

# Apprenticeship and Certification Study Guide



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# Introduction

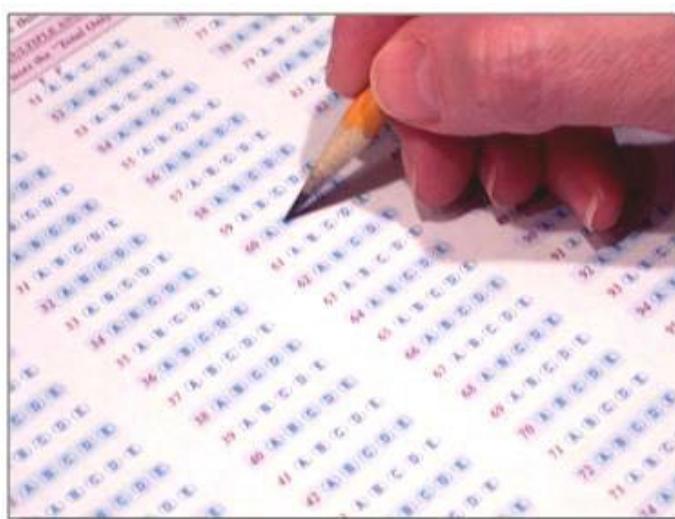
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This Study Guide has been developed by the Newfoundland and Labrador Department of Education and Early Childhood Development, Apprenticeship and Trades Certification Division, to assist apprentices and trade qualifiers as they prepare to write the Red Seal Exam. Red Seal Exams are available for all Red Seal trades. For a list of Red Seal trades please refer to the Department of Education and Early Childhood Development website: <https://www.gov.nl.ca/atcd/designated-trades/list-of-designated-trades/>

**Some of the specific goals of this guide are:**

- ⇒ to help you understand the skills and knowledge that might be covered on the exam
- ⇒ to help you identify your strengths and weaknesses
- ⇒ to provide organization and structure for a course of study
- ⇒ to provide a list of resources to help you with your study plan
- ⇒ to support and supplement the teaching and learning process

This study guide outlines the theoretical portion of the program. The intent is not to replace technical training provided under the guidance of instructors. Rather, it is a tool to be used in conjunction with formal training.



## Exam Process

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### Before the Exam

You must contact the nearest Apprenticeship and Trades Certification Divisional office to make request to write the Red Seal exam (*See Appendix A for a list of regional offices*). Upon approval, the Apprenticeship Program Officer (APO) will notify you of your eligibility to write the exam, and provide you with scheduling information. If you require special accommodations due to a disability or language barrier, please contact your regional office for information on applying for this service.

### During the Exam

#### You must bring:

- personal identification such as a photo or signature ID or valid Newfoundland and Labrador driver's license
- your notification letter

#### The following will be provided:

- a calculator (*see Appendix B for calculator information*)
- all other items required such as pencils, scrap paper, etc.

#### Important Note:

Personal cell phones, calculators, or other electronic equipment are NOT allowed into the exam room. If you do bring them, they will be stored away and returned to you when you have completed the exam.

### After the Exam

Results will be mailed to you approximately seven to ten days after completion of the exam. All necessary instructions and information will be provided in the results letter.

The percentage mark you obtained will be provided. You will also be given a section by section breakdown, showing how many questions were in each section, as well as the number of questions in each section you completed successfully.

If you are successful in obtaining a 70% or more on your exam, you will be issued a Newfoundland and Labrador Certificate of Qualification with a Red Seal endorsement.

# Exam Format

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All Red Seal exams are written in multiple choice format. Each exam has between 100 and 150 questions. A multiple choice question consists of a stem (a complete question) followed by four options (A, B, C, D). The stem contains all the information necessary to answer the question. The options consist of the one correct answer and three “distracters.” Distracters are incorrect. (See Appendix C for a sample answer sheet).

Red Seal exams contain three types of questions:

## Level 1    Knowledge and Recall

Questions at this level test your ability to recall and understand definitions, facts, and principles.

## Level 2    Procedural and Application

Questions at this level test your ability to apply your knowledge of procedures to a new situation.

## Level 3    Critical Thinking

Questions at this level test your ability to interpret data, solve problems and arrive at valid conclusions.

### Level 1 Examples:

1. When selecting a replacement component, which factor ensures that a conveyor electronic weigh scale will function properly?
  - A. Maximum length of belt.
  - B. Minimum width of belt.
  - C. Average speed of belt.
  - D. Sensor specifications.



2. Upon which principle of operation is a bulls-eye level gauge used on a steam boiler service based?

- A. Conductivity of water.
- B. Voltage change of thermocouple.
- C. Differing refractive indexes of steam and water.
- D. Resistance change of a resistance temperature detector.



3. Where is an intrinsic safety barrier panel installed?

- A. In a hazardous area with the ground bus bars returned to plant ground.
- B. In a safe area with no grounds.
- C. In a hazardous area with no grounds.
- D. In a safe area with an isolated ground.



### Level 2 Examples:

1. When removing a 129 V DC explosion-proof instrument from service, which procedure would ensure equipment and personal safety?

- A. Lockout and tag, inform operations, open breaker, isolate from process.
- B. Lockout and tag, isolate from process, open breaker, inform operations.
- C. Inform operations, lockout and tag, open breaker, isolate from process.
- D. Inform operations, isolate from process, open breaker, lockout and tag.



2. While calibrating a variable speed drive, 10% input equals 15% speed, 50% input equals 55% speed and 90% input equals 95% speed. What type of error is indicated?

- A. Zero.
- B. Span.
- C. Angularity.
- D. Alignment.



