

Critical Work Functions

- | | |
|--|-------------|
| 1. Install and commission new industrial control system equipment in a new application | AEKS Matrix |
| 2. Maintain, calibrate, lubricate, clean and tune industrial control system equipment | AEKS Matrix |
| 3. Troubleshoot and diagnose malfunctions of industrial control system equipment | AEKS Matrix |
| 4. Repair or replace malfunctioning industrial control system equipment | AEKS Matrix |
| 5. Maintain, test, clean, verify, repair or replace auxiliary systems | AEKS Matrix |

Note: The Industrial Instrumentation and Controls Technician skill standards were developed by the Industrial Instrumentation and Controls Technology Alliance (IICTA) in collaboration with the Center for Digital and Fieldbus Technological Education at Lee College and funding from the National Science Foundation. The skill standards were recognized November 9, 2004, by the Texas Skill Standards Board (TSSB).

Occupational Title: Industrial Instrumentation and Controls Technician

Key Purpose: The Industrial Instrumentation and Controls Technician troubleshoots, maintains, repairs and installs process control and related equipment to produce quality products and ensure safe, cost-effective operations.

Critical Work Function		Occupational Skills, Knowledge and Conditions			
1 Install and commission new industrial control system equipment in a new application.					
Key Activities		Performance Criteria		Occupational Skills and Knowledge	Conditions
Those duties or task clusters that are necessary to perform each critical work function.		Specific demonstrable performance and standards that indicate when the key activity has been performed successfully.		Those skills and knowledge that are specific to the occupation, such as technical processes or procedures common across the occupation that are critical to the related key activity.	Tools, resources and equipment necessary to carry out key activities and their related performance criteria.
KA1.1	Install pneumatic, electronic and digital controllers, and remote telemetry units.	Number	Criteria	Read and redline P&IDs Read and use instrument loop sheets Read and use specification sheets Read and use ladder diagrams Use of reference material Use or conversion of measurements to the metric system Knowledge of math (trigonometry) Knowledge of basic electrical AC/DC theory Ability to learn new technology Knowledge of test equipment Preparation of Job Safety Analysis Knowledge of permits and area classifications Proper tubing and wiring installation Proper use of hand tools Knowledge of controller schemes (e.g. PID, ratio, cascade, feedforward, etc.)	Personal Protective Equipment (PPE) P&IDs Loop sheets Specification sheets Ladder diagrams Reference material Site-specific safety procedures Job Safety Analysis (JSA) Material Safety Data Sheets (MSDS) Permits and area classifications Hand tools Digital volt meter Tubing and conduit benders
		1.1.1	Installation meets the requirements of company/manufacturer/Health, Safety and Environment work practices, area classifications and specific application.		
		1.1.2	Controller is configured according to the application.		
		1.1.3	Controller is calibrated to engineering specifications using certified standards when applicable.		
		1.1.4	Physical inspection meets company/manufacturer/industry standards.		
		1.1.5	Functional test meets company/manufacturer/industry standards.		
		1.1.6	Known inputs result in expected outputs as specified by the manufacturer.		
		1.1.7	Documentation is completed according to company guidelines.		

KA1.2	Install pneumatic, electronic and digital control valves, and self operated pressure regulators.	Number	Criteria	Read and redline P&IDs Read and use instrument loop sheets Read and use specification sheets Use of reference material Knowledge of math Knowledge of basic electrical AC/DC theory Ability to learn new technology Knowledge of computerized maintenance programs Knowledge of test equipment Preparation of Job Safety Analysis Knowledge of permits and area classifications Proper use of hand tools Tubing and wiring installation Knowledge of controller schemes (e.g. PID, ratio, cascade, feedforward, etc.) Knowledge of piping specifications Basic rigging	Personal Protective Equipment (PPE) P&IDs Loop sheets Specification sheets Reference material Site-specific safety procedures Computerized maintenance programs Job Safety Analysis (JSA) Material Safety Data Sheets (MSDS) Permits and area classifications Data forms Hand tools Digital volt meter Tubing and conduit benders Protocol communicator Signal simulator
		1.2.1	Installation meets the requirements of company/manufacturer/Health, Safety and Environment work practices, area classifications and specific application.		
		1.2.2	Control valve / positioner is configured according to the application.		
		1.2.3	Control valve / positioner is calibrated to engineering specifications using certified standards when applicable.		
		1.2.4	Physical inspection meets company/manufacturer/industry standards.		
		1.2.5	Functional test meets company/manufacturer/industry standards.		
		1.2.6	Known inputs result in expected outputs as specified by the manufacturer.		
		1.2.7	Documentation is completed according to company guidelines.		

KA1.3	Install current to pneumatic (I/P), pneumatic to current (P/I), voltage to current (E/I), current to voltage (I/E), digital to analog, (D/A), and analog to digital (A/D) transducers.	Number	Criteria	Read and redline P&IDs Read and use instrument loop sheets Read and use specification sheets Use of reference material Knowledge of basic electrical AC/DC theory Ability to learn new technology Knowledge of computerized maintenance programs Knowledge of test equipment Preparation of Job Safety Analysis Knowledge of permits and area classifications Proper use of hand tools Tubing and wiring installation	Personal Protective Equipment (PPE) P&IDs Loop sheets Specification sheets Reference material Site-specific safety procedures Computerized maintenance programs Job Safety Analysis (JSA) Material Safety Data Sheets (MSDS) Permits and area classifications Data forms Hand tools Digital volt meter Portable pressure tester Signal simulator
		1.3.1	Installation meets the requirements of company/manufacturer/Health, Safety and Environment work practices, area classifications and specific application.		
		1.3.2	Transducer is configured according to the application.		
		1.3.3	Transducer is calibrated to engineering specifications using certified standards when applicable.		
		1.3.4	Physical inspection meets company/manufacturer/industry standards.		
		1.3.5	Functional test meets company/manufacturer/industry standards.		
		1.3.6	Known inputs result in expected outputs as specified by the manufacturer.		
		1.3.7	Documentation is completed according to company guidelines.		

KA1.4	Install pneumatic, electronic and digital transmitters and measuring devices.	Number	Criteria		
		1.4.1	Installation meets the requirements of company/manufacturer/Health, Safety and Environment work practices, area classifications and specific application.	Read and redline P&IDs Read and use instrument loop sheets Read and use specification sheets Use of reference material Knowledge of math Knowledge of the controlled process Knowledge of basic electrical AC/DC theory	Personal Protective Equipment (PPE) P&IDs Loop sheets Specification sheets Reference material Site-specific safety procedures Computerized maintenance programs Job Safety Analysis (JSA) Material Safety Data Sheets (MSDS)
		1.4.2	Transmitter is configured according to the application.	Ability to learn new technology Knowledge of computerized maintenance programs	Permits and area classifications Data forms Hand tools
		1.4.3	Transmitter is calibrated to engineering specifications using certified standards when applicable.	Knowledge of test equipment Preparation of Job Safety Analysis	Test equipment
		1.4.4	Physical inspection meets company/manufacturer/industry standards.	Knowledge of permits and area classifications Proper use of hand tools Tubing and wiring installation	Tubing and conduit benders Digital volt meter Portable pressure tester Protocol communicator
		1.4.5	Functional test meets company/manufacturer/industry standards.	Knowledge of piping specifications Configuration and calibration knowledge	Signal simulator Temperature calibration equipment
		1.4.6	Known inputs result in expected outputs as specified by the manufacturer.		
		1.4.7	Documentation is completed according to company guidelines.		

KA1.5	Install pneumatic, electronic and digital relays and alarm panels.	Number	Criteria	Read and redline P&IDs Read and use instrument loop sheets Read and use specification sheets Use of reference material Knowledge of basic electrical AC/DC theory Ability to learn new technology Knowledge of test equipment Preparation of Job Safety Analysis Knowledge of permits and area classifications Proper use of hand tools Tubing and wiring installation Proper use of test equipment	Personal Protective Equipment (PPE) P&IDs Loop sheets Specification sheets Reference material Site-specific safety procedures Computerized maintenance programs Job Safety Analysis (JSA) Material Safety Data Sheets (MSDS) Permits and area classifications Data forms Hand tools Digital volt meter Portable pressure tester
		1.5.1	Installation meets the requirements of company/manufacturer/Health, Safety and Environment work practices, area classifications and specific application.		
		1.5.2	Relay is configured according to the application.		
		1.5.3	Relay is calibrated to engineering specifications using certified standards when applicable.		
		1.5.4	Physical inspection meets company/manufacturer/industry standards.		
		1.5.5	Functional test meets company/manufacturer/industry standards.		
		1.5.6	Known inputs result in expected outputs as specified by the manufacturer.		
		1.5.7	Documentation is completed according to company guidelines.		

KA1.6	Install pH, conductivity, gas chromatograph, turbidity, infrared, combustible, ultraviolet, oxygen, lower explosive limit and other analyzers and sample systems.	Number	Criteria	Read and redline P&IDs Read and use instrument loop sheets Read and use specification sheets Read and use computer control logic Use of reference material Use or conversion of measurements to the metric system	Personal Protective Equipment (PPE) P&IDs Loop sheets Specification sheets Control logic diagrams Reference material Site-specific safety procedures
		1.6.1	Installation meets the requirements of company/manufacturer/Health, Safety and Environment work practices, area classifications and specific application.	Knowledge of the controlled process Knowledge of math (algebra and trig)	Computerized maintenance programs
		1.6.2	Analyzer is configured according to the application.	Knowledge of physics Knowledge of basic electrical AC/DC theory	Job Safety Analysis (JSA) Material Safety Data Sheets (MSDS)
		1.6.3	Analyzer is calibrated to engineering specifications using certified standards when applicable.	Ability to learn new technology Knowledge of computerized maintenance programs	Permits and area classifications Data forms Hand tools
		1.6.4	Physical inspection meets company/manufacturer/industry standards.	Preparation of Job Safety Analysis Knowledge of permits and area classifications	Tubing and conduit benders Analyzer specific calibration standards
		1.6.5	Functional test meets company/manufacturer/industry standards.	Knowledge of analyzer specific calibration equipment	Screens, filters, and bottles
		1.6.6	Known inputs result in expected outputs as specified by the manufacturer.	Knowledge of environmental, regulatory, service requirements and consequences of sample release	Analyzer specific calibration equipment
		1.6.7	Documentation is completed according to company guidelines.	Ability to interpret calibration results Calibration and configuration knowledge Knowledge of standards (I.e. gases, buffers, samples, color charts, etc.) Proper use of hand tools Tubing and wiring installation	

KA1.7	Install pneumatic, electronic and digital switches.	Number	Criteria	Read and redline P&IDs Read and use instrument loop sheets Read and use specification sheets Use of reference material Knowledge of basic electrical AC/DC theory Ability to learn new technology Knowledge of test equipment Preparation of Job Safety Analysis Knowledge of permits and area classifications Proper use of hand tools Tubing and wiring installation Proper use of test equipment	Personal Protective Equipment (PPE) P&IDs Loop sheets Specification sheets Reference material Site-specific safety procedures Computerized maintenance programs Job Safety Analysis (JSA) Material Safety Data Sheets (MSDS) Permits and area classifications Data forms Hand tools Digital volt meter Portable pressure tester
		1.7.1	Installation meets the requirements of company/manufacturer/Health, Safety and Environment work practices, area classifications and specific application.		
		1.7.2	Switch is configured according to the application.		
		1.7.3	Switch is calibrated to engineering specifications using certified standards when applicable.		
		1.7.4	Physical inspection meets company/manufacturer/industry standards.		
		1.7.5	Functional test meets company/manufacturer/industry standards.		
		1.7.6	Known inputs result in expected outputs as specified by the manufacturer.		
		1.7.7	Documentation is completed according to company guidelines.		

