Instrumentation and Control Technician

Guide to Course Content

2024

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Saskatchewan Apprenticeship and Trade Certification Commission

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Recognition:
To promote transparency and consistency, this document has been adapted from the 2020 Instrumentation and Control Technician Red Seal Occupational Standard (Employment and Social Development Canada).

A complete version of the Occupational Standard can be found at www.red-seal.ca

STRUCTURE OF THE GUIDE TO COURSE CONTENT

To facilitate understanding of the occupation, this guide to course content contains the following sections:

Task Matrix: a chart which outlines graphically the major work activities, tasks and sub-tasks of this standard detailing the essential skills and the level of training where the content is covered. The Task Matrix is broken down into the following:

Major Work Activity (MWA): the largest division within the standard that is comprised of a distinct set of trade activities.

Task: distinct actions that describe the activities within a major work activity.

Sub-task: distinct actions that describe the activities within a task.

Training Profile Chart: a chart which outlines the model for Saskatchewan Apprenticeship and Trade Certification Commission (SATCC) technical training.

Technical Training Course Content for the Instrumentation and Control Technician trade: a chart which outlines the model for SATCC technical training sequencing.

TRAINING REQUIREMENTS FOR THE INSTRUMENTATION AND CONTROL TECHNICIAN TRADE

To graduate from each level of the apprenticeship program, an apprentice must successfully complete the required technical training and compile enough on-the-job experience to total at least 1700 hours each year. Total trade time required is 6800 hours and at least 4 years in the trade.

There are four levels of technical training delivered by Saskatchewan Polytechnic in Moose Jaw:

Level One:	10 weeks
Level Two:	10 weeks
Level Three:	10 weeks
Level Four:	10 weeks

The information contained in this guide to course content details the technical training delivered for each level of apprenticeship. An apprentice spends approximately 15% of their apprenticeship term in a technical training institute learning the technical and theoretical aspects of the trade. The hours and percentages of technical and practical training may vary according to class needs and progress.

The content of the technical training components is subject to change without notice.

Entrance Requirements for Apprenticeship Training

Your grade twelve transcripts (with no modified classes) or GED 12 is your guarantee that you meet the educational entrance requirements for apprenticeship in Saskatchewan. In fact, employers prefer and recommend apprentices who have completed high school. This ensures the individual has all of the necessary skills required to successfully complete the apprenticeship program, and receive journeyperson certification.

Individuals with “modified” or “general” classes in math or science do not meet our entry requirements. These individuals are required to take an entrance assessment prescribed by the SATCC.

English is the language of instruction in all apprenticeship programs and is the common language for business in Saskatchewan. Before admission, all apprentices and/or “upgraders” must be able to understand and communicate in the English language. Applicants whose first language is not English must have a minimum Canadian Language Benchmark Assessment of six (CLB6).

Note: A CLB assessment is valid for a one-year period from date of issue.

Designated Trade Name	**Math Credit** at the Indicated Grade Level❶	**Science Credit** at Grade Level
Instrumentation and Control Technician	Grade 11	Grade 10

❶ - (One of the following) WA – Workplace and Apprenticeship; or F – Foundations; or P – Pre-calculus, or a Math at the indicated grade level (Modified and General Math credits are not acceptable.).

*Applicants who have graduated in advance of 2015-2016, or who do not have access to the revised Science curricula will require a Science at the minimum grade level indicated by trade.

For information about high school curriculum, including Math and Science course names, please see: http://www.curriculum.gov.sk.ca/#

Individuals not meeting the entrance requirements will be subject to an assessment and any required training

INSTRUMENTATION AND CONTROL TECHNICIAN TASK MATRIX CHART

This chart outlines the major work activities, tasks and sub-tasks from the 2020 Instrumentation and Control Technician Red Seal Occupational Standard. Each sub-task details the corresponding essential skill and level of training where the content is covered. *

* Sub-tasks with numbers in the boxes is where the content will be delivered in training.

A - Performs Common Occupational Skills — 9%

A-1 Performs safety-related functions	**1.01 Maintains safe work environment** **1** **(2, 3, 4 In Context)**	**1.02 Uses personal protective equipment (PPE) and safety equipment** **1** **(2, 3, 4 In Context)**	**1.03 Performs de-energizing, lock-out and tag-out procedures** **1** **(2, 3, 4 In Context)**	
A-2 Uses tools and equipment	**A-2.01 Uses calibration, configuration and test equipment** **1** **(2, 3, 4 In Context)**	**A-2.02 Uses hand and power tools** **1** **(2, 3, 4 In Context)**	**A-2.03 Uses access equipment** **1** **(2, 3, 4 In Context)**	**A-2.04 Uses rigging, hoisting and lifting equipment** **1** **(2, 3, 4 In Context)**
A-3 Organizes work	**A-3.01 Uses documentation** **1**	**A-3.02 Interprets drawings and schematics** **1**	**A-3.03 Plans tasks** **3**	
A-4 Uses communication and mentoring techniques	**A-4.01 Uses communication techniques** **1**	**A-4.02 Uses mentoring techniques** **4**		