3. Which types of transducers can be used to measure displacement or motion?

- A. LVDTs, piezoelectric, and variable resistance.
- B. LVDTs, variable resistance, and thermoelectric.
- C. Variable resistance, and thermoelectric.
- D. Thermoelectric, LVDTs, and sonic.



### Level 3 Examples:

1. When installing a control valve on a steam process, which of the following valve ratings could be used? The process pressure is 1000 psi and 250°C.

- A. Valve rating 2000 psi, 100°C.
- B. Valve rating 500 psi, 500°C.
- C. Valve rating 1000 psi, 500°C.
- D. Valve rating 1000 psi, 150°C.



2. After replacing the speed-sensing probe, what is the probable cause of a 60 Hz reading being detected on the output signal of an induction-type speed sensor?

- A. The polarity is reversed.
- B. The terminals are corroded.
- C. The sensor is out of alignment.
- D. The shielding has not been properly grounded.



3. A nuclear density meter on an oil pipeline is showing erratic output. What is the probable fault?

- A. The scintillation counter is defective.
- B. The source has decayed.
- C. The shutter has been left practically closed.
- D. The source beam path is permanently obstructed.



**Source of Questions:**

<https://www.red-seal.ca/eng/s.1mpl.2.2x.1mQ.5.2st.3.4ns.shtml?tid=130>

## Exam Content

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### Understanding the *Red Seal Occupational Standard (RSOS)*

The Red Seal model has historically been based on the development of the National Occupational Analysis (NOA) which supports the development of multiple-choice format examinations.

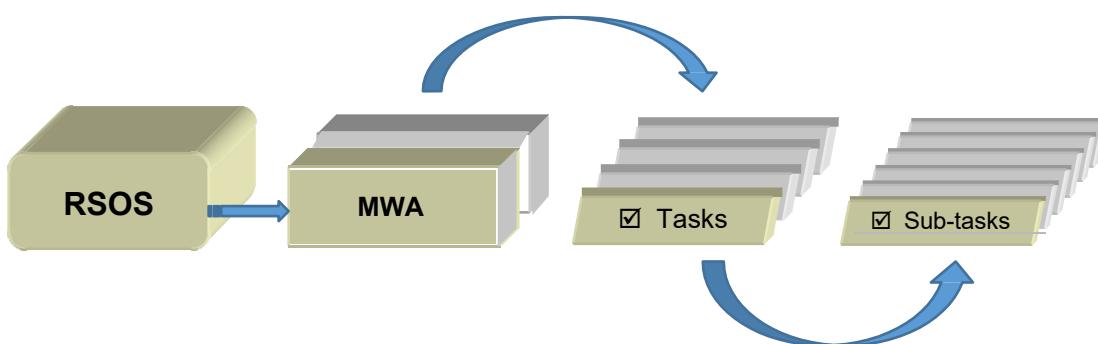
The RSOS was introduced in 2015 and is now taking the place of the NOA. Each RSOS or NOA sets the standard for a Red Seal trade. The Red Seal Examination is based on the Red Seal Standard.

The new standards provide greater consistency in learning resources and allow for increased industry involvement in the development of these standards. This new model places increases emphasis on apprenticeship training and assessing skills with industry learning objectives, outcomes and performance criteria.

The RSOS for each trade describes the tasks and sub-tasks; skills and knowledge requirements; summary of essential skills; safety information; trends affecting the trade; technical terms; names of tools and equipment; acronyms; learning objectives and outcomes; industry expected performance and essential skills related to each sub-task.

The RSOS is an excellent tool to use as you study for the Red Seal exam. RSOSs can be found at <http://www.red-seal.ca/resources/n.4.1-eng.html>

RSOS material is organized into the following categories: **MWA (Major Working Activity)**. The MWAs are further broken down into **TASKS (describes activities within an MWA)** and **SUB-TASKS (describe activities within a task – This is what the exam is based on)**.

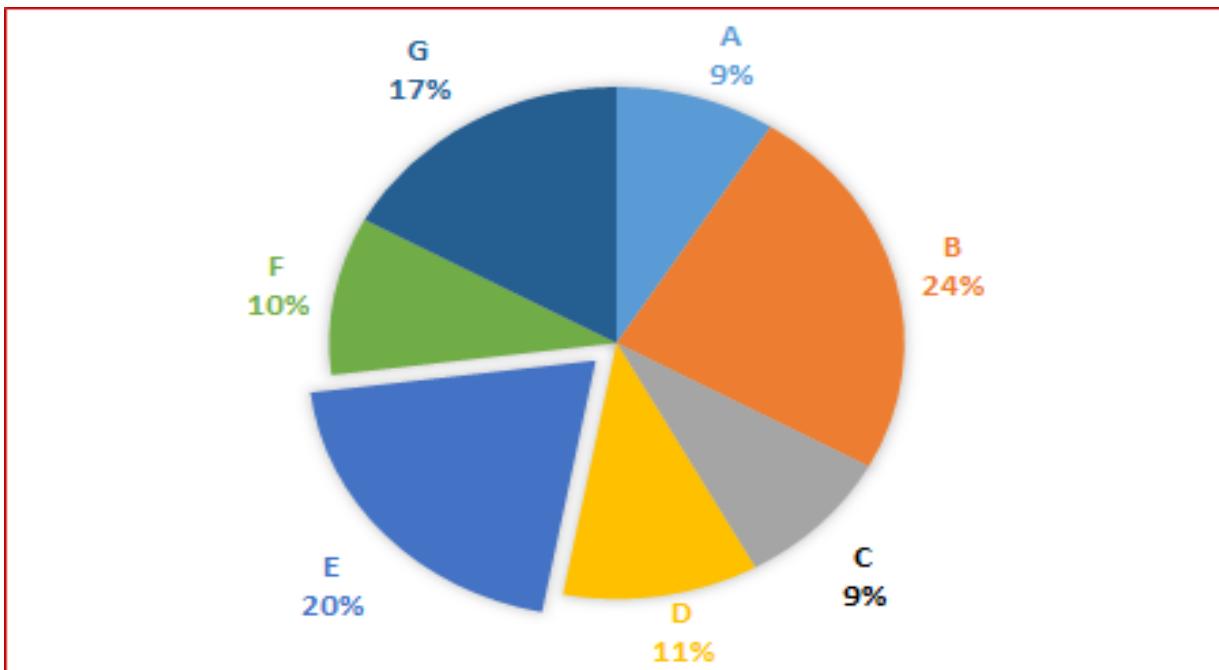


The NOA will continue to be used as the occupational standard for trades that do not yet have an RSOS developed.