KA1.8	Install electronic, digital and variable frequency drive (VFD) or variable speed drive (VSD) motor controllers.	Number	Criteria		
		1.8.1	Installation meets the requirements of company/manufacturer/Health, Safety and Environment work practices, area classifications and specific application.	Read and redline P&IDs Read and redline electrical drawings Read and use instrument loop sheets Read and use specification sheets Read and use control logic diagrams Use of reference material Knowledge of math	Personal Protective Equipment (PPE) P&IDs Electrical drawings Loop sheets Specification sheets Control logic diagrams Reference material
		1.8.2	Motor controller is configured according to the application.	Electrical knowledge Motor control circuit knowledge	Site-specific safety procedures Computerized maintenance programs
		1.8.3	Motor controller is calibrated to engineering specifications using certified standards when applicable.	Knowledge of gated power devices (SCR, triacs, etc.) Ability to learn new technology	Job Safety Analysis (JSA) Material Safety Data Sheets (MSDS) Permits and area classifications
		1.8.4	Physical inspection meets company/manufacturer/industry standards.	Knowledge of computerized maintenance programs Preparation of Job Safety Analysis	Data forms Hand tools Volt-ohm meter Hot sticks
		1.8.5	Functional test meets company/manufacturer/industry standards.	Knowledge of permits and area classifications Proper use of hand tools	Digital volt meter Oscilloscope Tubing and conduit benders
		1.8.6	Known inputs result in expected outputs as specified by the manufacturer.	Knowledge of electrical wiring Knowledge of electrical test equipment	Hypot tester Protocol communicator Megohm meter Amp probe
		1.8.7	Documentation is completed according to company guidelines.	Knowledge of configuration requirements	Phase comparison tester Signal simulator Non-contact voltage tester

KA1.9	Install DCS, PLC and fieldbus process control networks.	Number	Criteria	Read and redline P&IDs Read and redline PC network drawings Read and use specification sheets Knowledge of basic electrical AC/DC theory Ability to learn new technology Knowledge of computerized maintenance programs Knowledge of test equipment Preparation of Job Safety Analysis Knowledge of industrial communication protocols Knowledge of cable connector requirements	Personal Protective Equipment (PPE) P&IDs Network drawings Specification sheets Reference material Site-specific safety procedures Computerized maintenance programs Job Safety Analysis (JSA) Data forms Hand tools Cable testers Digital volt meter Oscilloscope Protocol analyzer
		1.9.1	Installation meets the requirements of company/manufacturer/Health, Safety and Environment work practices, area classifications and specific application.		
		1.9.2	Process control network is configured according to application.		
		1.9.3	Process control network is calibrated to engineering specifications using certified standards when applicable.		
		1.9.4	Physical inspection meets company/manufacturer/industry standards.		
		1.9.5	Functional test meets company/manufacturer/industry standards.		
		1.9.6	Known inputs result in expected outputs as specified by the manufacturer.		
		1.9.7	Documentation is completed according to company guidelines.		

KA1.10	Install 600-volt or less motors and rotating equipment protection devices such as vibration monitoring and motor control relays.	Number	Criteria			
		1.10.1	Installation meets the requirements of company/manufacturer/Health, Safety and Environment work practices, area classifications and specific application.	Read and redline electrical drawings Read and use specification sheets Read and use motor control logic diagrams Use of reference material Use or conversion of electric circuit measurements	Personal Protective Equipment (PPE) Electrical drawings Specification sheets Motor control logic diagrams Reference material Site-specific safety procedures Computerized maintenance programs	
		1.10.2	Motor is configured according to the application.	Knowledge of math (trigonometry) Knowledge of physics (length and leverage)	Job Safety Analysis (JSA) Material Safety Data Sheets (MSDS) Permits and area classifications	Data forms
		1.10.3	Physical inspection meets company/manufacturer/industry standards.	Electrical knowledge Motor control circuit knowledge Ability to learn new technology	Hand tools Volt-ohm meter Digital volt meter Oscilloscope	Tubing and conduit benders
		1.10.4	Functional test meets company/manufacturer/industry standards.	Knowledge of computerized maintenance programs Preparation of Job Safety Analysis	Wobulator Hypot tester Megohm meter	Amp probe
		1.10.5	Known inputs result in expected outputs as specified by the manufacturer.	Knowledge of national electric code Knowledge of phasing and motor rotation	Phase comparison tester	Non-contact voltage tester
		1.10.6	Documentation is completed according to company guidelines.	Read and use nameplate data Calibrating vibration monitors Basic rigging		

Occupational Title: Industrial Instrumentation and Controls Technician

Academic and Employability Knowledge and Skill Matrix

CWF 1 Install and commission new industrial control system equipment in a new application.

Listening	Speaking	Using Information and Communications Technology	Gathering and Analyzing Information	Analyzing and Solving Problems	Making Decisions and Judgments	Organizing and Planning	Using Social skills	Adaptability	Working in Teams	Leading Others	Building Consensus	Self and Career Development	Writing	Reading	Mathematics	Science
4	3	4	4	3	3	2	3	4	4	1	1	3	2	5	3	3

Statement of Assessment

Strategy:

Tools: The assessment process should include the following.

Written tests that include:

- 1) True-false, multiple choice and essay questions that rely on extended responses to further clarify an understanding of the knowledge being assessed.
- 2) Graphic representations (e.g. P&IDs, loop drawings and one-line electrical drawings) that reveals an understanding of symbology and connections between processes and devices.
- 3) Preparation and justification of a reasonable solution to a problem scenario.

Hands-on demonstrations of knowledge, skills and attitudes that:

- 1) Represents a problematic or challenging situation in the context of a career-technical perspective.
- 2) Involves a real life scenario, problem or situation to solve.
- 3) Applies relevant knowledge or skills.
- 4) Focuses on the application of knowledge and skills learned in one situation as it connects to a new and different one.
- 5) Reveals an ability to plan, organize and create a product or an event.
- 6) Requires study to analyze or evaluate the problem or situation.
- 7) Illustrates by individual performance the attained levels of knowledge, skills and attitudes.
- 8) Includes observation of events, groups and individuals that focuses on the salient traits of the skill or attitude being observed.

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Key Purpose: The Industrial Instrumentation and Controls Technician troubleshoots, maintains, repairs and installs process control and related equipment to produce quality products and ensure safe, cost-effective operations.

Critical Work Function		Occupational Skills, Knowledge and Conditions																			
2 Maintain, calibrate, lubricate, clean and tune industrial control system equipment.																					
Key Activities	Performance Criteria	Occupational Skills and Knowledge	Conditions																		
Those duties or task clusters that are necessary to perform each critical work function.	Specific demonstrable performance and standards that indicate when the key activity has been performed successfully.	Those skills and knowledge that are specific to the occupation, such as technical processes or procedures common across the occupation that are critical to the related key activity.	Tools, resources and equipment necessary to carry out key activities and their related performance criteria.																		
KA2.1 Maintain pneumatic, electronic and digital controllers, and remote telemetry units.	<table border="1"> <thead> <tr> <th>Number</th> <th>Criteria</th> </tr> </thead> <tbody> <tr> <td>2.1.1</td> <td>Work is performed to meet the requirements of company/manufacturer/ Health, Safety and Environment work practices, specific application and area classification.</td> </tr> <tr> <td>2.1.2</td> <td>Routine maintenance is performed according to job scope.</td> </tr> <tr> <td>2.1.3</td> <td>Physical inspection meets company/manufacturer/industry parameters.</td> </tr> <tr> <td>2.1.4</td> <td>Configuration is verified according to the application.</td> </tr> <tr> <td>2.1.5</td> <td>Calibration is verified according to engineering specifications with certified standards when applicable.</td> </tr> <tr> <td>2.1.6</td> <td>Functional test meets company/manufacturer/industry standards.</td> </tr> <tr> <td>2.1.7</td> <td>Known inputs result in expected outputs as specified by the manufacturer.</td> </tr> <tr> <td>2.1.8</td> <td>Documentation is completed according to company guidelines.</td> </tr> </tbody> </table>	Number	Criteria	2.1.1	Work is performed to meet the requirements of company/manufacturer/ Health, Safety and Environment work practices, specific application and area classification.	2.1.2	Routine maintenance is performed according to job scope.	2.1.3	Physical inspection meets company/manufacturer/industry parameters.	2.1.4	Configuration is verified according to the application.	2.1.5	Calibration is verified according to engineering specifications with certified standards when applicable.	2.1.6	Functional test meets company/manufacturer/industry standards.	2.1.7	Known inputs result in expected outputs as specified by the manufacturer.	2.1.8	Documentation is completed according to company guidelines.	<p>Read and redline P&IDs Read and use instrument loop sheets Read and use specification sheets Read and use ladder logic diagrams Use of reference material Knowledge of math Knowledge of basic electrical AC/DC theory Ability to learn new technology Knowledge of computerized maintenance programs Knowledge of test equipment Preparation of Job Safety Analysis Knowledge of permits and area classifications Proper use of hand tools Tubing and wiring installation Knowledge of controller schemes (e.g. PID, ratio, cascade, feedforward, etc.) Understand consequences of changes Knowledge of preventive maintenance schedules</p>	<p>Personal Protective Equipment (PPE) P&IDs Loop sheets Specification sheets Ladder logic diagrams Reference material Site-specific safety procedures Computerized maintenance programs Job Safety Analysis (JSA) Material Safety Data Sheets (MSDS) Permits and area classifications Data forms Hand tools Digital volt meter Protocol communicator Signal simulator</p>
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KA2.2	Maintain pneumatic, electronic and digital control valves, and self operated pressure regulators.	Number	Criteria	Read and redline P&IDs Read and use instrument loop sheets Read and use specification sheets Use of reference material Knowledge of basic electrical AC/DC theory Ability to learn new technology Knowledge of computerized maintenance programs Knowledge of test equipment Preparation of Job Safety Analysis Knowledge of permits and area classifications Proper use of hand tools Tubing and wiring installation Knowledge of controller schemes (e.g. PID, ratio, cascade, feedforward, etc.) Understand consequences of changes Knowledge of preventive maintenance schedules	Personal Protective Equipment (PPE) P&IDs Loop sheets Specification sheets Reference material Site-specific safety procedures Computerized maintenance programs Job Safety Analysis (JSA) Material Safety Data Sheets (MSDS) Permits and area classifications Data forms Hand tools Digital volt meter Protocol communicator Signal simulator
		2.2.1	Work is performed to meet the requirements of company/manufacturer/ Health, Safety and Environment work practices, specific application and area classification.		
		2.2.2	Routine maintenance is performed according to job scope.		
		2.2.3	Physical inspection meets company/manufacturer/industry parameters.		
		2.2.4	Configuration is verified according to the application.		
		2.2.5	Calibration is verified according to engineering specifications with certified standards when applicable.		
		2.2.6	Functional test meets company/manufacturer/industry standards.		
		2.1.7	Known inputs result in expected outputs as specified by the manufacturer.		
		2.1.8	Documentation is completed according to company guidelines.		