B – Installs and Services Process Measuring and Indicating Devices 24%

B-5 Installs and services pressure, temperature, level and flow devices	**B-5.01 Installs pressure, temperature, level and flow devices** 1, 2	**B-5.02 Maintains pressure, temperature, level and flow devices** 1, 2	**B-5.03 Diagnoses pressure, temperature, level and flow devices** 1, 2	**B-5.04 Repairs pressure, temperature, level and flow devices** 1, 2
B-6 Installs and services signal transducers	**B-6.01 Performs installation and configuration of signal transducers** 2	**B-6.02 Diagnoses signal transducers** 2	**B-6.03 Performs maintenance and repairs on signal transducers** 2	
B-7 Installs and services motion, speed, position and vibration devices	**B-7.01 Installs motion, speed, position and vibration devices** 3	**B-7.02 Maintains motion, speed, position and vibration devices** 3	**B-7.03 Diagnoses motion, speed, position and vibration devices** 3	**B-7.04 Repairs motion, speed, position and vibration devices** 3
B-8 Installs and services mass, density and consistency devices	**B-8.01 Installs mass, density and consistency devices** 2, 3	**B-8.02 Maintains mass, density and consistency devices** 2, 3	**B-8.03 Diagnoses mass, density and consistency devices** 2, 3	**B-8.04 Repairs mass, density and consistency devices** 2, 3
B-9 Installs and services process analyzers	**B-9.01 Installs process analyzers** 3, 4	**B-9.02 Maintains process analyzers** 3, 4	**B-9.03 Diagnoses process analyzers** 3, 4	**B-9.04 Repairs process analyzers** 3, 4
B-10 Installs and services multiple variable computing devices	**B-10.01 Installs multiple variable computing devices** 4	**B-10.02 Maintains multiple variable computing devices** 4	**B-10.03 Diagnoses multiple variable computing devices** 4	**B-10.04 Repairs multiple variable computing devices** 4

C – Installs and Services Safety and Security Systems and Devices — 9%

C-11 Installs and services safety systems and devices	C-11.01 Installs safety systems and devices 4	C-11.02 Maintains safety systems and devices 4	C-11.03 Diagnoses safety systems and devices 4	C-11.04 Repairs safety systems and devices 4	
C-12 Installs and services facility security systems (NOT COMMON CORE)	C-12.01 Installs facility security systems NOT COMMON CORE	C-12.02 Maintains facility security systems NOT COMMON CORE	C-12.03 Diagnoses facility security systems NOT COMMON CORE	C-12.04 Repairs facility security systems NOT COMMON CORE	
C-13 Installs and services safety instrumented systems (SIS)	C-13.01 Installs SIS 4	C-13.02 Configures SIS 4	C-13.03 Maintains SIS 4	C-13.04 Diagnoses SIS 4	C-13.05 Repairs SIS 4

D – Installs and Services Hydraulic, Pneumatic and Electrical Systems — 11%

D-14 Installs and services control devices for hydraulic systems	D-14.01 Installs control devices for hydraulic systems 2	D-14.02 Diagnoses control devices for hydraulic systems 2	D-14.03 Performs maintenance and repairs on control devices for hydraulic systems 2
D-15 Installs and services pneumatic equipment	D-15.01 Installs pneumatic equipment 1, 2	D-15.02 Diagnoses pneumatic equipment 1, 2	D-15.03 Performs maintenance and repairs on pneumatic equipment 1, 2

D-16 Installs and services electrical and electronic equipment	**D-16.01 Installs electrical and electronic equipment** **1, 2 (3, 4 In Context)**	**D-16.02 Diagnoses electrical and electronic equipment** **1, 2 (3, 4 In Context)**	**D-16.03 Performs maintenance and repairs for electrical and electronic equipment** **1, 2 (3, 4 In Context)**

E – Installs, Configures and Services Final Control Elements — 20%

E-17 Installs and services valves	**E-17.01 Installs valves** **1, 2**	**E-17.02 Maintains valves** **1, 2**	**E-17.03 Diagnoses valves** **1, 2**	**E-17.04 Repairs valves** **1, 2**
E-18 Installs and services actuators	**E-18.01 Installs actuators** **1, 2**	**E-18.02 Maintains actuators** **1, 2**	**E-18.03 Diagnoses actuators** **1, 2**	**E-18.04 Repairs actuators** **1, 2**
E-19 Installs and services positioners	**E-19.01 Installs positioners** **1, 2**	**E-19.02 Maintains positioners** **1, 2**	**E-19.03 Diagnoses positioners** **1, 2**	**E-19.04 Repairs positioners** **1, 2**
E-20 Configures and services variable speed drives (VSD)	**E-20.01 Configures VSD** **3**	**E-20.02 Maintains VSD** **3**	**E-20.03 Diagnoses VSD** **3**	**E-20.04 Repairs VSD** **3**