## RSOS Pie Chart

The RSOS Pie Chart presents the MWA percentages in the form of a pie chart which tells you the approximate number of questions from each MWA. For example, 9% of the questions on the **Instrumentation and Control Technician** Exam will be based on **MWA A**.

Instrumentation and Control Technician



MAJOR WORKING ACTIVITIES (MWA) Titles			
<b>MWA A</b>	Performs Common Occupational Skills	<b>MWA E</b>	Installs, Configures and Services Final Control Elements
<b>MWA B</b>	Installs and Services Process Measuring and Indicating Devices	<b>MWA F</b>	Installs and Services Communication Systems and Devices
<b>MWA C</b>	Installs and Services Safety and Security Systems and Devices	<b>MWA G</b>	Installs and Services Control Systems and Process Control
<b>MWA D</b>	Installs and Services Hydraulic, Pneumatic & Electrical Systems		

## Exam Breakdown

The **Instrumentation and Control Technician** exam currently has 125 questions. The following table shows a breakdown of the number of questions that come from each RSOS MWA. It is important to note that the exact number of questions can change at any time. When you are ready to write your exam, you may contact your regional office to verify the number of questions (See Appendix A).

MWA A	Performs Common Occupational Skills	# of Questions
<b>Task 1</b>	Performs safety-related functions	4
<b>Task 2</b>	Uses tools and equipment	4
<b>Task 3</b>	Organizes work	3
<b>Task 4</b>	Uses communication and mentoring techniques	1
<b>MWA B</b>	<b>Installs and Services Process Measuring and Indicating Devices</b>	<b>30</b>
<b>Task 5</b>	Installs and services pressure, temperature, level and flow devices	9
<b>Task 6</b>	Installs and services signal transducers	4
<b>Task 7</b>	Installs and services motion, speed, position and vibration devices	4
<b>Task 8</b>	Installs and services mass, density and consistency devices	4
<b>Task 9</b>	Installs and services process analyzers	5
<b>Task 10</b>	Installs and services multiple variable computing devices	4
<b>MWA C</b>	<b>Installs and Services Safety and Security Systems and Devices</b>	<b>11</b>
<b>Task 11</b>	Installs and services safety systems and devices	6
<b>Task 12</b>	Installs and services facility security systems. ( <b>NOT COMMON CORE</b> )	N/A
<b>Task 13</b>	Installs and services safety instrumented systems (SISs)	5
<b>MWA D</b>	<b>Installs and Services Hydraulic, Pneumatic and Electrical Systems</b>	<b>14</b>
<b>Task 14</b>	Installs and services control devices for hydraulic systems	2
<b>Task 15</b>	Installs and services pneumatic equipment	6
<b>Task 16</b>	Installs and services electrical and electronic equipment	6
<b>MWA E</b>	<b>Installs, Configures and Services Final Control Elements</b>	<b>25</b>
<b>Task 17</b>	Installs and services valves	6
<b>Task 18</b>	Installs and services actuators	7
<b>Task 19</b>	Installs and services positioners	8
<b>Task 20</b>	Configures and services variable speed drives (VSDs)	4
<b>MWA F</b>	<b>Installs and Services Communication Systems and Devices</b>	<b>12</b>
<b>Task 21</b>	Installs and services control network systems	5
<b>Task 22</b>	Installs and services signal converters	4
<b>Task 23</b>	Installs and services gateways, bridges and media converters	3
<b>MWA G</b>	<b>Installs and Services Control Systems and Process Control</b>	<b>21</b>
<b>Task 24</b>	Establishes and optimizes process control strategies	5
<b>Task 25</b>	Installs and services stand-alone controllers (SACs)	3
<b>Task 26</b>	Installs and services programmable logic controllers (PLCs)	4
<b>Task 27</b>	Installs and services distributed control systems (DCSs)	4
<b>Task 28</b>	Installs and services human machine interface (HMI)	3
<b>Task 29</b>	Installs and services supervisory control and data acquisition (SCADA) systems	2
<b>Total</b>		<b>125</b>

## RSOS Sub-tasks

The following *RSOS Task Profile Checklist* outlines the MWAs, tasks and sub-tasks for your trade. The Red Seal exam is written to test your knowledge and abilities regarding the sub-tasks in the RSOS. This chart can be used to review your current knowledge. You can review by placing a checkmark (✓) next to those you understand fully.

Place your focus on those you do not understand and study them until you are comfortable with the material. Think of possible questions in that particular content area.

The RSOS also contains a list of “supporting knowledge and abilities” for each sub-task. They are the skills and knowledge you must have to perform a sub-task. The supporting knowledge and abilities identified under each sub-task will be very helpful as you review. The list can be found in the RSOS for your trade.