KA2.3	Maintain current to pneumatic (I/P), pneumatic to current (P/I), voltage to current (E/I), current to voltage (I/E), digital to analog, (D/A), and analog to digital (A/D) transducers.	Number	Criteria	Read and redline P&IDs Read and use instrument loop sheets Read and use specification sheets Use of reference material Knowledge of basic electrical AC/DC theory Ability to learn new technology Knowledge of computerized maintenance programs Knowledge of test equipment Preparation of Job Safety Analysis Knowledge of permits and area classifications Proper use of hand tools Tubing and wiring installation Understand consequences of changes Knowledge of preventive maintenance schedules	Personal Protective Equipment (PPE) P&IDs Loop sheets Specification sheets Reference material Site-specific safety procedures Computerized maintenance programs Job Safety Analysis (JSA) Material Safety Data Sheets (MSDS) Permits and area classifications Data forms Hand tools Digital volt meter Portable pressure tester Signal simulator
		2.3.1	Work is performed to meet the requirements of company/manufacturer/ Health, Safety and Environment work practices, specific application and area classification.		
		2.3.2	Routine maintenance is performed according to job scope.		
		2.3.3	Physical inspection meets company/manufacturer/industry parameters.		
		2.3.4	Configuration is verified according to the application.		
		2.3.5	Calibration is verified according to engineering specifications with certified standards when applicable.		
		2.3.6	Functional test meets company/manufacturer/industry standards.		
		2.3.7	Known inputs result in expected outputs as specified by the manufacturer.		
		2.3.8	Documentation is completed according to company guidelines.		

KA2.4	Maintain pneumatic, electronic and digital transmitters and measuring devices.	Number	Criteria	Read and redline P&IDs Read and use instrument loop sheets Read and use specification sheets Use of reference material Knowledge of basic electrical AC/DC theory Ability to learn new technology Knowledge of computerized maintenance programs Knowledge of test equipment Preparation of Job Safety Analysis Knowledge of permits and area classifications Proper use of hand tools Tubing and wiring installation Understand consequences of changes Knowledge of preventive maintenance schedules	Personal Protective Equipment (PPE) P&IDs Loop sheets Specification sheets Reference material Site-specific safety procedures Computerized maintenance programs Job Safety Analysis (JSA) Material Safety Data Sheets (MSDS) Permits and area classifications Data forms Hand tools Digital volt meter Portable pressure tester Signal simulator
		2.4.1	Work is performed to meet the requirements of company/manufacturer/ Health, Safety and Environment work practices, specific application and area classification.		
		2.4.2	Routine maintenance is performed according to job scope.		
		2.4.3	Physical inspection meets company/manufacturer/industry parameters.		
		2.4.4	Configuration is verified according to the application.		
		2.4.5	Calibration is verified according to engineering specifications with certified standards when applicable.		
		2.4.6	Functional test meets company/manufacturer/industry standards.		
		2.4.7	Known inputs result in expected outputs as specified by the manufacturer.		
		2.4.8	Documentation is completed according to company guidelines.		

KA2.5	Maintain pneumatic, electronic and digital relays and alarm panels.	Number	Criteria			
		2.5.1	Work is performed to meet the requirements of company/manufacturer/ Health, Safety and Environment work practices, specific application and area classification.	Read and redline P&IDs Read and use instrument loop sheets Read and use specification sheets Use of reference material Knowledge of the controlled process Knowledge of math Knowledge of basic electrical AC/DC theory	Personal Protective Equipment (PPE) P&IDs Loop sheets Specification sheets Reference material Site-specific safety procedures Computerized maintenance programs Job Safety Analysis (JSA) Material Safety Data Sheets (MSDS) Permits and area classifications Data forms Hand tools Test equipment Digital volt meter Portable pressure tester Protocol communicator Signal simulator Temperature calibration equipment	
		2.5.2	Routine maintenance is performed according to job scope.	Ability to learn new technology Knowledge of computerized maintenance programs		
		2.5.3	Physical inspection meets company/manufacturer/industry parameters.	Knowledge of test equipment Preparation of Job Safety Analysis		
		2.5.4	Configuration is verified according to the application.	Knowledge of permits and area classifications Proper use of hand tools		
		2.5.5	Calibration is verified according to engineering specifications with certified standards when applicable.	Tubing and wiring installation Configuration and calibration knowledge Understand consequences of changes Knowledge of preventive maintenance schedules		
		2.5.6	Functional test meets company/manufacturer/industry standards.			
		2.5.7	Known inputs result in expected outputs as specified by the manufacturer.			
		2.5.8	Documentation is completed according to company guidelines.			

KA2.6	Maintain pH, conductivity, gas chromatograph, turbidity, infrared, combustible, ultraviolet, oxygen, lower explosive limit and other analyzers and sample systems.	Number	Criteria		
		2.6.1	Work is performed to meet the requirements of company/manufacturer/ Health, Safety and Environment work practices, specific application and area classification.	Read and redline P&IDs Read and use instrument loop sheets Read and use specification sheets Read and use control logic diagrams Use of reference material Use or conversion of measurements to the metric system	Personal Protective Equipment (PPE) P&IDs Loop sheets Specification sheets Control logic diagrams Reference material Site-specific safety procedures
		2.6.2	Routine maintenance is performed according to job scope.	Knowledge of math Knowledge of chemistry Knowledge of physics Knowledge of basic electrical AC/DC theory	Computerized maintenance programs Job Safety Analysis (JSA) Material Safety Data Sheets (MSDS) Permits and area classifications Data forms Hand tools Protocol communicator Tubing and conduit benders
		2.6.3	Physical inspection meets company/manufacturer/industry parameters.	Ability to learn new technology Knowledge of computerized maintenance programs Preparation of Job Safety Analysis	Analyzer specific calibration equipment Analyzer specific calibration standards Screens, filters, and bottles Analyzer specific calibration equipment
		2.6.4	Configuration is verified according to the application.	Knowledge of permits and area classifications Proper use of hand tools Knowledge of analyzer specific calibration equipment	
		2.6.5	Calibration is verified according to engineering specifications with certified standards when applicable.	Knowledge of environmental, regulatory, service requirements and consequences of sample release Ability to interpret calibration results Calibration and configuration knowledge	
		2.6.6	Functional test meets company/manufacturer/industry standards.	Knowledge of standards (I.e. gases, buffers, samples, color charts, etc.) Proper use of hand tools Tubing and wiring installation	
		2.6.7	Known inputs result in expected outputs as specified by the manufacturer.	Knowledge of legal requirements for in service reporting and custody transfer Knowledge of system interactions (e.g. interlocks and trips) Understand consequences of changes Knowledge of preventive maintenance schedules	
		2.6.8	Documentation is completed according to company guidelines.		

KA2.7	Maintain pneumatic, electronic and digital switches.	Number	Criteria	Read and redline P&IDs Read and use instrument loop sheets Read and use specification sheets Use of reference material Knowledge of basic electrical AC/DC theory Ability to learn new technology Knowledge of computerized maintenance programs Knowledge of test equipment Preparation of Job Safety Analysis Knowledge of permits and area classifications Proper use of hand tools Tubing and wiring installation Understand consequences of changes Knowledge of preventive maintenance schedules	Personal Protective Equipment (PPE) P&IDs Loop sheets Specification sheets Reference material Site-specific safety procedures Computerized maintenance programs Job Safety Analysis (JSA) Material Safety Data Sheets (MSDS) Permits and area classifications Data forms Hand tools Digital volt meter Portable pressure tester
		2.7.1	Work is performed to meet the requirements of company/manufacturer/ Health, Safety and Environment work practices, specific application and area classification.		
		2.7.2	Routine maintenance is performed according to job scope.		
		2.7.3	Physical inspection meets company/manufacturer/industry parameters.		
		2.7.4	Configuration is verified according to the application.		
		2.7.5	Calibration is verified according to engineering specifications with certified standards when applicable.		
		2.7.6	Functional test meets company/manufacturer/industry standards.		
		2.7.7	Known inputs result in expected outputs as specified by the manufacturer.		
		2.7.8	Documentation is completed according to company guidelines.		

KA2.8	Maintain electronic, digital and variable frequency drive (VFD) or variable speed drive (VSD) motor controllers.	Number	Criteria		
		2.8.1	Work is performed to meet the requirements of company/manufacturer/ Health, Safety and Environment work practices, specific application and area classification.	Read and redline P&IDs Read and use instrument loop sheets Read and use electrical drawings Read and use specification sheets Read and use control logic diagrams Use of reference material Knowledge of math	Personal Protective Equipment (PPE) P&IDs Electrical drawings Loop sheets Specification sheets Control logic diagrams Reference material
		2.8.2	Routine maintenance is performed according to job scope.	Electrical knowledge Ability to learn new technology Knowledge of computerized maintenance programs	Site-specific safety procedures Computerized maintenance programs Job Safety Analysis (JSA) Material Safety Data Sheets (MSDS)
		2.8.3	Physical inspection meets company/manufacturer/industry parameters.	Preparation of Job Safety Analysis Knowledge of permits and area classifications	Permits and area classifications Data forms Hand tools
		2.8.4	Configuration is verified according to the application.	Proper use of hand tools Basic mechanical knowledge	Volt-ohm meters Hot sticks
		2.8.5	Calibration is verified according to engineering specifications with certified standards when applicable.	Motor control circuit knowledge Knowledge of gated power devices (SCR, triacs, etc.) Knowledge of electrical wiring	Digital volt meter Oscilloscope Multi-amp tester Protocol communicator
		2.8.6	Functional test meets company/manufacturer/industry standards.	Knowledge of electrical test equipment Knowledge of configuration requirements	Amp probe Infrared camera Non-contact voltage tester
		2.8.7	Known inputs result in expected outputs as specified by the manufacturer.	Understand consequences of changes Knowledge of preventive maintenance schedules	
		2.8.8	Documentation is completed according to company guidelines.		