F – Installs and Services Communication Systems and Devices — 10%

F-21 Installs and services control network systems	F-21.01 Performs installation and configuration on control network systems 3, 4	F-21.02 Diagnoses control network systems 3, 4	F-21.03 Performs maintenance and repairs on control network systems 3, 4
F-22 Installs and services signal converters	F-22.01 Performs installation and configuration of signal converters 3, 4	F-22.02 Diagnoses signal converters 3, 4	F-22.03 Performs maintenance and repairs on signal converters 3, 4
F-23 Installs and services gateways, bridges and media converters	F-23.01 Performs installation and configuration of gateways, bridges and media converters 3, 4	F-23.02 Diagnoses gateways, bridges and media converters 3, 4	F-23.03 Performs maintenance and repairs on gateways, bridges and media converters 3, 4

G – Installs and Services Control Systems and Process Control — 17%

G-24 Establishes and optimizes process control strategies	G-24.01 Determines process control strategy 3, 4	G-24.02 Optimizes process control 3, 4	
G-25 Installs and services stand-alone controllers (SAC)	G-25.01 Installs SAC 3, 4	G-25.02 Configures SAC 3, 4	G-25.03 Performs maintenance, diagnostics and repairs on SAC 3, 4

G-26 Installs and services programmable logic controllers (PLC)	**G-26.01 Installs PLC** **3, 4**	**G-26.02 Configures PLC** **3, 4**	**G-26.03 Performs maintenance, diagnostics and repairs on PLC** **3, 4**
G-27 Installs and services distributed control systems (DCS)	**G-27.01 Installs DCS** **4**	**G-27.02 Configures DCS** **4**	**G-27.03 Performs maintenance, diagnostics and repairs on DCS** **4**
G-28 Installs and services human machine interface (HMI)	**G-28.01 Installs HMI** **3, 4**	**G-28.02 Configures HMI** **3, 4**	**G-28.03 Performs maintenance, diagnostics and repairs on HMI** **3, 4**
G-29 Installs and services supervisory control and data acquisition (SCADA) systems	**G-29.01 Installs SCADA systems** **4**	**G-29.02 Configures SCADA systems** **4**	**G-29.03 Performs maintenance, diagnostics and repairs on SCADA systems** **4**

TRAINING PROFILE CHART

This Training Profile Chart represents Saskatchewan Apprenticeship and Trade Certification Commission (SATCC) technical training at the topic level.

Level One	Transcript Code	Hours
Basic Electronics	CIRC 109 - Theory	50
	CIRC 110 - Shop	50
Instrument Measurement 1	MEAS 113 - Theory	60
	MEAS 114 - Shop	40
Instrumentation Practices	INST 108	40
Mathematics	MATH 157	30
Physics	PHYS 122	30
		300

Level Two	Transcript Code	Hours
Electronics	CIRC 204	70
Instrument Control 1	CNTR 211 - Theory	30
	CNTR 212 – Shop	30
Final Control Elements	INST 212 – Theory	30
	INST 213 - Shop	30
Instrument Measurement 2	MEAS 203	50
Analytical Instruments 1	MEAS 204	30
Chemistry 1	CHEM 202	30
		300

Level Three	Transcript Code	Hours
Chemistry 2	CHEM 301	30
Instrument Control 2	CNTR 300	40
Instrument Logic	CIRC 300	50
Analytical Instruments 2	MEAS 300	30
Instrument Measurement 3	MEAS 301	50
Project Management	PROJ 302	50
Data Communications 1	CIRC 301	50
		300

Level Four	Transcript Code	Hours
Process Applications	CNTR 400	30
Data Communications 2	CIRC 400	50
Analytical Instruments 3	MEAS 400	30
Programmable Logic Controllers	CIRC 401	60
Distributed Systems	CNTR 401	60
Instrument Control 3	CNTR 402	30
Mentoring	MENT 401	10
Chemistry	CHEM 400	30
		300

TECHNICAL TRAINING COURSE CONTENT

This chart outlines the model for Saskatchewan Apprenticeship and Trade Certification Commission (SATCC) technical training sequencing.

Level One — 10 weeks — 300 hours

Physics — 30 hours

- calculate the pressures of static and moving liquids
- examine the expansion and contraction properties of materials with temperature
- compare how matter stores heat with temperature changes
- classify three forms of heat transfer
- demonstrate four methods of vector addition
- differentiate between work, power and energy
- compare the mechanical advantage of simple machines

This section of training exceeds the minimum sequencing as set out by the Instrumentation and Control Technician Red Seal Occupational Standard.