**Task Profile Checklist**  
**Based on RSOS 2020**  
**Instrumentation and Control Technician**

### **MWA A: Performs Common Occupational Skills**

<input type="checkbox"/> <b>Task 1: Performs safety-related functions</b>
<b>Sub-Tasks</b>
<input type="checkbox"/> Maintains safe work environment. <input type="checkbox"/> Uses personal protective equipment (PPE) and safety equipment <input type="checkbox"/> Performs de-energizing, lock-out and tag-out procedures
<input type="checkbox"/> <b>Task 2: Uses tools and equipment</b>
<b>Sub-Tasks</b>
<input type="checkbox"/> Uses calibration, configuration and test equipment <input type="checkbox"/> Uses hand and power tools <input type="checkbox"/> Uses access equipment <input type="checkbox"/> Uses rigging, hoisting and lifting equipment
<input type="checkbox"/> <b>Task 3: Organizes work</b>
<b>Sub-Tasks</b>
<input type="checkbox"/> Uses documentation <input type="checkbox"/> Interprets drawings and schematics <input type="checkbox"/> Plans tasks
<input type="checkbox"/> <b>Task 4: Uses communication and mentoring techniques</b>
<b>Sub-Tasks</b>
<input type="checkbox"/> Uses communication techniques <input type="checkbox"/> Uses mentoring techniques

### **MWA B: Installs and Services Process Measuring and Indicating Devices**

<input type="checkbox"/> <b>Task 5: Installs and services pressure, temperature, level and flow devices</b>
<b>Sub-Tasks</b>
<input type="checkbox"/> Installs pressure, temperature, level and flow devices <input type="checkbox"/> Maintains pressure, temperature, level and flow devices <input type="checkbox"/> Diagnoses pressure, temperature, level and flow devices <input type="checkbox"/> Repairs pressure, temperature, level and flow devices
<input type="checkbox"/> <b>Task 6: Installs and services signal transducers</b>
<b>Sub-Tasks</b>
<input type="checkbox"/> Performs installation and configuration of signal transducers <input type="checkbox"/> Diagnoses signal transducers <input type="checkbox"/> Performs maintenance and repairs on signal transducers

## MWA B: Installs and Services Process Measuring and Indicating Devices (Cont'd)

### Task 7: Installs and services motion, speed, position and vibration devices

Sub Tasks	<ul style="list-style-type: none"><li><input type="checkbox"/> Installs motion, speed, position and vibration devices</li><li><input type="checkbox"/> Maintains motion, speed, position and vibration devices</li><li><input type="checkbox"/> Diagnoses motion, speed, position and vibration devices</li><li><input type="checkbox"/> Repairs motion, speed, position and vibration devices</li></ul>
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### Task 8: Installs and services mass, density and consistency devices

Sub Tasks	<ul style="list-style-type: none"><li><input type="checkbox"/> Installs mass, density and consistency devices</li><li><input type="checkbox"/> Maintains mass, density and consistency devices</li><li><input type="checkbox"/> Diagnoses mass, density and consistency devices</li><li><input type="checkbox"/> Repairs mass, density and consistency devices</li></ul>
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### Task 9: Installs and services process analyzers

Sub Tasks	<ul style="list-style-type: none"><li><input type="checkbox"/> Installs process analyzers</li><li><input type="checkbox"/> Maintains process analyzers</li><li><input type="checkbox"/> Diagnoses process analyzers</li><li><input type="checkbox"/> Repairs process analyzers</li></ul>
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### Task 10: Installs and services multiple variable computing devices

Sub Tasks	<ul style="list-style-type: none"><li><input type="checkbox"/> Installs multiple variable computing devices</li><li><input type="checkbox"/> Maintains multiple variable computing devices</li><li><input type="checkbox"/> Diagnoses multiple variable computing devices</li><li><input type="checkbox"/> Repairs multiple variable computing devices</li></ul>
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## MWA C: Installs and Services Safety and Security Systems and Devices

### Task 11: Installs and services safety systems and devices

Sub Tasks	<ul style="list-style-type: none"><li><input type="checkbox"/> Installs safety systems and devices</li><li><input type="checkbox"/> Maintains safety systems and devices</li><li><input type="checkbox"/> Diagnoses safety systems and devices</li><li><input type="checkbox"/> Repairs safety systems and devices</li></ul>
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### Task 12: Installs and services facility security systems. (NOT COMMON CORE)

Sub Tasks	<ul style="list-style-type: none"><li><input type="checkbox"/> Installs facility security systems. (NOT COMMON CORE)</li><li><input type="checkbox"/> Maintains facility security systems. (NOT COMMON CORE)</li><li><input type="checkbox"/> Diagnoses facility security systems. (NOT COMMON CORE)</li><li><input type="checkbox"/> Repairs facility security systems. (NOT COMMON CORE)</li></ul>
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### Task 13: Installs and services safety instrumented systems (SISs)

Sub Tasks	<ul style="list-style-type: none"><li><input type="checkbox"/> Installs SISs</li><li><input type="checkbox"/> Configures SISs</li><li><input type="checkbox"/> Maintains SISs</li><li><input type="checkbox"/> Diagnoses SISs</li><li><input type="checkbox"/> Repairs SISs</li></ul>
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## MWA D: Installs and Services Hydraulic, Pneumatic and Electrical Systems

### Task 14: Installs and services control devices for hydraulic systems

Sub-Tasks	
	<input type="checkbox"/> Installs control devices for hydraulic systems
	<input type="checkbox"/> Diagnoses control devices for hydraulic systems
	<input type="checkbox"/> Performs maintenance and repairs on control devices for hydraulic systems

### Task 15: Installs and services pneumatic equipment

Sub-Tasks	
	<input type="checkbox"/> Installs pneumatic equipment
	<input type="checkbox"/> Diagnoses pneumatic equipment
	<input type="checkbox"/> Performs maintenance and repairs on pneumatic equipment