KA2.9	Maintain DCS, PLC and fieldbus process control networks.	Number	Criteria	Read and use process control network drawings Read and use specification sheets Use of reference material Ability to learn new technology Knowledge of equipment diagnostic indicators Understand consequences of changes Knowledge of preventive maintenance schedules	Process control network drawings Specification sheets Reference material
		2.9.1	Work is performed to meet the requirements of company/manufacturer/ Health, Safety and Environment work practices, specific application and area classification.		
		2.9.2	Process control network is adjusted according to the application.		
		2.9.3	Process control network is calibrated to engineering specifications with certified standards when applicable.		
		2.9.4	Physical inspection meets company/manufacturer/industry parameters.		
		2.9.5	Functional test meets company/manufacturer/industry standards.		
		2.9.6	Known inputs result in expected outputs as specified by the manufacturer.		
		2.9.7	Documentation is completed according to company guidelines.		

KA2.10	Maintain 600-volt or less motors and rotating equipment protection devices such as vibration monitoring and motor control relays.	Number	Criteria		
		2.10.1	Work is performed to meet the requirements of company/manufacturer/ Health, Safety and Environment work practices, specific application and area classification.	Read and redline electrical drawings Read and use specification sheets Read and use control logic diagrams Use of reference material Use or conversion of electrical measurements Knowledge of math	Personal Protective Equipment (PPE) Electrical drawings Control logic diagrams Specification sheets Reference material Site-specific safety procedures Computerized maintenance programs
		2.10.2	Physical inspection meets company/manufacturer/industry parameters.	Electrical knowledge Ability to learn new technology Knowledge of computerized maintenance programs	Job Safety Analysis (JSA) Material Safety Data Sheets (MSDS) Permits and area classifications Data forms
		2.10.3	Functional test meets company/manufacturer/industry standards.	Preparation of Job Safety Analysis Knowledge of permits and area classifications	Hand tools Volt-ohm meters Digital volt meter
		2.10.4	Known inputs result in expected outputs as specified by the manufacturer.	Proper use of hand tools Read and use nameplate data Calibrating vibration monitors	Oscilloscope Wobulator Amp probe
		2.10.5	Documentation is completed according to company guidelines.	Understand consequences of changes Knowledge of preventive maintenance schedules	

Occupational Title: Industrial Instrumentation and Controls Technician

Academic and Employability Knowledge and Skill Matrix

CWF 2 Maintain, calibrate, lubricate, clean and tune industrial control system equipment.

Listening	Speaking	Using Information and Communications Technology	Gathering and Analyzing Information	Analyzing and Solving Problems	Making Decisions and Judgments	Organizing and Planning	Using Social skills	Adaptability	Working in Teams	Leading Others	Building Consensus	Self and Career Development	Writing	Reading	Mathematics	Science
4	3	5	4	4	3	4	3	4	4	1	4	3	3	5	4	4

Statement of Assessment

Strategy:

Tools: The assessment process should include the following.

Written tests that include:

- 1) True-false, multiple choice and essay questions that rely on extended responses to further clarify an understanding of the knowledge being assessed.
- 2) Graphic representations (e.g. P&IDs, loop drawings and one-line electrical drawings) that reveals an understanding of symbology and connections between processes and devices.
- 3) Preparation and justification of a reasonable solution to a problem scenario.

Hands-on demonstrations of knowledge, skills and attitudes that:

- 1) Represents a problematic or challenging situation in the context of a career-technical perspective.
- 2) Involves a real life scenario, problem or situation to solve.
- 3) Applies relevant knowledge or skills.
- 4) Focuses on the application of knowledge and skills learned in one situation as it connects to a new and different one.
- 5) Reveals an ability to plan, organize and create a product or an event.
- 6) Requires study to analyze or evaluate the problem or situation.
- 7) Illustrates by individual performance the attained levels of knowledge, skills and attitudes.
- 8) Includes observation of events, groups and individuals that focuses on the salient traits of the skill or attitude being observed.
- 9) Documentation of the development process from initial steps to final preparation.

Occupational Title: Industrial Instrumentation and Controls Technician

Key Purpose: The Industrial Instrumentation and Controls Technician troubleshoots, maintains, repairs and installs process control and related equipment to produce quality products and ensure safe, cost-effective operations.

Critical Work Function		Occupational Skills, Knowledge and Conditions			
3 Troubleshoot and diagnose malfunctions of industrial control system equipment.					
Key Activities		Performance Criteria		Occupational Skills and Knowledge	Conditions
Those duties or task clusters that are necessary to perform each critical work function.		Specific demonstrable performance and standards that indicate when the key activity has been performed successfully.		Those skills and knowledge that are specific to the occupation, such as technical processes or procedures common across the occupation that are critical to the related key activity.	Tools, resources and equipment necessary to carry out key activities and their related performance criteria.
KA3.1	Troubleshoot pneumatic, electronic and digital controllers, and remote telemetry units	Number	Criteria	Read and redline P&IDs Read and use instrument loop sheets Read and use specification sheets Read and use ladder diagrams Use of reference material Knowledge of the controlled process Knowledge of math Knowledge of physics Knowledge of basic electrical AC/DC theory Ability to learn new technology Knowledge of computerized maintenance programs Knowledge of test equipment Preparation of Job Safety Analysis Knowledge of permits and area classifications Proper use of hand tools Tubing and wiring installation Knowledge of controller schemes (e.g. PID, ratio, cascade, feedforward, etc.)	Personal Protective Equipment (PPE) P&IDs Loop sheets Specification sheets Ladder diagrams Reference material Site-specific safety procedures Computerized maintenance programs Job Safety Analysis (JSA) Material Safety Data Sheets (MSDS) Permits and area classifications Data forms Hand tools Protocol communicator Digital volt meter Signal simulator
		3.1.1	Work is performed to meet the requirements of company/manufacturer/Health, Safety and Environment work practices, specific application and area classification.		
		3.1.2	The point of deviation is identified where the known inputs result in unexpected outputs.		
		3.1.3	Source of malfunction is isolated.		
		3.1.4	Documentation is completed according to company guidelines.		

KA3.2	Troubleshoot pneumatic, electronic and digital control valves, and self operated pressure regulators.	Number	Criteria		
		3.2.1	Work is performed to meet the requirements of company/manufacturer/ Health, Safety and Environment work practices, specific application and area classification.	Read and redline P&IDs Read and use instrument loop sheets Read and use specification sheets Use of reference material Knowledge of math Knowledge of the controlled process Knowledge of basic electrical AC/DC theory Ability to learn new technology	Personal Protective Equipment (PPE) P&IDs Loop sheets Specification sheets Reference material Site-specific safety procedures Computerized maintenance programs Job Safety Analysis (JSA) Material Safety Data Sheets (MSDS)
		3.2.2	The point of deviation is identified where the known inputs result in unexpected outputs.	Knowledge of computerized maintenance programs Knowledge of test equipment Preparation of Job Safety Analysis	Permits and area classifications Data forms Hand tools Digital volt meter
		3.2.3	Source of malfunction is isolated.	Knowledge of permits and area classifications	Tubing and conduit benders Protocol communicator
		3.2.4	Documentation is completed according to company guidelines.	Proper use of hand tools Tubing and wiring installation Knowledge of controller schemes (e.g. PID, ratio, cascade, feedforward, etc.)	Signal simulator

KA3.3	Troubleshoot current to pneumatic (I/P), pneumatic to current (P/I), voltage to current (E/I), current to voltage (I/E), digital to analog, (D/A), and analog to digital (A/D) transducers.	Number	Criteria	Read and redline P&IDs Read and use instrument loop sheets Read and use specification sheets Use of reference material Knowledge of the controlled process Knowledge of basic electrical AC/DC theory Ability to learn new technology Knowledge of computerized maintenance programs Knowledge of test equipment Preparation of Job Safety Analysis Knowledge of permits and area classifications Proper use of hand tools Tubing and wiring installation	Personal Protective Equipment (PPE) P&IDs Loop sheets Specification sheets Reference material Site-specific safety procedures Computerized maintenance programs Job Safety Analysis (JSA) Material Safety Data Sheets (MSDS) Permits and area classifications Data forms Hand tools Digital volt meter Portable pressure tester Signal simulator
		3.3.1	Work is performed to meet the requirements of company/manufacturer/Health, Safety and Environment work practices, specific application and area classification.		
		3.3.2	The point of deviation is identified where the known inputs result in unexpected outputs.		
		3.3.3	Source of malfunction is isolated.		
		3.3.4	Documentation is completed according to company guidelines.		

KA3.4	Troubleshoot pneumatic, electronic and digital transmitters and measuring devices.	Number	Criteria		
		3.4.1	Work is performed to meet the requirements of company/manufacturer/Health, Safety and Environment work practices, specific application and area classification.	Read and redline P&IDs Read and use instrument loop sheets Read and use specification sheets Use of reference material Knowledge of the controlled process Knowledge of math Knowledge of physics Knowledge of basic electrical AC/DC theory	Personal Protective Equipment (PPE) P&IDs Loop sheets Specification sheets Reference material Site-specific safety procedures Computerized maintenance programs Job Safety Analysis (JSA) Material Safety Data Sheets (MSDS)
		3.4.2	The point of deviation is identified where the known inputs result in unexpected outputs.	Ability to learn new technology Knowledge of computerized maintenance programs Knowledge of test equipment	Permits and area classifications Data forms Hand tools Test equipment
		3.4.3	Source of malfunction is isolated.	Preparation of Job Safety Analysis Knowledge of permits and area classifications	Tubing and conduit benders Digital volt meter Portable pressure tester
		3.4.4	Documentation is completed according to company guidelines.	Proper use of hand tools Tubing and wiring installation Knowledge of piping specifications Configuration and calibration knowledge	Protocol communicator Signal simulator Temperature calibration equipment