Mathematics — 30 hours

- perform basic numerical computations
- perform basic algebraic operations
- perform basic trigonometry functions
- perform basic graphing with linear equations
- perform basic operations with exponentials and logarithms

This section of training exceeds the minimum sequencing as set out by the Instrumentation and Control Technician Red Seal Occupational Standard.

Basic Electronics – Theory — 50 hours

- current, voltage and resistance in series, parallel and series-parallel circuits
- the effects of resistance/inductance/capacitance (RLC) on AC and DC circuits
- transformer types, characteristics and applications
- determine R, X, and Z in AC circuits and resonant circuits
- solid-state electrical components, their characteristics and applications
- types of solid-state circuits, their characteristics and operation

Basic Electronics – Shop — 50 hours

- measure current, voltage and resistance in an electrical circuit
- analyze Ohm's and Kirchhoff's laws
- measure the equivalent resistance of series-parallel circuits
- evaluate various theorems
- evaluate AC measurements
- measure time constant of RC and RL circuits
- evaluate voltages and phase angles in AC circuits
- measure characteristics of diodes
- evaluate the rectified dc power supply using half-wave, full-wave and bridge rectified configurations
- measure load regulations for Zener regulator circuits

RSOS subtasks covered in this section of training:

A-1 Performs safety-related functions
A-1.03 Performs de-energizing, lock-out and tag-out procedures

A-2 Uses tools and equipment
A-2.01 Uses calibration, configuration and test equipment
A-2.02 Uses hand and power tools

D-16 Installs and services electrical and electronic equipment
D-16.02 Diagnoses electrical and electronic equipment
D-16.03 Performs maintenance and repairs for electrical and electronic equipment

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Instrument Measurement 1– Theory — 60 hours

- describe transmitter signals and instrumentation terminology
- compare pneumatic and electronic primary sensing elements
- pressure measuring instrument types, relationships, and installation procedures
- level measuring instrument types, relationships, and installation procedures
- flow measuring instrument types, relationships and installation procedures
- temperature instrument types, relationships and installation procedures

Instrument Measurement 1– Shop — 40 hours

- pneumatic and electrical pressure measuring instrument types, and the procedures to install, maintain and calibrate
- pneumatic and electrical level measuring instrument types, and the procedures to install, maintain and calibrate
- pneumatic and electrical flow measuring instrument types, and the procedures to install, maintain and calibrate
- pneumatic and electrical temperature measuring instrument types, and the procedures to install, maintain and calibrate
- valve types, their components, characteristics, and applications

RSOS subtasks covered in this section of training:

B-5 Installs and services pressure, temperature, level and flow devices
B-5.01 Installs pressure, temperature, level and flow devices
B-5.02 Maintains pressure, temperature, level and flow devices
B-5.03 Diagnoses pressure, temperature, level and flow devices
B-5.04 Repairs pressure, temperature, level and flow devices

D-15 Installs and services pneumatic equipment
D-15.01 Installs pneumatic equipment
D-15.02 Diagnoses pneumatic equipment
D-15.03 Performs maintenance and repairs on pneumatic equipment

D-16 Installs and services electrical and electronic equipment
D-16.01 Installs electrical and electronic equipment
D-16.02 Diagnoses electrical and electronic equipment
D-16.03 Performs maintenance and repairs for electrical and electronic equipment

E-17 Installs and services valves
E-17.01 Installs valves
E-17.02 Maintains valves
E-17.03 Diagnoses valves
E-17.04 Repairs valves

E-18 Installs and services actuators
E-18.01 Installs actuators
E-18.02 Maintains actuators
E-18.03 Diagnoses actuators
E-18.04 Repairs actuators

E-19 Installs and services positioners
E-19.01 Installs positioners
E-19.02 Maintains positioners
E-19.03 Diagnoses positioners
E-19.04 Repairs positioners

Instrumentation Practices — 40 hours

- interpret process and instrument diagrams (P&ID), loop diagrams, and safety documentation
- safe working practices
- perform installation of tubing using tube bending techniques
- PPE and safety equipment, their applications, maintenance, and procedures for use
- hand and power tools, their components, applications, and procedures for use

RSOS subtasks covered in this section of training:

A-1 Performs safety-related functions
A-1.01 Maintains safe work environment
A-1.02 Uses personal protective equipment (PPE) and safety equipment
A-1.03 Performs de-energizing, lock-out and tag-out procedures

A-2 Uses tools and equipment
A-2.01 Uses calibration, configuration and test equipment
A-2.02 Uses hand and power tools
A-2.03 Uses access equipment
A-2.04 Uses rigging, hoisting and lifting equipment

A-3 Organizes work
A-3.01 Uses documentation
A-3.02 Interprets drawings and schematics

A-4 Uses communication and mentoring techniques
A-4.01 Uses communication techniques

