



# AUTOMOTIVE SERVICE TECHNICIAN

Version: 2019

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# Atlantic Apprenticeship Curriculum Standard

## Automotive Service Technician

# PLAN OF TRAINING

## Atlantic Apprenticeship Curriculum Standard

### Automotive Service Technician

March, 2019



**Government of Newfoundland and Labrador  
Department of Advanced Education, Skills and Labour  
Apprenticeship and Trades Certification Division**

Approved by:

A handwritten signature in blue ink, appearing to read "Dave H.", written over a horizontal line.

Chairperson, Provincial Apprenticeship and Certification Board

Date: March 20, 2019

## Preface

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This Atlantic Apprenticeship Curriculum Standard is intended to assist instructional staff in the design and delivery of technical, in-class training in support of the Automotive Service Technician program.

This document contains all the technical training elements required to complete the Automotive Service Technician apprenticeship program and has been developed based on the 2016 Red Seal Occupational Standard (RSOS). The RSOS can be found on the Red Seal website ([www.red-seal.ca](http://www.red-seal.ca)).

Implementation of this AACS for Apprenticeship training is outlined in the following table.

| Level   | Implementation Effective |
|---------|--------------------------|
| Level 1 | 2019-2020                |
| Level 2 | 2020-2021                |
| Level 3 | 2021-2022                |
| Level 4 | 2022-2023                |

*\*\* The above implementation schedule was current at time of printing. Please **confirm** with Apprenticeship Staff prior to commencing training.*

Granting of credit or permission to challenge level examinations for pre-employment or pre-apprenticeship training for the Automotive Service Technician trade will be based on the content outlined in this standard. Training providers must contact their provincial apprenticeship authority for more information on the process and requirements for determining eligibility for credit towards an apprenticeship program. Programs which have been deemed acceptable by the jurisdictional apprenticeship authority will be identified in transfer credit matrix developed through the Atlantic Apprenticeship Harmonization Project.

## Acknowledgements

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The development of the Atlantic Apprenticeship Curriculum Standard (AACS) is an initiative of the Atlantic Apprenticeship Council's Atlantic Apprenticeship Harmonization Project (AAHP) through the Atlantic Workforce Partnership and Employment and Social Development Canada.

The Atlantic Apprenticeship Council wishes to acknowledge the contributions of the following industry and instructional representatives on the Atlantic Trade Advisory Committee (ATAC) who participated in the development of this document in May, 2018.

|                  |                           |
|------------------|---------------------------|
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Advisory committees, industry representatives, instructors and apprenticeship staff provided valuable input to the development of this document. Without their dedication to quality apprenticeship training, this document could not have been produced.

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## User Guide

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Atlantic Apprenticeship Curriculum Standards (AACS) are developed based on Red Seal Occupational Standards (RSOS), National Occupational Analyses (NOA), Interprovincial Program Guides (IPG), if available, and extensive industry consultation. This document represents the minimum content to be delivered as part of the harmonized Atlantic program for the Automotive Service Technician trade.

The AACS's are deliberately constructed for ease of use and flexibility of structure in order to adapt to all delivery requirements. They detail units of training, unit outcomes and objectives. They do not impose a delivery model or teaching format.

Jurisdictions and/or training providers will select and develop delivery materials and techniques that accommodate a variety of learning styles and delivery patterns. The AACS does not dictate study materials, textbooks or learning activities to be used in delivery.

The document includes a Level Structure to facilitate mobility for apprentices moving from one jurisdiction to another.

### *Structure*

The content of the AACS is divided into units. Unit codes are used as a means of identification and are not intended to convey the order of delivery. It is at the discretion of the training provider to deliver the content in the required logical sequence of delivery within the level. Jurisdictions are free to deliver units one at a time or concurrently within a level, provided all outcomes are met.

The Learning Outcomes describe what the apprentice should know or be able to do at the end of training. Wording of the Learning Outcomes, "Demonstrate knowledge of..." acknowledges the broad spectrum of ways in which knowledge can be assessed (i.e. practical projects, multiple choice testing, presentations, etc.) by instructional staff within the training.

Summative evaluation will be through a multiple-choice Level Examination administered through the jurisdictional Apprenticeship Authority.