KA3.5	Troubleshoot pneumatic, electronic and digital relays and alarm panels.	Number	Criteria		
		3.5.1	Work is performed to meet the requirements of company/manufacturer/ Health, Safety and Environment work practices, specific application and area classification.	Read and redline P&IDs Read and use instrument loop sheets Read and use specification sheets Use of reference material Knowledge of the controlled process Knowledge of basic electrical AC/DC theory Ability to learn new technology Knowledge of computerized maintenance programs	Personal Protective Equipment (PPE) P&IDs Loop sheets Specification sheets Reference material Site-specific safety procedures Computerized maintenance programs Job Safety Analysis (JSA) Material Safety Data Sheets (MSDS) Permits and area classifications
		3.5.2	The point of deviation is identified where the known inputs result in unexpected outputs.	Knowledge of test equipment Preparation of Job Safety Analysis Knowledge of permits and area classifications	Data forms Hand tools Digital volt meter Portable pressure tester
		3.5.3	Source of malfunction is isolated.	Proper use of hand tools	
		3.5.4	Documentation is completed according to company guidelines.	Tubing and wiring installation	

KA3.6	Troubleshoot pH, conductivity, gas chromatograph, turbidity, infrared, combustible, ultraviolet, oxygen, lower explosive limit and other analyzers and sample systems.	Number	Criteria		
		3.6.1	Work is performed to meet the requirements of company/manufacturer/ Health, Safety and Environment work practices, specific application and area classification.	Read and redline P&IDs Read and use instrument loop sheets Read and use specification sheets Read and use control logic diagrams Use of reference material Use or conversion of measurements to the metric system Knowledge of the controlled process Knowledge of math	Personal Protective Equipment (PPE) P&IDs Loop sheets Specification sheets Control logic diagrams Reference material Site-specific safety procedures Computerized maintenance programs Job Safety Analysis (JSA)
		3.6.2	The point of deviation is identified where the known inputs result in unexpected outputs.	Knowledge of chemistry Knowledge of physics Knowledge of basic electrical AC/DC theory	Material Safety Data Sheets (MSDS) Permits and area classifications Data forms Hand tools
		3.6.3	Source of malfunction is isolated.	Ability to learn new technology Knowledge of computerized maintenance programs	Tubing and conduit benders Protocol communicator
		3.6.4	Documentation is completed according to company guidelines.	Preparation of Job Safety Analysis Knowledge of permits and area classifications	Analyzer specific calibration standards Screens, filters, and bottles Analyzer specific calibration equipment
				Proper use of hand tools Knowledge of analyzer specific calibration equipment Knowledge of environmental, regulatory, service requirements and consequences of sample release Ability to interpret calibration results Calibration and configuration knowledge Knowledge of standards (I.e. gases, buffers, samples, color charts, etc.) Tubing and wiring installation	

KA3.7	Troubleshoot pneumatic, electronic and digital switches.	Number	Criteria		
		3.7.1	Work is performed to meet the requirements of company/manufacturer/ Health, Safety and Environment work practices, specific application and area classification.	Read and redline P&IDs Read and use instrument loop sheets Read and use specification sheets Use of reference material Knowledge of the controlled process Knowledge of basic electrical AC/DC theory Ability to learn new technology Knowledge of computerized maintenance programs	Personal Protective Equipment (PPE) P&IDs Loop sheets Specification sheets Reference material Site-specific safety procedures Computerized maintenance programs Job Safety Analysis (JSA) Material Safety Data Sheets (MSDS) Permits and area classifications
		3.7.2	The point of deviation is identified where the known inputs result in unexpected outputs.	Knowledge of test equipment Preparation of Job Safety Analysis Knowledge of permits and area classifications	Data forms Hand tools Digital volt meter Portable pressure tester
		3.7.3	Source of malfunction is isolated.	Proper use of hand tools	
		3.7.4	Documentation is completed according to company guidelines.	Tubing and wiring installation	

KA3.8	Troubleshoot electronic, digital and variable frequency drive (VFD) or variable speed drive (VSD) motor controllers.	Number	Criteria		
		3.8.1	Work is performed to meet the requirements of company/manufacturer/ Health, Safety and Environment work practices, specific application and area classification.	Read and redline P&IDs Read and use electrical drawings Read and use instrument loop sheets Read and use specification sheets Read and use control logic diagrams Use of reference material Knowledge of the controlled process Knowledge of math Electrical knowledge	Personal Protective Equipment (PPE) P&IDs Electrical drawings Loop sheets Specification sheets Control logic diagrams Reference material Site-specific safety procedures Computerized maintenance programs
		3.8.2	The point of deviation is identified where the known inputs result in unexpected outputs.	Motor control circuit knowledge Knowledge of gated power devices (SCR, triacs, etc.) Ability to learn new technology	Job Safety Analysis (JSA) Material Safety Data Sheets (MSDS) Permits and area classifications Data forms Hand tools
		3.8.3	Source of malfunction is isolated.	Knowledge of computerized maintenance programs Preparation of Job Safety Analysis	Volt-ohm meter Hot sticks
		3.8.4	Documentation is completed according to company guidelines.	Knowledge of permits and area classifications Proper use of hand tools Knowledge of electrical wiring Knowledge of electrical test equipment Knowledge of configuration requirements	Digital volt meter Oscilloscope Hypot tester Multi-amp tester Protocol communicator Megohm meter Amp probe Infrared camera Signal simulator Non-contact voltage tester Power quality monitor

KA3.9	Troubleshoot DCS, PLC and fieldbus process control networks.	Number	Criteria	Read and ruse process control network drawings Read and use specification sheets Use of reference material Knowledge of the controlled process Knowledge of basic electrical AC/DC theory Ability to learn new technology Knowledge of computerized maintenance programs Knowledge of test equipment Preparation of Job Safety Analysis Knowledge of permits and area classifications Proper use of hand tools Knowledge of industrial communication protocols Knowledge of cable connector requirements Knowledge of equipment diagnostic indicators	Personal Protective Equipment (PPE) Process control network drawings Specification sheets Reference material Site-specific safety procedures Computerized maintenance programs Job Safety Analysis (JSA) Data forms Hand tools Digital volt meter Oscilloscope Protocol analyzer Cable testers
		3.9.1	Work is performed to meet the requirements of company/manufacturer/ Health, Safety and Environment work practices, specific application and area classification.		
		3.9.2	The point of deviation is identified where the known inputs result in unexpected outputs.		
		3.9.3	Source of malfunction is isolated.		
		3.9.4	Documentation is completed according to company guidelines.		

KA3.10	Troubleshoot 600-volt or less motors and rotating equipment protection devices such as vibration monitoring and motor control relays.	Number	Criteria		
		3.10.1	Work is performed to meet the requirements of company/manufacturer/Health, Safety and Environment work practices, specific application and area classification.	Read and redline electrical drawings Read and use specification sheets Read and use control logic diagrams Use of reference material Use or conversion of electrical measurements Knowledge of the controlled process Knowledge of math Knowledge of physics (force and power)	Personal Protective Equipment (PPE) Electrical drawings Specification sheets Motor control logic diagrams Reference material Site-specific safety procedures Computerized maintenance programs Job Safety Analysis (JSA) Material Safety Data Sheets (MSDS)
		3.10.2	The point of deviation is identified where the known inputs result in unexpected outputs.	Electrical knowledge Motor control circuit knowledge Ability to learn new technology Knowledge of computerized maintenance programs	Permits and area classifications Data forms Hand tools Volt-ohm meter Digital volt meter
		3.10.3	Source of malfunction is isolated.	Preparation of Job Safety Analysis Knowledge of national electric code	Oscilloscope Wobulator
		3.10.4	Documentation is completed according to company guidelines.	Knowledge of phasing and motor rotation Read and use nameplate data Calibrating vibration monitors Knowledge of megger tests Knowledge of bridge tests knowledge of power quality	Hypot tester Multi-amp tester Megohm meter Amp probe Infrared camera Non-contact voltage tester

Occupational Title: Industrial Instrumentation and Controls Technician

Academic and Employability Knowledge and Skill Matrix

CWF 3 Troubleshoot and diagnose malfunctions of industrial control system equipment.

Listening	Speaking	Using Information and Communications Technology	Gathering and Analyzing Information	Analyzing and Solving Problems	Making Decisions and Judgments	Organizing and Planning	Using Social skills	Adaptability	Working in Teams	Leading Others	Building Consensus	Self and Career Development	Writing	Reading	Mathematics	Science
4	4	4	5	5	4	5	4	4	5	1	5	3	3	5	4	5

Statement of Assessment

Strategy:

Tools: The assessment process should include the following.

Written tests that include:

- 1) True-false, multiple choice and essay questions that rely on extended responses to further clarify an understanding of the knowledge being assessed.
- 2) Graphic representations (e.g. P&IDs, loop drawings and one-line electrical drawings) that reveals an understanding of symbology and connections between processes and devices.
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Hands-on demonstrations of knowledge, skills and attitudes that:

- 1) Represents a problematic or challenging situation in the context of a career-technical perspective.
- 2) Involves a real life scenario, problem or situation to solve.
- 3) Applies relevant knowledge or skills.
- 4) Focuses on the application of knowledge and skills learned in one situation as it connects to a new and different one.
- 5) Reveals an ability to plan, organize and create a product or an event.
- 6) Requires study to analyze or evaluate the problem or situation.
- 7) Illustrates by individual performance the attained levels of knowledge, skills and attitudes.
- 8) Includes observation of events, groups and individuals that focuses on the salient traits of the skill or attitude being observed.

Occupational Title: Industrial Instrumentation and Controls Technician

Key Purpose: The Industrial Instrumentation and Controls Technician troubleshoots, maintains, repairs and installs process control and related equipment to produce quality products and ensure safe, cost-effective operations.