Level Two — 10 weeks — 300 hours

Instrument Measurement 2 — 50 hours

- assess wiring principles for measurement instrumentation
- construct electrical process loop wiring diagrams from piping and instrument drawings (P&ID's) as per ISA (International Society of Automation) Standards
- analyze methods of protection for hazardous locations
- configure process alarms
- interpret the principle of operation of microprocessor-based instruments
- demonstrate knowledge to calibrate conventional and microprocessor-based instruments

RSOS subtasks covered in this section of training:

B-5 Installs and services pressure, temperature, level and flow devices
B-5.01 Installs pressure, temperature, level and flow devices
B-5.02 Maintains pressure, temperature, level and flow devices
B-5.03 Diagnoses pressure, temperature, level and flow devices
B-5.04 Repairs pressure, temperature, level and flow devices

B-6 Installs and services signal transducers
B-6.01 Performs installation and configuration of signal transducers
B-6.02 Diagnoses signal transducers
B-6.03 Performs maintenance and repairs on signal transducers

D-16 Installs and services electrical and electronic equipment
D-16.01 Installs electrical and electronic equipment
D-16.02 Diagnoses electrical and electronic equipment
D-16.03 Performs maintenance and repairs for electrical and electronic equipment

Electronics — 70 hours

- solid-state device operation and their applications
- analyze the fundamentals of solid-state devices
- differences between analog and digital signals
- logic gates, truth tables and flip flops, use and application
- general network topologies used in local area networks (LANs)

RSOS subtasks covered in this section of training:

D-16 Installs and services electrical and electronic equipment
D-16.01 Installs electrical and electronic equipment
D-16.02 Diagnoses electrical and electronic equipment
D-16.03 Performs maintenance and repairs for electrical and electronic equipment

Instrument Control 1 – Theory — 30 hours

- fundamental elements associated with pneumatic controllers
- commonly used control theory terms and basic types of control modes
- procedures used to install and calibrate pneumatic controllers
- procedures used to troubleshoot and repair pneumatic controllers
- pneumatic controllers installation and calibration

Instrument Control 1 – Shop — 30 hours

- employ commonly used control modes and terms as they apply to pneumatic analogue controllers
- calibrate single, two, and three mode controllers
- tune single, two, and three mode controllers
- examine advanced control techniques including cascade, feedforward, ratio, and override

RSOS subtasks covered in this section of training:

B-6 Installs and services signal transducers
B-6.01 Performs installation and configuration of signal transducers
B-6.02 Diagnoses signal transducers
B-6.03 Performs maintenance and repairs on signal transducers

D-14 Installs and services control devices for hydraulic systems
D-14.01 Installs control devices for hydraulic systems
D-14.02 Diagnoses control devices for hydraulic systems
D-14.03 Performs maintenance and repairs on control devices for hydraulic systems

D-16 Installs and services electrical and electronic equipment
D-16.01 Installs electrical and electronic equipment
D-16.02 Diagnoses electrical and electronic equipment
D-16.03 Performs maintenance and repairs for electrical and electronic equipment

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Final Control Elements – Theory — 30 hours

- compare various final control elements
- actuators, their components, calculations, and operation
- control valves, their components, calculations, and operation
- characteristics and applications of control valve accessories
- operation of pneumatic systems and their components

Final Control Elements – Shop — 30 hours

- procedures used to inspect and overhaul control valves
- procedures used to inspect and overhaul actuators
- procedures used to inspect, overhaul, and calibrate positioners
- perform general maintenance on control valve assemblies
- perform inspection and calibration of current-to-pressure (I/P) transducers
- demonstrate operation of various final control elements

RSOS subtasks covered in this section of training:

D-14 Installs and services control devices for hydraulic systems
D-14.01 Installs control devices for hydraulic systems
D-14.02 Diagnoses control devices for hydraulic systems
D-14.03 Performs maintenance and repairs on control devices for hydraulic systems

D-15 Installs and services pneumatic equipment
D-15.01 Installs pneumatic equipment
D-15.02 Diagnoses pneumatic equipment
D-15.03 Performs maintenance and repairs on pneumatic equipment

D-16 Installs and services electrical and electronic equipment
D-16.01 Installs electrical and electronic equipment
D-16.02 Diagnoses electrical and electronic equipment
D-16.03 Performs maintenance and repairs for electrical and electronic equipment

E-17 Installs and services valves
E-17.01 Installs valves
E-17.02 Maintains valves
E-17.03 Diagnoses valves
E-17.04 Repairs valves

E-18 Installs and services actuators
E-18.01 Installs actuators
E-18.02 Maintains actuators
E-18.03 Diagnoses actuators
E-18.04 Repairs actuators

E-19 Installs and services positioners
E-19.01 Installs positioners
E-19.02 Maintains positioners
E-19.03 Diagnoses positioners
E-19.04 Repairs positioners

Analytical Instruments 1 — 30 hours

- process sample systems and conditioning of samples
- process analyzers, their components, purpose, applications, characteristics, and operation
- procedures used to install, maintain, calibrate and troubleshoot process analyzers
- vibration analysis and its importance in rotating equipment
- procedures used for humidity analysis
- procedures used for solution density analysis