### Task 16: Installs and services electrical and electronic equipment

Sub-Tasks	
	<input type="checkbox"/> Installs electrical and electronic equipment
	<input type="checkbox"/> Diagnoses electrical and electronic equipment
	<input type="checkbox"/> Performs maintenance and repairs for electrical and electronic equipment

## MWA E: Installs, Configures and Services Final Control Elements

### Task 17: Installs and services valves

Sub-Tasks	
	<input type="checkbox"/> Installs valves
	<input type="checkbox"/> Maintains valves
	<input type="checkbox"/> Diagnoses valves
	<input type="checkbox"/> Repairs valves

### Task 18: Installs and services actuators

Sub-Tasks	
	<input type="checkbox"/> Installs actuators
	<input type="checkbox"/> Maintains actuators
	<input type="checkbox"/> Diagnoses actuators
	<input type="checkbox"/> Repairs actuators

## MWA E: Final Control Devices (Cont'd)

### Task 19: Installs and services positioners

**Sub-Tasks**

- Installs positioners
- Maintains positioners
- Diagnoses positioners
- Repairs positioners

### Task 20: Configures and services variable speed drives (VSD)s

**Sub-Tasks**

- Configures VSDs
- Maintains VSDs
- Diagnoses VSDs
- Repairs VSDs

## MWA F: Installs and Services Communications Systems and Devices

### Task 21: Installs and services control network systems

**Sub-Tasks**

- Performs installation and configuration on control network systems
- Diagnoses control network systems
- Performs maintenance and repairs on control network systems

### Task 22: Installs and services signal converters

**Sub-Tasks**

- Performs installation and configuration of signal converters
- Diagnoses signal converters
- Performs maintenance and repairs on signal converters

### Task 23: Installs and services gateways, bridges and media converters

**Sub-Tasks**

- Performs installation and configuration of gateways, bridges and media converters
- Diagnoses gateways, bridges and media converters
- Performs maintenance and repairs on gateways, bridges and media converters

## MWA G: Installs and Services Control Systems and Process Control

### **Task 24: Establishes and optimizes process control strategies**

#### **Sub-Tasks**

- Determines process control strategy
- Optimizes process control

### **Task 25: Installs and services stand-alone controllers (SACs)**

#### **Sub-Tasks**

- Installs SACs
- Configures SACs
- Performs maintenance, diagnostics and repairs on SACs

### **Task 26: Installs and services programmable logic controllers (PLCs)**

#### **Sub-Tasks**

- Installs PLCs
- Configures PLCs
- Performs maintenance, diagnostics and repairs on PLCs

### **Task 27: Installs and services distributed control systems (DCSs)**

#### **Sub-Tasks**

- Installs DCSs
- Configures DCSs
- Performs maintenance, diagnostics and repairs on DCSs

### **Task 28: Installs and services human machine interfaces (HMIs)**

#### **Sub-Tasks**

- Installs HMIs
- Configures HMIs
- Performs maintenance, diagnostics and repairs on HMIs

### **Task 29: Installs and services supervisory control and data acquisition (SCADA) systems**

#### **Sub-Tasks**

- Installs SCADA systems
- Configures SCADA systems
- Performs maintenance, diagnostics and repairs on SCADA systems

## Create a Study Plan

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As you prepare for your exam, it is important to plan a schedule. The following two tables will help you stay on track.

The first table is a “**Weekly Study Plan.**” In this table list the areas you will focus your study for each day. You should include items you need to review as well as items you need to study. Remember, more time will be needed for study in areas you find difficult, whereas you may only require review in areas you are more familiar with. As you work through the RSOS sub-task list you can start to fill in this table.

The second table is a “**Study Time Table.**” It is important to create a study schedule where you determine the best days of the week and times of day for you to study.

Print several copies of these tables and fill out for each week of study. It is important to stick to your study schedule.

**Weekly Study Plan for Week of: \_\_\_\_\_**

	<b>Area of Study 1</b>	<b>Area of Study 2</b>	<b>Area of Study 3</b>	<b>Area of Study 4</b>	<b>Area of Study 5</b>	<b>Area of Study 6</b>
<b>Mon.</b>						
<b>Tues.</b>						
<b>Wed.</b>						
<b>Thu.</b>						
<b>Fri.</b>						
<b>Sat.</b>						
<b>Sun.</b>						

**Study Time Table for Week of: \_\_\_\_\_**

	<b>Monday</b>	<b>Tuesday</b>	<b>Wednesday</b>	<b>Thursday</b>	<b>Friday</b>	<b>Saturday</b>	<b>Sunday</b>
<b>8:00 AM - 9:00 AM</b>							
<b>9:00 AM - 10:00 AM</b>							
<b>10:00 AM - 11:00 AM</b>							
<b>11:00 AM - 12:00 Noon</b>							
<b>12:00 Noon - 1:00 PM</b>							
<b>1:00 PM - 2:00 PM</b>							
<b>2:00 PM - 3:00 PM</b>							
<b>3:00 PM - 4:00 PM</b>							
<b>4:00 PM - 5:00 PM</b>							
<b>5:00 PM - 6:00 PM</b>							
<b>6:00 PM - 7:00 PM</b>							
<b>7:00 PM - 8:00 PM</b>							

# Resources - Websites

Study information can be drawn from a variety of sources. A sample list of study materials (websites and books) is provided below. These and other helpful resources may be found in a local college bookstore, on the internet, or at your place of employment. You may also be able to borrow them from an apprentice or journeyperson in your trade.

## Study Strategies and Exam Preparation Guide

The *Study Strategies & Exam Preparation Guide* is meant to be used in conjunction with this study guide. It provides direction and information on such areas as study habits, test preparation and test taking techniques.