Critical Work Function		Occupational Skills, Knowledge and Conditions																	
4 Repair or replace malfunctioning industrial control system equipment.																			
Key Activities	Performance Criteria	Occupational Skills and Knowledge	Conditions																
Those duties or task clusters that are necessary to perform each critical work function.	Specific demonstrable performance and standards that indicate when the key activity has been performed successfully.	Those skills and knowledge that are specific to the occupation, such as technical processes or procedures common across the occupation that are critical to the related key activity.	Tools, resources and equipment necessary to carry out key activities and their related performance criteria.																
KA4.1 Repair or replace pneumatic, electronic and digital controllers, and remote telemetry units.	<table border="1"> <thead> <tr> <th>Number</th> <th>Criteria</th> </tr> </thead> <tbody> <tr> <td>4.1.1</td> <td>Corrective repairs are performed according to job scope, company/manufacturer/Health, Safety and Environment work practices, specific application and area classification.</td> </tr> <tr> <td>4.1.2</td> <td>Physical inspection meets company/manufacturer/industry parameters.</td> </tr> <tr> <td>4.1.3</td> <td>Configuration is verified according to the application.</td> </tr> <tr> <td>4.1.4</td> <td>Calibration is verified according to engineering specifications with certified standards when applicable.</td> </tr> <tr> <td>4.1.5</td> <td>Functional test meets company/manufacturer/industry standards.</td> </tr> <tr> <td>4.1.6</td> <td>Known inputs result in expected outputs as specified by the manufacturer.</td> </tr> <tr> <td>4.1.7</td> <td>Documentation is completed according to company guidelines.</td> </tr> </tbody> </table>	Number	Criteria	4.1.1	Corrective repairs are performed according to job scope, company/manufacturer/Health, Safety and Environment work practices, specific application and area classification.	4.1.2	Physical inspection meets company/manufacturer/industry parameters.	4.1.3	Configuration is verified according to the application.	4.1.4	Calibration is verified according to engineering specifications with certified standards when applicable.	4.1.5	Functional test meets company/manufacturer/industry standards.	4.1.6	Known inputs result in expected outputs as specified by the manufacturer.	4.1.7	Documentation is completed according to company guidelines.	<p>Read and redline P&IDs Read and use instrument loop sheets Read and use specification sheets Read and use ladder logic diagrams Use of reference material Knowledge of math Knowledge of basic electrical AC/DC theory Ability to learn new technology Knowledge of computerized maintenance programs Knowledge of test equipment Preparation of Job Safety Analysis Knowledge of permits and area classifications Proper use of hand tools Tubing and wiring installation Knowledge of controller schemes (e.g. PID, ratio, cascade, feedforward, etc.) Knowledge of management of change process</p>	<p>Personal Protective Equipment (PPE) P&IDs Loop sheets Specification sheets Ladder logic diagrams Reference material Site-specific safety procedures Computerized maintenance programs Job Safety Analysis (JSA) Material Safety Data Sheets (MSDS) Permits and area classifications Data forms Hand tools Digital volt meter Tubing and conduit benders Protocol communicator Hand tools</p>
	Number	Criteria																	
	4.1.1	Corrective repairs are performed according to job scope, company/manufacturer/Health, Safety and Environment work practices, specific application and area classification.																	
	4.1.2	Physical inspection meets company/manufacturer/industry parameters.																	
	4.1.3	Configuration is verified according to the application.																	
	4.1.4	Calibration is verified according to engineering specifications with certified standards when applicable.																	
	4.1.5	Functional test meets company/manufacturer/industry standards.																	
	4.1.6	Known inputs result in expected outputs as specified by the manufacturer.																	
4.1.7	Documentation is completed according to company guidelines.																		

KA4.2	Repair or replace pneumatic, electronic and digital control valves, and self operated pressure regulators.	Number	Criteria		
		4.2.1	Corrective repairs are performed according to job scope, company/manufacturer/Health, Safety and Environment work practices, specific application and area classification.	Read and redline P&IDs Read and use instrument loop sheets Read and use specification sheets Use of reference material Knowledge of math Knowledge of chemistry Knowledge of basic electrical AC/DC theory	Personal Protective Equipment (PPE) P&IDs Loop sheets Specification sheets Reference material Site-specific safety procedures Computerized maintenance programs Job Safety Analysis (JSA) Material Safety Data Sheets (MSDS)
		4.2.2	Physical inspection meets company/manufacturer/industry parameters.	Ability to learn new technology Knowledge of computerized maintenance programs	Permits and area classifications Data forms Hand tools
		4.2.3	Configuration is verified according to the application.	Knowledge of test equipment Preparation of Job Safety Analysis	Digital volt meter
		4.2.4	Calibration is verified according to engineering specifications with certified standards when applicable.	Knowledge of permits and area classifications Proper use of hand tools Tubing and wiring installation	Tubing and conduit benders Protocol communicator Signal simulator
		4.2.5	Functional test meets company/manufacturer/industry standards.	Knowledge of controller schemes (e.g. PID, ratio, cascade, feedforward, etc.) Knowledge of management of change process	
		4.2.6	Known inputs result in expected outputs as specified by the manufacturer.	Knowledge of piping specifications	
		4.2.7	Documentation is completed according to company guidelines.		

KA4.3	Repair or replace current to pneumatic (I/P), pneumatic to current (P/I), voltage to current (E/I), current to voltage (I/E), digital to analog, (D/A), and analog to digital (A/D) transducers.	Number	Criteria	Read and redline P&IDs Read and use instrument loop sheets Read and use specification sheets Use of reference material Knowledge of basic electrical AC/DC theory Ability to learn new technology Knowledge of computerized maintenance programs Knowledge of test equipment Preparation of Job Safety Analysis Knowledge of permits and area classifications Proper use of hand tools Tubing and wiring installation Knowledge of management of change process	Personal Protective Equipment (PPE) P&IDs Loop sheets Specification sheets Reference material Site-specific safety procedures Computerized maintenance programs Job Safety Analysis (JSA) Material Safety Data Sheets (MSDS) Permits and area classifications Data forms Hand tools Digital volt meter Portable pressure tester signal simulator
		4.3.1	Corrective repairs are performed according to job scope, company/manufacturer/Health, Safety and Environment work practices, specific application and area classification.		
		4.3.2	Physical inspection meets company/manufacturer/industry parameters.		
		4.3.3	Configuration is verified according to the application.		
		4.3.4	Calibration is verified according to engineering specifications with certified standards when applicable.		
		4.3.5	Functional test meets company/manufacturer/industry standards.		
		4.3.6	Known inputs result in expected outputs as specified by the manufacturer.		
		4.3.7	Documentation is completed according to company guidelines.		

KA4.4	Repair or replace pneumatic, electronic and digital transmitters and measuring devices.	Number	Criteria		
		4.4.1	Corrective repairs are performed according to job scope, company/manufacturer/Health, Safety and Environment work practices, specific application and area classification.	Read and redline P&IDs Read and use instrument loop sheets Read and use specification sheets Use of reference material Use or conversion of measurements to the metric system Knowledge of math Knowledge of physics	Personal Protective Equipment (PPE) P&IDs Loop sheets Specification sheets Reference material Site-specific safety procedures Computerized maintenance programs Job Safety Analysis (JSA)
		4.4.2	Physical inspection meets company/manufacturer/industry parameters.	Knowledge of basic electrical AC/DC theory Ability to learn new technology	Material Safety Data Sheets (MSDS) Permits and area classifications Data forms
		4.4.3	Configuration is verified according to the application.	Knowledge of computerized maintenance programs	Hand tools Test equipment
		4.4.4	Calibration is verified according to engineering specifications with certified standards when applicable.	Knowledge of test equipment Preparation of Job Safety Analysis	Tubing and conduit benders Digital volt meter
		4.4.5	Functional test meets company/manufacturer/industry standards.	Knowledge of permits and area classifications Proper use of hand tools Knowledge of management of change process	Portable pressure tester Protocol communicator Signal simulator
		4.4.6	Known inputs result in expected outputs as specified by the manufacturer.	Tubing and wiring installation Knowledge of piping specifications	Temperature calibration equipment
		4.4.7	Documentation is completed according to company guidelines.	Configuration and calibration knowledge	

KA4.5	Repair or replace pneumatic, electronic and digital relays and alarm panels.	Number	Criteria	Read and redline P&IDs Read and use instrument loop sheets Read and use specification sheets Use of reference material Knowledge of solid state electronics Knowledge of basic electrical AC/DC theory Ability to learn new technology Knowledge of computerized maintenance programs Knowledge of test equipment Preparation of Job Safety Analysis Knowledge of permits and area classifications Proper use of hand tools Tubing and wiring installation Knowledge of management of change process	Personal Protective Equipment (PPE) P&IDs Loop sheets Specification sheets Reference material Site-specific safety procedures Computerized maintenance programs Job Safety Analysis (JSA) Material Safety Data Sheets (MSDS) Permits and area classifications Data forms Hand tools Digital volt meter Portable pressure tester
		4.5.1	Corrective repairs are performed according to job scope, company/manufacturer/Health, Safety and Environment work practices, specific application and area classification.		
		4.5.2	Physical inspection meets company/manufacturer/industry parameters.		
		4.5.3	Configuration is verified according to the application.		
		4.5.4	Calibration is verified according to engineering specifications with certified standards when applicable.		
		4.5.5	Functional test meets company/manufacturer/industry standards.		
		4.5.6	Known inputs result in expected outputs as specified by the manufacturer.		
		4.5.7	Documentation is completed according to company guidelines.		

KA4.6	Repair or replace pH, conductivity, gas chromatograph, turbidity, infrared, combustible, ultraviolet, oxygen, lower explosive limit and other analyzers and sample systems.	Number	Criteria		
		4.6.1	Corrective repairs are performed according to job scope, company/manufacturer/Health, Safety and Environment work practices, specific application and area classification.	Read and redline P&IDs Read and use instrument loop sheets Read and use specification sheets Read and use control logic diagrams Use of reference material Use or conversion of measurements to the metric system Knowledge of the controlled process	Personal Protective Equipment (PPE) P&IDs Loop sheets Specification sheets Control logic diagrams Reference material Site-specific safety procedures Computerized maintenance programs
		4.6.2	Physical inspection meets company/manufacturer/industry parameters.	Knowledge of math Knowledge of physics Knowledge of basic electrical AC/DC theory	Job Safety Analysis (JSA) Material Safety Data Sheets (MSDS) Permits and area classifications Data forms Hand tools
		4.6.3	Configuration is verified according to the application.	Ability to learn new technology	Protocol communicator
		4.6.4	Calibration is verified according to engineering specifications with certified standards when applicable.	Knowledge of computerized maintenance programs Knowledge of test equipment Preparation of Job Safety Analysis	Tubing and conduit benders Analyzer specific calibration standards Screens, filters, and bottles
		4.6.5	Functional test meets company/manufacturer/industry standards.	Knowledge of permits and area classifications Proper use of hand tools	Analyzer specific calibration equipment
		4.6.6	Known inputs result in expected outputs as specified by the manufacturer.	Knowledge of management of change process Knowledge of analyzer specific calibration equipment	
		4.6.7	Documentation is completed according to company guidelines.	Knowledge of environmental, regulatory, service requirements and consequences of sample release Ability to interpret calibration results Calibration and configuration knowledge Knowledge of standards (I.e. gases, buffers, samples, color charts, etc.) Tubing and wiring installation	

KA4.7	Repair or replace pneumatic, electronic and digital switches.	Number	Criteria		
		4.7.1	Corrective repairs are performed according to job scope, company/manufacturer/Health, Safety and Environment work practices, specific application and area classification.	Read and redline P&IDs Read and use instrument loop sheets Read and use specification sheets Use of reference material Knowledge of solid state electronics Knowledge of basic electrical AC/DC theory Ability to learn new technology	Personal Protective Equipment (PPE) P&IDs Loop sheets Specification sheets Reference material Site-specific safety procedures Computerized maintenance programs Job Safety Analysis (JSA)
		4.7.2	Physical inspection meets company/manufacturer/industry parameters.	Knowledge of computerized maintenance programs Knowledge of test equipment Preparation of Job Safety Analysis	Material Safety Data Sheets (MSDS) Permits and area classifications Data forms Hand tools
		4.7.3	Configuration is verified according to the application.	Knowledge of permits and area classifications	Digital volt meter
		4.7.4	Calibration is verified according to engineering specifications with certified standards when applicable.	Proper use of hand tools Tubing and wiring installation Knowledge of management of change process	Portable pressure tester
		4.7.5	Functional test meets company/manufacturer/industry standards.		
		4.7.6	Known inputs result in expected outputs as specified by the manufacturer.		
		4.7.7	Documentation is completed according to company guidelines.		