RSOS subtasks covered in this section of training:

B-8 Installs and services mass, density and consistency devices
B-8.01 Installs mass, density and consistency devices
B-8.02 Maintains mass, density and consistency devices
B-8.03 Diagnoses mass, density and consistency devices
B-8.04 Repairs mass, density and consistency devices

D-16 Installs and services electrical and electronic equipment
D-16.01 Installs electrical and electronic equipment
D-16.02 Diagnoses electrical and electronic equipment
D-16.03 Performs maintenance and repairs for electrical and electronic equipment

Chemistry 1 **30 hours**

- demonstrate safe laboratory protocol
- classify periodic table elements and examine the chemical nomenclature of ionic and molecular compounds
- solve problems involving stoichiometric values in chemical reactions
- solve problems involving solubilities of gases, liquids, and solids
- solve problems involving the density of gases, liquids, and solids
- solve problems involving humidity in the calculation of condensation dew points
- demonstrate knowledge of mass, density and consistency

This section of training exceeds the minimum sequencing as set out by the Instrumentation and Control Technician Red Seal Occupational Standard.

Level Two topics from the RSOS that are taught in context:

A-1 Safety-Related Functions
A-2 Tools and Equipment

For details regarding the In Context Topic, see page 27

Level Three — 10 weeks — 300 hours

Chemistry 2 — 40 hours

- acid/base chemistry using pH calculations and measurements
- measure and calculate the correlation between ionic solution concentrations and conductivity measurements
- measure and calculate the relationship of chemical oxidation-reduction reactions to electrode potentials in voltaic and concentration electrolytic cells
- demonstrate and measure the process of UV light absorption in quantitatively measuring solution turbidity, suspension, and dissolved solids concentration
- measure and calculate dissolved oxygen concentrations due to changes in soluble salts, turbulence, aeration, pollution, temperature, and pressure

This section of training exceeds the minimum sequencing as set out by the Instrumentation and Control Technician Red Seal Occupational Standard.

Project Management — 50 hours

- examine project management concepts
- perform the steps required to initiate an industrial instrumentation project
- demonstrate how to develop a comprehensive project plan
- identify the resources required to execute a project plan
- identify the monitoring and controlling requirements of a project plan
- identify closing requirements of a project plan

RSOS subtasks covered in this section of training

A-3 Organizes work
A-3.03 Plans tasks

Instrument Control 2 — 40 hours

- feedforward process control applications
- selective process control applications
- ratio control process control applications
- cascade control process control applications
- multivariable control process control applications

RSOS subtasks covered in this section of training:

G-24 Establishes and optimizes process control strategies
G-24.01 Determines process control strategy
G-24.02 Optimizes process control

Instrument Logic — 50 hours

- electromechanical relays, terminology and related devices used in building relay logic circuits
- application of relays and switches in the design of functional relay logic circuits
- PLCs and related devices used in building logic circuits
- apply knowledge of PLC programming in the design of various logic circuits
- explain the operation and features of Variable Frequency Drives (VFDs)
- apply knowledge of VFD operation in the control of motors

RSOS subtasks covered in this section of training:

E-20 Configures and services variable speed drives (VSD)
E-20.01 Configures VSD
E-20.02 Maintains VSD
E-20.03 Diagnoses VSD
E-20.04 Repairs VSD

F-22 Installs and services signal converters
F-22.01 Performs installation and configuration of signal converters
F-22.02 Diagnoses signal converters
F-22.03 Performs maintenance and repairs on signal converters

G-26 Installs and services programmable logic controllers (PLC)
G-26.01 Installs PLC
G-26.02 Configures PLC
G-26.03 Performs maintenance, diagnostics and repairs on PLC

Analytical Instruments 2 — 40 hours

- pH measurement principles
- ORP measurement principles
- conductivity measurement principles
- turbidity measurement principles
- dissolved oxygen measurement principles

RSOS subtasks covered in this section of training:

B-7 Installs and services motion, speed, position and vibration devices
B-7.01 Installs motion, speed, position and vibration devices
B-7.02 Maintains motion, speed, position and vibration devices
B-7.03 Diagnoses motion, speed, position and vibration devices
B-7.04 Repairs motion, speed, position and vibration devices

B-8 Installs and services mass, density and consistency devices
B-8.01 Installs mass, density and consistency devices
B-8.02 Maintains mass, density and consistency devices
B-8.03 Diagnoses mass, density and consistency devices
B-8.04 Repairs mass, density and consistency devices

B-9 Installs and services process analyzers
B-9.01 Installs process analyzers
B-9.02 Maintains process analyzers
B-9.03 Diagnoses process analyzers
B-9.04 Repairs process analyzers