## **User Guide** *(continued)*

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The 2016 Red Seal Occupational Standard References (RSOS) to AACS Comparison chart outlines the relation between each RSOS sub-task and the AACS units. RSOS References have also been detailed in each unit to highlight the direct link between the unit and relevant sub-tasks in the RSOS.

In the Level Structure section, the document identifies suggested hours in order to provide an indication of the time it should take to cover the material in the unit and is provided as a guide only. Adjustments to the suggested hours for each unit may be required to account for rate of apprentice learning, statutory holidays, storm days, registration and examinations. These suggested hours detailed for each unit will represent both theory and practical training (if relevant) and for consistency will be based on a standard of 30 hours per week of training. The true length of time required to deliver an outcome successfully will depend upon the learning activities and teaching methods used.

There are two types of objectives found in the AACS document: theoretical and practical.

The theoretical objectives represent the material that is to be covered during the technical training in order to convey the required knowledge to the apprentice.

The practical objectives represent the tasks or skills that have been deemed by the Atlantic Trade Advisory Committee as critical for the apprentices to receive exposure to while attending technical training. For example, exposure could be done through instructor demonstration or individual or group performance of the skill or task. Training providers are encouraged to use practical demonstration and opportunities for hands-on learning whenever possible. Practical objectives are not intended to replace the on-the-job training component of the apprentice's program or to mirror or replace the logbook skills that are to be taught and evaluated in the workplace.

Detailed content for each objective has not been developed. Where detail is required for clarity, content has been provided.



## Glossary of Terms

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These definitions are intended as a guide to how language is used in the document.

|                       |  |
|-----------------------|--|
| <b>ADJUST</b>         | To put in good working order; regulate; bring to a proper state or position.                           |
| <b>APPLICATION</b>    | The use to which something is put and/or the circumstance in which an individual would use it.         |
| <b>CHARACTERISTIC</b> | A feature that helps to identify, tell apart or describe recognizably; a distinguishing mark or trait. |
| <b>COMPONENT</b>      | A part that can be separated from or attached to a system; a segment or unit.                          |
| <b>DEFINE</b>         | To state the meaning of (a word, phrase, etc.).  |
| <b>DESCRIBE</b>       | To give a verbal account of; tell about in detail.   |
| <b>EXPLAIN</b>        | To make plain or clear; illustrate; rationalize.   |
| <b>IDENTIFY</b>       | To point out or name objectives or types.  |
| <b>INTERPRET</b>      | To translate information from observation, charts, tables, graphs and written material.                |
| <b>MAINTAIN</b>       | To keep in a condition of good repair or efficiency.   |
| <b>METHOD</b>         | A means or manner of doing something that has procedures attached to it.                               |
| <b>OPERATE</b>        | How an object works; to control or direct the functioning of.  |
| <b>PROCEDURE</b>      | A prescribed series of steps taken to accomplish an end.   |
| <b>PURPOSE</b>        | The reason for which something exists or is done, made or used.  |

## **Glossary of Terms** *(continued)*

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|                  |  |
|------------------|--|
| <b>SERVICE</b>   | <p>Routine inspection and replacement of worn or deteriorating parts.</p> <p>An act or business function provided to a customer in the course of an individual's profession (e.g., haircut).</p>   |
| <b>TECHNIQUE</b> | <p>Within a procedure, the manner in which technical skills are applied.</p>   |
| <b>TEST</b>      | <p>v. To subject to a procedure that ascertains effectiveness, value, proper function or other quality.</p> <p>n. A way of examining something to determine its characteristics or properties, or to determine whether or not it is working correctly.</p> |

## Essential Skills Profiles

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Through extensive research, the Government of Canada and other national and international agencies have identified and validated key essential skills for the workplace. These skills are used in nearly every job and at different levels of complexity. They provide the foundation for learning all other skills and enable people to evolve with their jobs and adapt to workplace change.

Essential Skills Profiles describe how workers in various occupations use each of the key essential skills. They include:

- a brief description of the occupation;
- examples of tasks that illustrate how each essential skill is applied; and,
- complexity ratings that indicate the level of difficulty of the example tasks.

Essential Skills profiles can be found on the Employment and Social Development Canada (ESDC) website at [www.esdc.gc.ca/eng/jobs/les/profiles/index.shtml](http://www.esdc.gc.ca/eng/jobs/les/profiles/index.shtml).