KA4.8	Repair or replace electronic, digital and variable frequency drive (VFD) or variable speed drive (VSD) motor controllers.	Number	Criteria			
		4.8.1	Corrective repairs are performed according to job scope, company/manufacturer/Health, Safety and Environment work practices, specific application and area classification.	Read and redline P&IDs Read and redline electrical drawings Read and use instrument loop sheets Read and use specification sheets Read and use control logic diagrams Use of reference material Knowledge of math Electrical knowledge	Personal Protective Equipment (PPE) P&IDs Electrical drawings Loop sheets Specification sheets Control logic diagrams Reference material Site-specific safety procedures	
		4.8.2	Physical inspection meets company/manufacturer/industry parameters.	Motor control circuit knowledge Knowledge of gated power devices (SCR, triacs, etc.)	Computerized maintenance programs Job Safety Analysis (JSA) Material Safety Data Sheets (MSDS)	
		4.8.3	Configuration is verified according to the application.	Ability to learn new technology Knowledge of computerized maintenance programs	Permits and area classifications Data forms Hand tools	
		4.8.4	Calibration is verified according to engineering specifications with certified standards when applicable.	Preparation of Job Safety Analysis Knowledge of permits and area classifications Proper use of hand tools	Volt-ohm meter Hot sticks Digital volt meter Oscilloscope	
		4.8.5	Functional test meets company/manufacturer/industry standards.	Knowledge of electrical wiring Knowledge of electrical test equipment Knowledge of configuration requirements	Tubing and conduit benders Hypot tester Multi-amp tester	
		4.8.6	Known inputs result in expected outputs as specified by the manufacturer.	Knowledge of management of change process	Protocol communicator Megohm meter Amp probe	
		4.8.7	Documentation is completed according to company guidelines.		Phase comparison tester Signal simulator Non-contact voltage tester	

KA4.9	Repair or replace DCS, PLC and fieldbus process control networks.	Number	Criteria		
		4.9.1	Corrective repairs are performed according to job scope, company/manufacturer/Health, Safety and Environment work practices, specific application and area classification.	Read and redline P&IDs Read and redline PC network drawings Read and use specification sheets Use of reference material Knowledge of basic electrical AC/DC theory Ability to learn new technology Knowledge of computerized maintenance programs	Personal Protective Equipment (PPE) P&IDs PC network drawings Specification sheets Reference material Site-specific safety procedures Computerized maintenance programs Job Safety Analysis (JSA)
		4.9.2	Physical inspection meets company/manufacturer/industry parameters.	Knowledge of test equipment Preparation of Job Safety Analysis	Data forms Hand tools Digital volt meter Oscilloscope Protocol analyzer Cable tester
		4.9.3	Configuration is verified according to the application.	Knowledge of industrial communication protocols	
		4.9.4	Calibration is verified according to engineering specifications with certified standards when applicable.	Knowledge of cable connector requirements Knowledge of management of change process	
		4.9.5	Functional test meets company/manufacturer/industry standards.		
		4.9.6	Known inputs result in expected outputs as specified by the manufacturer.		
		4.9.7	Documentation is completed according to company guidelines.		

KA4.10	Repair or replace 600-volt or less motors and rotating equipment protection devices such as vibration monitoring and motor control relays.	Number	Criteria			
		4.10.1	Corrective repairs are performed according to job scope, company/manufacturer/Health, Safety and Environment work practices, specific application and area classification.	Read and redline electrical drawings Read and use specification sheets Read and use motor control logic diagrams Use of reference material Use or conversion of electric circuit measurements Knowledge of math	Personal Protective Equipment (PPE) Electrical drawings Specification sheets Motor control logic diagrams Reference material Site-specific safety procedures Computerized maintenance programs Job Safety Analysis (JSA) Material Safety Data Sheets (MSDS)	
		4.10.2	Physical inspection meets company/manufacturer/industry parameters.	Electrical knowledge Motor control circuit knowledge Ability to learn new technology	Permits and area classifications Data forms	Hand tools Volt-ohm meter
		4.10.3	Functional test meets company/manufacturer/industry standards.	Knowledge of computerized maintenance programs Preparation of Job Safety Analysis	Knowledge of national electric code	Digital volt meter Oscilloscope
		4.10.4	Known inputs result in expected outputs as specified by the manufacturer.	Knowledge of phasing and motor rotation Knowledge of megger tests	Knowledge of phasing and motor rotation Knowledge of megger tests	Tubing and conduit benders Wobulator
		4.10.5	Documentation is completed according to company guidelines.	Read and use nameplate data Calibrating vibration monitors Basic rigging Knowledge of management of change process	Read and use nameplate data Calibrating vibration monitors Basic rigging Knowledge of management of change process	Hypot tester Multi-amp tester Megohm meter Amp probe Phase comparison tester Non-contact voltage tester

Occupational Title: Industrial Instrumentation and Controls Technician

Academic and Employability Knowledge and Skill Matrix

CWF 4 Repair or replace malfunctioning industrial control system equipment.

Listening	Speaking	Using Information and Communications Technology	Gathering and Analyzing Information	Analyzing and Solving Problems	Making Decisions and Judgments	Organizing and Planning	Using Social skills	Adaptability	Working in Teams	Leading Others	Building Consensus	Self and Career Development	Writing	Reading	Mathematics	Science
4	4	4	4	4	3	4	3	4	4	1	4	3	3	5	3	3

Statement of Assessment

Strategy:

Tools: The assessment process should include the following.

Written tests that include:

- 1) True-false, multiple choice and essay questions that rely on extended responses to further clarify an understanding of the knowledge being assessed.
- 2) Graphic representations (e.g. P&IDs, loop drawings and one-line electrical drawings) that reveals an understanding of symbology and connections between processes and devices.
- 3) Preparation and justification of a reasonable solution to a problem scenario.

Hands-on demonstrations of knowledge, skills and attitudes that:

- 1) Represents a problematic or challenging situation in the context of a career-technical perspective.
- 2) Involves a real life scenario, problem or situation to solve.
- 3) Applies relevant knowledge or skills.
- 4) Focuses on the application of knowledge and skills learned in one situation as it connects to a new and different one.
- 5) Reveals an ability to plan, organize and create a product or an event.
- 6) Requires study to analyze or evaluate the problem or situation.
- 7) Illustrates by individual performance the attained levels of knowledge, skills and attitudes.
- 8) Includes observation of events, groups and individuals that focuses on the salient traits of the skill or attitude being observed.

Occupational Title: Industrial Instrumentation and Controls Technician

Key Purpose: The Industrial Instrumentation and Controls Technician troubleshoots, maintains, repairs and installs process control and related equipment to produce quality products and ensure safe, cost-effective operations.

Critical Work Function		Occupational Skills, Knowledge and Conditions	
5 Maintain, test, clean, verify, repair or replace auxiliary systems.			
Key Activities	Performance Criteria	Occupational Skills and Knowledge	Conditions
Those duties or task clusters that are necessary to perform each critical work function.	Specific demonstrable performance and standards that indicate when the key activity has been performed successfully.	Those skills and knowledge that are specific to the occupation, such as technical processes or procedures common across the occupation that are critical to the related key activity.	Tools, resources and equipment necessary to carry out key activities and their related performance criteria.
KA5.1 Maintain Heating Ventilation and Air Conditioning (HVAC) systems including the heater, condenser/evaporator, fans, filters and thermostats that control the temperature and/or humidity in a closed space.	Number	Criteria	Read and use specification sheets Read and use ladder logic diagrams Use of reference material Knowledge of math Knowledge of physics Knowledge of basic electrical AC/DC theory Ability to learn new technology Knowledge of computerized maintenance programs Preparation of Job Safety Analysis Proper use of hand tools Basic mechanical knowledge Knowledge of motor controls Knowledge of refrigeration principles
	5.1.1	Work is performed to meet the requirements of company/manufacturer/ Health, Safety and Environment work practices, specific application and area classification.	
	5.1.2	Routine maintenance is performed according to job scope.	
	5.1.3	Physical inspection meets company/manufacturer/industry parameters.	
	5.1.4	Functional test meets company/manufacturer/industry standards.	
	5.1.5	Documentation is completed according to company guidelines.	
		Personal Protective Equipment (PPE) Ladder logic diagrams Specification sheets Reference material Site-specific safety procedures Computerized maintenance programs Job Safety Analysis (JSA) Material Safety Data Sheets (MSDS) Data forms Hand tools Volt-ohm meter Digital volt meter Megohm meter Amp probe	

KA5.2	Maintain lighting systems including the indoor and outdoor lights, changing light bulbs, replacing fluorescent ballasts, checking breakers and switches.	Number	Criteria	Read and redline electrical drawings Read and use specification sheets Use of reference material Knowledge of basic electrical AC/DC theory Ability to learn new technology Knowledge of computerized maintenance programs Preparation of Job Safety Analysis Proper use of hand tools	Personal Protective Equipment (PPE) Specification sheets Reference material Site-specific safety procedures Computerized maintenance programs Job Safety Analysis (JSA) Material Safety Data Sheets (MSDS) Data forms Hand tools Volt-ohm meter Digital volt meter Amp probe
		5.2.1	Work is performed to meet the requirements of company/manufacturer/ Health, Safety and Environment work practices, specific application and area classification.		
		5.2.2	Routine maintenance is performed according to job scope.		
		5.2.3	Physical inspection meets company/manufacturer/industry parameters.		
		5.2.4	Functional test meets company/manufacturer/industry standards.		
		5.2.5	Documentation is completed according to company guidelines.		