Instrument Measurement 3 — 50 hours

- perform configurations, calibrations, and asset management using industrial database software
- demonstrate the capabilities of a Digital Valve Controller
- procedures to safely install, maintain, calibrate, and troubleshoot microprocessor-based pressure transmitters
- procedures to safely install, maintain, calibrate, and troubleshoot microprocessor-based level transmitters
- procedures to safely install, maintain, calibrate, and troubleshoot microprocessor-based flow transmitters
- procedures to safely install, maintain, calibrate, and troubleshoot microprocessor-based temperature transmitters

RSOS subtasks covered in this section of training:

G-25 Installs and services stand-alone controllers (SAC)
G-25.01 Installs SAC
G-25.02 Configures SAC
G-25.03 Performs maintenance, diagnostics and repairs on SAC

G-28 Installs and services human machine interface (HMI)
G-28.01 Installs HMI
G-28.02 Configures HMI
G-28.03 Performs maintenance, diagnostics and repairs on HMI

Data Communications 1 — 50 hours

- classify various types of communication media
- apply knowledge of existing traditional and current communication protocols
- examine various types of Industrial Local Area Network (ILAN) topologies
- differentiate network media access techniques
- categorize various encoding and error checking methods
- classify various types of network architecture

RSOS subtasks covered in this section of training:

F-21 Installs and services control network systems
F-21.01 Performs installation and configuration on control network systems
F-21.02 Diagnoses control network systems
F-21.03 Performs maintenance and repairs on control network systems

F-22 Installs and services signal converters
F-22.01 Performs installation and configuration of signal converters
F-22.02 Diagnoses signal converters
F-22.03 Performs maintenance and repairs on signal converters

F-23 Installs and services gateways, bridges and media converters
F-23.01 Performs installation and configuration of gateways, bridges and media converters
F-23.02 Diagnoses gateways, bridges and media converters
F-23.03 Performs maintenance and repairs on gateways, bridges and media converters

Level Three topics from the RSOS that are taught in context:

A-1 Safety-Related Functions
A-2 Tools and Equipment
D-16 Installs and Services Electrical and Electronic Equipment

For details regarding the In Context Topic, see page 27

Level Four — 10 weeks — 300 hours

Process Applications — 30 hours

- describe basic industrial boiler control
- apply boiler control principles using simulation software
- describe fundamental process of pulp and paper production
- describe fundamental process of mining
- describe fundamental aspects of petroleum refining

RSOS subtasks covered in this section of training:

G-24 Establishes and optimizes process control strategies
G-24.01 Determines process control strategy
G-24.02 Optimizes process control

Data Communications 2 — 50 hours

- examine the convergence of information technology (IT) and operational technology (OT)
- apply fundamental concepts of transmission control/internet protocol (TCP/IP) addressing
- analyze design methods for Industrial local area networks (ILANs)
- apply fundamental concepts of SCADA systems
- apply methods used to install, configure, and maintain SCADA systems
- apply methods used to troubleshoot SCADA systems
- examine open platform communications (OPC) unified architecture

RSOS subtasks covered in this section of training:

F-21 Installs and services control network systems
F-21.01 Performs installation and configuration on control network systems
F-21.02 Diagnoses control network systems
F-21.03 Performs maintenance and repairs on control network systems

F-22 Installs and services signal converters
F-22.01 Performs installation and configuration of signal converters
F-22.02 Diagnoses signal converters
F-22.03 Performs maintenance and repairs on signal converters

F-23 Installs and services gateways, bridges and media converters
F-23.01 Performs installation and configuration of gateways, bridges and media converters
F-23.02 Diagnoses gateways, bridges and media converters
F-23.03 Performs maintenance and repairs on gateways, bridges and media converters

G-29 Installs and services supervisory control and data acquisition (SCADA) systems
G-29.01 Installs SCADA systems
G-29.02 Configures SCADA systems
G-29.03 Performs maintenance, diagnostics and repairs on SCADA systems

Analytical Instruments 3- Gas Analyzers — 30 hours

- gas chromatography measurement principles
- toxic and combustible gas measurement principles
- flue gas measurement principles
- oxygen gas measurement principles

RSOS subtasks covered in this section of training:

B-9 Installs and services process analyzers
B-9.01 Installs process analyzers
B-9.02 Maintains process analyzers
B-9.03 Diagnoses process analyzers
B-9.04 Repairs process analyzers

Programmable Logic Controllers — 60 hours

- categorize the different aspects of modular programmable logic controllers (PLCs)
- configure a modular programmable logic controller
- compare the various aspects of process control using modular PLCs
- apply design principles using a modular PLC
- procedures to troubleshoot a PLC system
- procedures to commission a PLC system applying safety instrumented systems principles

RSOS subtasks covered in this section of training:

B-10 Installs and services multiple variable computing devices
B-10.01 Installs multiple variable computing devices
B-10.02 Maintains multiple variable computing devices
B-10.03 Diagnoses multiple variable computing devices
B-10.04 Repairs multiple variable computing devices