<https://www.gov.nl.ca/atcd/files/Study-Strategies-and-Exam-Prep-Guide-October-2023.pdf>

## Plan of Training (POT)

A *Provincial Plan of Training* details the full scope of learning for a particular occupation, including both technical training competencies and industry experiences necessary to write a Red Seal exam (and complete the requirements for Red Seal Certification), or to write a provincial examination. The Plan of Training is based on the RSOS.

<https://www.gov.nl.ca/atcd/designated-trades/pots-aacs/>

## Red Seal Website

**Red Seal** is a program that sets common standards to evaluate the skills of tradespeople across Canada. It is a partnership between the Federal Government and the provinces/territories.

The Red Seal model has been based on the National Occupational Analyses (NOA), which supports the development of multiple-choice examinations. A **new** Red Seal Occupational Standard (RSOS) was introduced in 2015 and is taking the place of the NOA.

<https://www.red-seal.ca/>

## Instrumentation and Control Technician PRACTICE Exam

This is **NOT** a Red Seal exam. This is a practice exam provided by the Red Seal Standards Program. It was developed using similar question types to that of a Red Seal exam. The exam is intended to be used for self-assessment in preparation for writing a Red Seal Exam.

<https://www.red-seal.ca/eng/s.1mpl.2.2x.1mQ.5.2st.3.4ns.shtml?tid=130>

## Red Seal Exam Self-Assessment Guide

Use this self-assessment tool to rate your own understanding and experience with the tasks of the trade that are on the Red Seal examination:

<https://www.red-seal.ca/eng/resources/selfexamspace.shtml?tid=130>

## Acronyms

The Red Seal website lists Acronyms which will be helpful in preparing for your Red Seal exam:

<https://red-seal.ca/eng/trades/instrumentctltech/app-a.shtml>

## Tools and Equipment

The Red Seal website lists Tools and Equipment which will be helpful in preparing for your Red Seal exam:

<https://red-seal.ca/eng/trades/instrumentctltech/app-b.shtml>

## Glossary

The Red Seal website also shows a Glossary which is helpful in preparing for the Red Seal exam:

<https://red-seal.ca/eng/trades/instrumentctltech/app-c.shtml>

## Resources – Book List

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The books listed below are sorted according to RSOS MWAs as referenced throughout this study guide. You can use this list to help you obtain information on specific topics. It is not necessary to use these books specifically, as you may find others that will be equally beneficial.

BOOK	A	B	C	D	E	F	G
Delmar's Standard Text of Electricity, 4 <sup>th</sup> Ed.	✓			✓			
Process Measurement and Analysis		✓	✓		✓	✓	✓
Process Control and Optimization		✓	✓		✓	✓	✓
Measurement and Control Basics		✓	✓		✓	✓	✓
Instrumentation, 4 <sup>th</sup> Ed.		✓	✓		✓	✓	✓
Canadian Electrical Code	✓					✓	
CE Code Pocket Reference	✓					✓	
Hand Tools for Instrumentation – Module 12101-01	✓						
Power Tools for Instrumentation – Module 12103-01	✓						
Fasteners – Module 12103-01	✓						
Filters, Regulators, and Dryers – Module 12210-03				✓			
Clean, Purge, and Test Tubing and Piping Systems – Module 12303-03				✓			
Grounding and Shielding of Instrumentation Wiring – Module 12306-03						✓	
Terminating Conductors – Module 12307-03						✓	
Troubleshooting and Commissioning a Loop – Module 12404-03	✓				✓		
Performing Loop Checks – Module 12403-03	✓				✓		
Tuning Loops – Module 12405-03	✓				✓		
Tubing – Module 12111-01				✓			

If you wish to obtain any of the resources listed above, here is the reference information:

- Delmar's Standard Text of Electricity*, 4<sup>th</sup> edition, Delmar Publishers, 2008, Herman, S., ISBN 978-1418065805
- Process Measurement and Analysis*, Instrument Engineers' Handbook, 4<sup>th</sup> Edition, 2003, Liptak, B.G., ISA. ISBN 0-8493-1083-0
- Process Control and Optimization*, Instrument Engineers' Handbook, 4<sup>th</sup> Edition, 2006, Liptak, B.G., ISA. ISBN 0-8493-1081-4
- Measurement and Control Basics*, 4<sup>th</sup> Edition, 2007, Hughes, T.A., ISA. ISBN 978-1-55617-916-7
- Instrumentation*, 4<sup>th</sup> Edition, 2005, ISBN 978-0-8269-3423-9
- Instrumentation Workbook*, 4<sup>th</sup> Edition, 2005. ISBN 978-0-8269-3424-6
- Canadian Electrical Code, Part 1 (Safety Standard to Electrical Installations)*, 2009, CSA. ISBN 978-1-55436-473-2

## Resources – Book List (Continued)

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- CE Code Pocket Reference* (Safety Standard for Electrical Installations), 2009, CSA. ISBN 978-1-55491-046-5
- Hand Tools for Instrumentation*, Module 12101-01, 2001, NCCER (National Center for Construction Education and Research Module). ISBN 0-13-868167-8
- Power Tools for Instrumentation*, Module 12103-01, 2001, NCCER (National Center for Construction Education and Research Module). ISBN 0-13-868225-9
- Fasteners*, Module 12106-01, NCCER (National Center for Construction Education and Research Module). ISBN 0-13-868324-7
- Filters, Regulators, and Dryers*, Module 12210-03, 2001, NCCER (National Center for Construction Education and Research Module). ISBN 0-13-103274-7
- Clean, Purge, and Test Tubing and Piping Systems*, Module 12303-03, 2001, NCCER (National Center for Construction Education and Research Module). ISBN 0-13-103298-4
- Grounding and Shielding of Instrumentation Wiring*, Module 12306-03, 2001, NCCER (National Center for Construction Education and Research Module). ISBN 0-13-103302-6
- Terminating Conductors*, Module 12307-03, 2001, NCCER (National Center for Construction Education and Research Module). ISBN 0-13-103303-4
- Troubleshooting and Commissioning a Loop*, Module 12404-03, 2001, NCCER (National Center for Construction Education and Research Module). ISBN 0-13-109614-1
- Performing Loop Checks*, Module 12303-03, 2001, NCCER (National Center for Construction Education and Research Module). ISBN 0-13-109613-3
- Tuning Loops*, Module 12405-03, 2001, NCCER (National Center for Construction Education and Research Module). ISBN 0-13-109613-3
- Tubing*, Module 12111-01, 2001, NCCER (National Center for Construction Education and Research Module).