KA5.3	Maintain backup power generation systems limited to low voltage generators (less than 600 volts) powered by diesel, gasoline or natural gas powered engines.	Number	Criteria		
		5.3.1	Work is performed to meet the requirements of company/manufacturer/ Health, Safety and Environment work practices, specific application and area classification.	Read and redline electrical drawings Read and use specification sheets Read and use motor control logic diagrams Use of reference material Use or conversion of electric circuit measurements	Personal Protective Equipment (PPE) Electrical drawings Specification sheets Motor control logic diagrams Reference material Site-specific safety procedures Computerized maintenance programs
		5.3.2	Routine maintenance is performed according to job scope.	Knowledge of math Knowledge of physics (length and leverage)	Job Safety Analysis (JSA) Material Safety Data Sheets (MSDS) Permits and area classifications
		5.3.3	Physical inspection meets company/manufacturer/industry parameters.	Electrical knowledge Motor control circuit knowledge Ability to learn new technology	Data forms Hand tools Volt-ohm meter
		5.3.4	Functional test meets company/manufacturer/industry standards.	Knowledge of computerized maintenance programs Preparation of Job Safety Analysis	Digital volt meter Megohm meter Amp probe
		5.3.5	Documentation is completed according to company guidelines.	Proper use of hand tools Knowledge of national electric code Knowledge of phasing and motor rotation Read and use nameplate data Calibrating vibration monitors Basic rigging	Phase comparison tester Non-contact voltage tester

KA5.4	Maintain cranes and/or hoists including the electric motors, controls and breakers.	Number	Criteria		
		5.4.1	Work is performed to meet the requirements of company/manufacturer/ Health, Safety and Environment work practices, specific application and area classification.	Read and redline electrical drawings Read and use specification sheets Read and use motor control logic diagrams Use of reference material Knowledge of math Electrical knowledge	Personal Protective Equipment (PPE) Electrical drawings Specification sheets Motor control logic diagrams Reference material Site-specific safety procedures Computerized maintenance programs
		5.4.2	Routine maintenance is performed according to job scope.	Motor control circuit knowledge Ability to learn new technology Knowledge of computerized maintenance programs	Job Safety Analysis (JSA) Material Safety Data Sheets (MSDS) Permits and area classifications Data forms
		5.4.3	Physical inspection meets company/manufacturer/industry parameters.	Preparation of Job Safety Analysis Proper use of hand tools Knowledge of national electric code	Hand tools Volt-ohm meter Digital volt meter
		5.4.4	Functional test meets company/manufacturer/industry standards.	Knowledge of phasing and motor rotation Read and use nameplate data Calibrating vibration monitors	Megohm meter Amp probe Phase comparison tester
		5.4.5	Documentation is completed according to company guidelines.	Basic rigging	Non-contact voltage tester

KA5.5	Maintain instrument air compressors including the compressor drive, compressor, filters, dryers and associated controls.	Number	Criteria			
		5.5.1	Work is performed to meet the requirements of company/manufacturer/ Health, Safety and Environment work practices, specific application and area classification.	Read and redline electrical drawings Read and use instrument loop sheets Read and use specification sheets Read and use programmable logic diagrams Use of reference material Electrical knowledge	Personal Protective Equipment (PPE) Electrical drawings Programmable logic diagrams Loop sheets Specification sheets Reference material Site-specific safety procedures	
		5.5.2	Routine maintenance is performed according to job scope.	Ability to learn new technology Knowledge of computerized maintenance programs	Computerized maintenance programs Job Safety Analysis (JSA) Material Safety Data Sheets (MSDS)	
		5.5.3	Physical inspection meets company/manufacturer/industry parameters.	Preparation of Job Safety Analysis Proper use of hand tools Knowledge of national electric code	Permits and area classifications Data forms Hand tools	
		5.5.4	Functional test meets company/manufacturer/industry standards.	Knowledge of phasing and motor rotation Read and use nameplate data Calibrating vibration monitors	Volt-ohm meter Digital volt meter Megohm meter	
		5.5.5	Documentation is completed according to company guidelines.	Basic rigging	Amp probe Phase comparison tester Non-contact voltage tester	

KA5.6	Maintain plant communication systems such as Supervisory Control And Data Acquisition (SCADA) systems, handheld radios and transmitting or repeater stations, and intercom systems.	Number	Criteria	Read and redline communication network drawings Read and use specification sheets Use of reference material Knowledge of basic electrical AC/DC theory Ability to learn new technology Knowledge of computerized maintenance programs Preparation of Job Safety Analysis Proper use of hand tools Knowledge of industrial communication protocols Knowledge of cable connector requirements Knowledge of radio frequency repeater technology Knowledge of diagnostic indicators	Personal Protective Equipment (PPE) Communication network drawings Specification sheets Reference material Site-specific safety procedures Computerized maintenance programs Job Safety Analysis (JSA) Data forms Hand tools Digital volt meter Protocol communicator Frequency analyzer
		5.6.1	Work is performed to meet the requirements of company/manufacturer/ Health, Safety and Environment work practices, specific application and area classification.		
		5.6.2	Routine maintenance is performed according to job scope.		
		5.6.3	Physical inspection meets company/manufacturer/industry parameters.		
		5.6.4	Functional test meets company/manufacturer/industry standards.		
		5.6.5	Documentation is completed according to company guidelines.		

KA5.7	Maintain Uninterruptible Power Supplies (UPS) and Inverters.	Number	Criteria		
		5.7.1	Work is performed to meet the requirements of company/manufacturer/ Health, Safety and Environment work practices, specific application and area classification.	Read and redline electrical drawings Read and use specification sheets Use of reference material Knowledge of math Knowledge of physics (specific gravity) Electrical knowledge Ability to learn new technology	Personal Protective Equipment (PPE) Electrical drawings Specification sheets Reference material Site-specific safety procedures Computerized maintenance programs Job Safety Analysis (JSA)
		5.7.2	Routine maintenance is performed according to job scope.	Knowledge of computerized maintenance programs Preparation of Job Safety Analysis	Material Safety Data Sheets (MSDS) Permits and area classifications Data forms
		5.7.3	Physical inspection meets company/manufacturer/industry parameters.	Knowledge of permits and area classifications Proper use of hand tools	Hand tools Volt-ohm meter Digital volt meter
		5.7.4	Functional test meets company/manufacturer/industry standards.	Knowledge of gated power devices (SCR, triacs, thyristors, etc.)	Hydrometer
		5.7.5	Documentation is completed according to company guidelines.		

KA5.8	Maintain cathodic protection systems.	Number	Criteria	Read and redline electrical drawings Read and use specification sheets Use of reference material Knowledge of basic electrical AC/DC theory Ability to learn new technology Knowledge of computerized maintenance programs Preparation of Job Safety Analysis Proper use of hand tools Knowledge of national electric code	Personal Protective Equipment (PPE) Electrical drawings Specification sheets Reference material Site-specific safety procedures Computerized maintenance programs Job Safety Analysis (JSA) Data forms Hand tools Digital volt meter Amp probe Non-contact voltage tester
		5.8.1	Work is performed to meet the requirements of company/manufacturer/ Health, Safety and Environment work practices, specific application and area classification.		
		5.8.2	Routine maintenance is performed according to job scope.		
		5.8.3	Physical inspection meets company/manufacturer/industry parameters.		
		5.8.4	Functional test meets company/manufacturer/industry standards.		
		5.8.5	Documentation is completed according to company guidelines.		

KA5.9	Maintain navigation aids including lights and switchgear associated with lighting systems required for navigation aids or warnings.	Number	Criteria	Read and redline electrical drawings Read and use specification sheets Use of reference material Knowledge of basic electrical AC/DC theory Ability to learn new technology Knowledge of computerized maintenance programs Preparation of Job Safety Analysis Proper use of hand tools	Personal Protective Equipment (PPE) Electrical drawings Specification sheets Reference material Site-specific safety procedures Computerized maintenance programs Job Safety Analysis (JSA) Data forms Hand tools Volt-ohm meter Digital volt meter Amp probe
		5.9.1	Work is performed to meet the requirements of company/manufacturer/ Health, Safety and Environment work practices, specific application and area classification.		
		5.9.2	Routine maintenance is performed according to job scope.		
		5.9.3	Physical inspection meets company/manufacturer/industry parameters.		
		5.9.4	Functional test meets company/manufacturer/industry standards.		
		5.9.5	Documentation is completed according to company guidelines.		

KA5.10	Maintain high voltage equipment including equipment that is energized with 600 volts or more.	Number	Criteria		
		5.10.1	Work is performed to meet the requirements of company/manufacturer/ Health, Safety and Environment work practices, specific application and area classification.	Read and redline electrical drawings Read and use specification sheets Read and use motor control diagrams Use of reference material Use or conversion of electrical measurements Knowledge of math	Personal Protective Equipment (PPE) Electrical drawings Specification sheets Reference material Site-specific safety procedures Computerized maintenance programs Job Safety Analysis (JSA)
		5.10.2	Routine maintenance is performed according to job scope.	Knowledge of high-voltage electrical theory Ability to learn new technology	Material Safety Data Sheets (MSDS) Data forms High-voltage tools and equipment
		5.10.3	Physical inspection meets company/manufacturer/industry parameters.	Knowledge of computerized maintenance programs Preparation of Job Safety Analysis	Volt-ohm meter Hot sticks Digital volt meter
		5.10.4	Functional test meets company/manufacturer/industry standards.	Knowledge of high-voltage tools and equipment Knowledge of terminating medium and high-voltage wiring	Hypot tester Multi-amp tester Megohm meter Amp probe
		5.10.5	Documentation is completed according to company guidelines.	Knowledge of national electric code Knowledge of OSHA 1910.269 and 1910.331-335	Phase comparison tester Infrared camera Non-contact high-voltage tester

Occupational Title: Industrial Instrumentation and Controls Technician

Academic and Employability Knowledge and Skill Matrix

CWF 5 Maintain, test, clean, verify, repair or replace auxiliary systems.

Listening	Speaking	Using Information and Communications Technology	Gathering and Analyzing Information	Analyzing and Solving Problems	Making Decisions and Judgments	Organizing and Planning	Using Social skills	Adaptability	Working in Teams	Leading Others	Building Consensus	Self and Career Development	Writing	Reading	Mathematics	Science
4	3	4	4	4	3	4	3	4	4	1	4	3	3	5	4	4

Statement of Assessment

Strategy:

Tools: The assessment process should include the following.

Written tests that include:

- 1) True-false, multiple choice and essay questions that rely on extended responses to further clarify an understanding of the knowledge being assessed.
- 2) Graphic representations (e.g. P&IDs, loop drawings and one-line electrical drawings) that reveals an understanding of symbology and connections between processes and devices.
- 3) Preparation and justification of a reasonable solution to a problem scenario.

Hands-on demonstrations of knowledge, skills and attitudes that:

- 1) Represents a problematic or challenging situation in the context of a career-technical perspective.
- 2) Involves a real life scenario, problem or situation to solve.
- 3) Applies relevant knowledge or skills.
- 4) Focuses on the application of knowledge and skills learned in one situation as it connects to a new and different one.
- 5) Reveals an ability to plan, organize and create a product or an event.
- 6) Requires study to analyze or evaluate the problem or situation.
- 7) Illustrates by individual performance the attained levels of knowledge, skills and attitudes.
- 8) Includes observation of events, groups and individuals that focuses on the salient traits of the skill or attitude being observed.