C-11 Installs and services safety systems and devices
C-11.01 Installs safety systems and devices
C-11.02 Maintains safety systems and devices
C-11.03 Diagnoses safety systems and devices
C-11.04 Repairs safety systems and devices

C-13 Installs and services safety instrumented systems (SIS)
C-13.01 Installs SIS
C-13.02 Configures SIS
C-13.03 Maintains SIS
C-13.04 Diagnoses SIS
C-13.05 Repairs SIS

F-21 Installs and services control network systems
F-21.01 Performs installation and configuration on control network systems
F-21.02 Diagnoses control network systems
F-21.03 Performs maintenance and repairs on control network systems

F-22 Installs and services signal converters
F-22.01 Performs installation and configuration of signal converters
F-22.02 Diagnoses signal converters
F-22.03 Performs maintenance and repairs on signal converters

F-23 Installs and services gateways, bridges and media converters
F-23.01 Performs installation and configuration of gateways, bridges and media converters
F-23.02 Diagnoses gateways, bridges and media converters
F-23.03 Performs maintenance and repairs on gateways, bridges and media converters

G-26 Installs and services programmable logic controllers (PLC)
G-26.01 Installs PLC
G-26.02 Configures PLC
G-26.03 Performs maintenance, diagnostics and repairs on PLC

Distributed Systems — 60 hours

- levels and different components included in DCS architecture
- configuration of components required in control modules
- develop a human machine interface (HMI) to represent a control process
- tune control loops using tools included in a modern DCS
- explain the need for safety instrumented systems (SIS) in DCS applications

RSOS subtasks covered in this section of training:

C-11 Installs and services safety systems and devices
C-11.01 Installs safety systems and devices
C-11.02 Maintains safety systems and devices
C-11.03 Diagnoses safety systems and devices
C-11.04 Repairs safety systems and devices

C-13 Installs and services safety instrumented systems (SIS)
C-13.01 Installs SIS
C-13.02 Configures SIS
C-13.03 Maintains SIS
C-13.04 Diagnoses SIS
C-13.05 Repairs SIS

G-27 Installs and services distributed control systems (DCS)
G-27.01 Installs DCS
G-27.02 Configures DCS
G-27.03 Performs maintenance, diagnostics and repairs on DCS

G-28 Installs and services human machine interface (HMI)
G-28.01 Installs HMI
G-28.02 Configures HMI
G-28.03 Performs maintenance, diagnostics and repairs on HMI

Instrument Control 3 — 30 hours

- basic concepts of fuzzy logic control
- understand the concept of developing a model, based on the laws of science
- understand the concept of model-based control
- understand the concepts of process control strategies used in industry

RSOS subtasks covered in this section of training:

G-24 Establishes and optimizes process control strategies
G-24.01 Determines process control strategy
G-24.02 Optimizes process control

G-25 Installs and services stand-alone controllers (SAC)
G-25.01 Installs SAC
G-25.02 Configures SAC
G-25.03 Performs maintenance, diagnostics and repairs on SAC

Mentoring — 10 hours

- purpose and benefits of workplace mentorship
- signs and implications of workplace stress
- workplace harassment policies

RSOS subtasks covered in this section of training:

A-4 Uses communication and mentoring techniques
A-4.02 Uses mentoring techniques

Chemistry 3 — 30 hours

- procedures to partition coefficients using molecular weight in gas chromatography
- demonstrate the electron orbital configurations affecting the magnetic properties of oxygen used in gas analyzers
- chemical reactions of oxygen and hydrogen using oxidation and reduction potentials
- chemical production and low explosive limit of harmful environmental gases
- chemical solubilities of liquid-liquid, solid-liquid and gas-liquid phases used in ultraviolet and infrared spectrophotometers

This section of training exceeds the minimum sequencing as set out by the Instrumentation and Control Technician Red Seal Occupational Standard.

Level four topics from the RSOS that are taught in context:

A-1 Safety-Related Functions
A-2 Tools and Equipment
D-16 Installs and Services Electrical and Electronic Equipment

For details regarding the In Context Topic, see page 27

In Context Topics

In context means learning that has already taken place and is being applied to the applicable task. Learning outcomes for in context topics are accomplished in other topics in that level.

A-1 Performs safety-related functions
A-1.01 Maintains safe work environment
A-1.02 Uses personal protective equipment (PPE) and safety equipment
A-1.03 Performs de-energizing, lock-out and tag-out procedures

A-2 Uses tools and equipment
A-2.01 Uses calibration, configuration and test equipment
A-2.02 Uses hand and power tools
A-2.03 Uses access equipment
A-2.04 Uses rigging, hoisting and lifting equipment

D-16 Installs and services electrical and electronic equipment
D-16.01 Installs electrical and electronic equipment
D-16.02 Diagnoses electrical and electronic equipment
D-16.03 Performs maintenance and repairs for electrical and electronic equipment