## **Disclaimer**

Various external resources (websites, textbooks) have been listed in this study guide to assist an individual in preparing to write a Red Seal Exam. This does not mean the Department of Education and Early Childhood Development, Newfoundland and Labrador endorses the material or that these are recommended as the best resources. There may be other resources of equal or greater value to an individual preparing for a Red Seal exam. The Department of Education and Early Childhood Development has no control over the content of external textbooks and websites listed, and no responsibility is assumed for the accuracy of the material.

## **Conclusion**

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We hope this guide has provided you with some useful tools as you prepare for your Red Seal exam. If you have any questions regarding your Red Seal exam please contact your regional office (*see Appendix A for a list of regional offices*).

We appreciate your comments and feedback regarding the usefulness of this study guide. If you have any comments or suggestions, we welcome your feedback. The feedback form at the end of this guide can be used for this purpose.

## Appendix A: Regional Offices

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If you have any questions regarding your Red Seal exam, please contact one of the following regional offices:

Department of Education and Early Childhood Development  
Apprenticeship and Trades Certification Division

Toll Free: 1-877-771-3737

<https://www.gov.nl.ca/atcd/contact-us/staff-listing-and-office-locations/>

Corner Brook
1-3 Union Street Aylward Building, 2 <sup>nd</sup> Floor Corner Brook, NL A2H 5M7
Telephone: (709) 637-2366 Facsimile: (709) 637-2519

Grand Falls-Windsor
42 Hardy Avenue Grand Falls-Windsor, NL A2A 2J9
Telephone: (709) 292-4215 Facsimile: (709) 292-4502

Clarenville
45 Tilley's Road Clarenville, NL A5A 1Z4
Telephone: (709) 466-3982 Facsimile: (709) 466-3987

St. John's
P.O. Box 8700 1170 Topsail Road Mount Pearl, NL A1B 4J6
Telephone: (709) 729-2729 Facsimile: (709) 729-5878

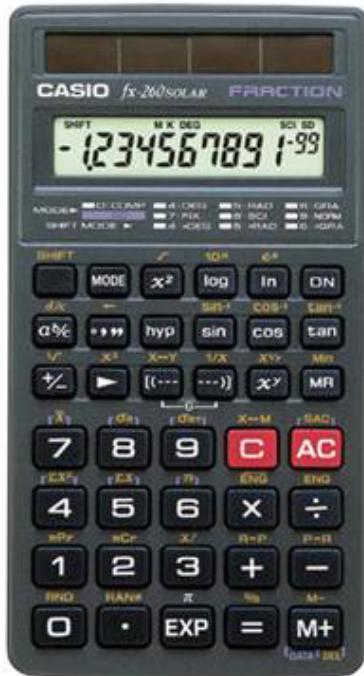
Happy Valley – Goose Bay
163 Hamilton River Road Bursey Building Happy Valley – Goose Bay, NL A0P 1E0
Telephone: (709) 896-6348 Facsimile: (709) 896-3733

## Appendix B: Calculator Use

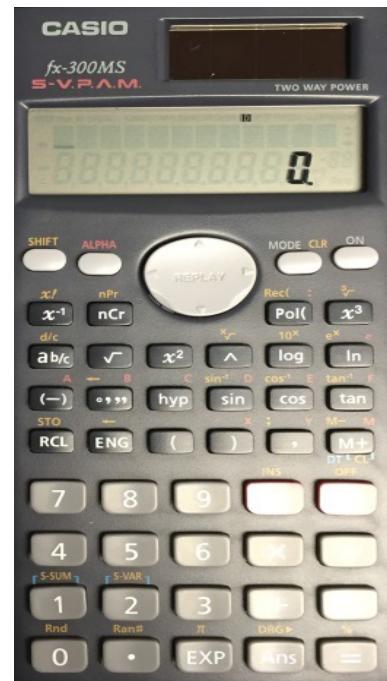
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The picture below shows a calculator with the same functions as the one you will be provided with during your exam. It is advisable to borrow or purchase one with similar functions so that you can familiarize yourself with it before you write your exam.

**Casio FX-260**



**Casio FX-300 MS**



## ***Appendix C: Answer Sheet Example***

With your exam you will be given an answer sheet similar to the one below. When answering multiple choice questions be sure to fill the circle completely and fill the circle that corresponds to the question on the exam.

**Dual readhead scanner ■■■ required ■■■ to score this sheet**

<b>KEY ID</b> <b>(A B C D)</b>	<b>SCORING &amp; PRINTING OPTIONS:</b>	<b>RESCORE</b>	<b>MULTIPLE ANSWER SCORING</b>
This sheet always uses the "Total Only" scoring option.			

**FEED IN THIS DIRECTION**  

<b>T F</b>	<b>T F</b>	<b>T F</b>	<b>T F</b>
1 (A B C D E)	26 (A B C D E)	51 (A B C D E)	76 (A B C D E)
2 (A B C D E)	27 (A B C D E)	52 (A B C D E)	77 (A B C D E)
3 (A B C D E)	28 (A B C D E)	53 (A B C D E)	78 (A B C D E)
4 (A B C D E)	29 (A B C D E)	54 (A B C D E)	79 (A B C D E)
5 (A B C D E)	30 (A B C D E)	55 (A B C D E)	80 (A B C D E)
6 (A B C D E)	31 (A B C D E)	56 (A B C D E)	81 (A B C D E)
7 (A B C D E)	32 (A B C D E)	57 (A B C D E)	82 (A B C D E)
8 (A B C D E)	33 (A B C D E)	58 (A B C D E)	83 (A B C D E)
9 (A B C D E)	34 (A B C D E)	59 (A B C D E)	84 (A B C D E)
10 (A B C D E)	35 (A B C D E)	60 (A B C D E)	85 (A B C D E)
11 (A B C D E)	36 (A B C D E)	61 (A B C D E)	86 (A B C D E)
12 (A B C D E)	37 (A B C D E)	62 (A B C D E)	87 (A B C D E)
13 (A B C D E)	38 (A B C D E)	63 (A B C D E)	88 (A B C D E)
14 (A B C D E)	39 (A B C D E)	64 (A B C D E)	89 (A B C D E)
15 (A B C D E)	40 (A B C D E)	65 (A B C D E)	90 (A B C D E)
16 (A B C D E)	41 (A B C D E)	66 (A B C D E)	91 (A B C D E)
17 (A B C D E)	42 (A B C D E)	67 (A B C D E)	92 (A B C D E)
18 (A B C D E)	43 (A B C D E)	68 (A B C D E)	93 (A B C D E)
19 (A B C D E)	44 (A B C D E)	69 (A B C D E)	94 (A B C D E)
20 (A B C D E)	45 (A B C D E)	70 (A B C D E)	95 (A B C D E)
21 (A B C D E)	46 (A B C D E)	71 (A B C D E)	96 (A B C D E)
22 (A B C D E)	47 (A B C D E)	72 (A B C D E)	97 (A B C D E)
23 (A B C D E)	48 (A B C D E)	73 (A B C D E)	98 (A B C D E)
24 (A B C D E)	49 (A B C D E)	74 (A B C D E)	99 (A B C D E)
25 (A B C D E)	50 (A B C D E)	75 (A B C D E)	100 (A B C D E)

**ANSWER KEY INFO.**

<b># OF KEYS</b>	<b>ITEM COUNT</b>
100 = 100%	0 0 0 0 0 0 0 0 0 0
80 = 80%	1 1 1 1 1 1 1 1 1 1
70 = 70%	2 2 2 2 2 2 2 2 2 2
60 = 60%	3 3 3 3 3 3 3 3 3 3
50 = 50%	4 4 4 4 4 4 4 4 4 4
40 = 40%	5 5 5 5 5 5 5 5 5 5
30 = 30%	6 6 6 6 6 6 6 6 6 6
20 = 20%	7 7 7 7 7 7 7 7 7 7
10 = 10%	8 8 8 8 8 8 8 8 8 8
0 = 0%	9 9 9 9 9 9 9 9 9 9

**PERFORMANCE ASSESSMENT**

<b>% OF TOTAL SCORE</b>	<b>POINTS EARNED</b>
100 = 100%	0 0 0 0 0 0 0 0 0 0
80 = 80%	1 1 1 1 1 1 1 1 1 1
70 = 70%	2 2 2 2 2 2 2 2 2 2
60 = 60%	3 3 3 3 3 3 3 3 3 3
50 = 50%	4 4 4 4 4 4 4 4 4 4
40 = 40%	5 5 5 5 5 5 5 5 5 5
30 = 30%	6 6 6 6 6 6 6 6 6 6
20 = 20%	7 7 7 7 7 7 7 7 7 7
10 = 10%	8 8 8 8 8 8 8 8 8 8
0 = 0%	9 9 9 9 9 9 9 9 9 9

**Bar Code**

**NUMBER CORRECT**

**PERCENT CORRECT**

**ROSTER NUMBER**

**SCORE**

**RESCORE**

**COMBINED POINTS EARNED**

**COMBINED PERCENT CORRECT**

**LETTER GRADE**

**SCORE**

**RESCORE**

**200 ITEM**

**STUDENT ID NUMBER**

**MARKING INSTRUCTIONS**

**Use a No. 2 Pencil**

**(A) (B) (C) (D) (E)**

**Fill oval completely**

**(A) (B) (C) (D) (E)**

**Erase cleanly**

**NAME \_\_\_\_\_**

**SUBJECT \_\_\_\_\_**

**PERIOD \_\_\_\_\_ DATE \_\_\_\_\_**

## **Feedback Form**

### **Study Guide – Instrumentation and Control Technician**

Please answer the following:

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- (1) This Study Guide is a useful tool for exam preparation.  
 strongly agree     agree     disagree     strongly disagree
  
- (2) The topics contained in the guide are arranged in a logical order.  
 strongly agree     agree     disagree     strongly disagree
  
- (3) The design and format of the guide caught my attention.  
 strongly agree     agree     disagree     strongly disagree
  
- (4) The instructions throughout the guide are clear and to the point.  
 strongly agree     agree     disagree     strongly disagree
  
- (5) The resources listed in this guide are suitable and valuable.  
 strongly agree     agree     disagree     strongly disagree
  
- (6) The guide should contain more information.  
 strongly agree     agree     disagree     strongly disagree

Suggested information/resources to include:

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Additional Comments:

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**Please complete this form and return via fax or mail to the following:**

Department of Education and Early Childhood Development  
Apprenticeship and Trades Certification Division  
Standards and Curriculum Unit  
45 Tilley's Road, Clarenville, NL A5A 1Z4  
Fax: (709) 466-3987

Department of Education and Early Childhood Development  
Apprenticeship and Trades Certification Division