The development and improvement of these Essential Skills is inherent throughout the apprenticeship training program as apprentices work towards achieving journey person status.

## Profile Chart

| <b>PERFORMS COMMON OCCUPATIONAL SKILLS</b>                          |   |   |   |
|---|---|---|---|
| <b>AST-100</b><br>Safety  | <b>AST-105</b><br>Tools and Equipment                             | <b>AST-110</b><br>Fasteners, Tubing,<br>Hoses and Fittings    | <b>AST-115</b><br>Hoisting and Lifting                                    |
| <b>AST-120</b><br>Communication                                     | <b>AST-125</b><br>Technical Information                           | <b>AST-135</b><br>Oxy-Acetylene Heating<br>and Cutting        | <b>AST-140</b><br>Gas Metal Arc Welding                                   |
| <b>AST-180</b><br>Vehicle Maintenance<br>Inspection                 | <b>AST-185</b><br>Pre-Delivery Inspection                         | <b>AST-400</b><br>Mentoring                                   | <b>AST-335</b><br>Motor Vehicle<br>Inspection                             |
| <b>DIAGNOSES AND REPAIRS ENGINE AND ENGINE SUPPORT SYSTEMS</b>      |   |   |   |
| <b>AST-175</b><br>Engine Principles                                 | <b>AST-200</b><br>Cooling Systems                                 | <b>AST-205</b><br>Engine Lubrication<br>Systems               | <b>AST-210</b><br>Accessory Drive<br>Systems                              |
| <b>AST-215</b><br>Engine Repair                                     | <b>AST-305</b><br>Gasoline Fuel Delivery<br>and Injection Systems | <b>AST-310</b><br>Gasoline Ignition<br>Systems                | <b>AST-320</b><br>Gasoline Emission<br>Control Systems                    |
| <b>AST-325</b><br>Gasoline Intake and<br>Exhaust Systems            | <b>AST-405</b><br>Diesel Fuel Delivery and<br>Injection Systems   | <b>AST-410</b><br>Diesel Emission Control<br>Systems          | <b>AST-415</b><br>Diesel Intake and<br>Exhaust Systems                    |
| <b>DIAGNOSES AND REPAIRS VEHICLE MODULE COMMUNICATION SYSTEMS</b>   |   |   |   |
| <b>AST-315</b><br>Vehicle Networking<br>Systems                     |   |   |   |
| <b>DIAGNOSES AND REPAIRS DRIVE LINE SYSTEMS</b>                     |   |   |   |
| <b>AST-155</b><br>Drive Shafts and Axles                            | <b>AST-250</b><br>Manual Transmissions<br>and Transaxles          | <b>AST-255</b><br>Clutches                                    | <b>AST-260</b><br>Final Drive Assemblies                                  |
| <b>AST-300</b><br>Transfer Cases                                    | <b>AST-435</b><br>Automatic<br>Transmissions and<br>Transaxles    |   |   |
| <b>DIAGNOSES AND REPAIRS ELECTRICAL AND COMFORT CONTROL SYSTEMS</b> |   |   |   |
| <b>AST-165</b><br>Electrical and Electronic<br>Principles           | <b>AST-220</b><br>Starting Systems                                | <b>AST-225</b><br>Charging Systems                            | <b>AST-230</b><br>Lighting and Wiper<br>Systems                           |
| <b>AST-330</b><br>Electrical Options and<br>Accessories             | <b>AST-420</b><br>Entertainment Systems                           | <b>AST-425</b><br>Instrumentation and<br>Information Displays | <b>AST-440</b><br>Heating, Ventilation and<br>Air Conditioning<br>Systems |

**Profile Chart** *(continued)*

| <b>DIAGNOSES AND REPAIRS STEERING AND SUSPENSION, BRAKING, CONTROL SYSTEMS, TIRES, HUBS AND WHEEL BEARINGS</b> |   |                                      |   |
|--|---|--------------------------------------|---|
| <b>AST-130</b><br>Tires, Wheels, Hubs and<br>Wheel Bearings  | <b>AST-145</b><br>Suspension Systems I  | <b>AST-150</b><br>Steering Systems I | <b>AST-160</b><br>Braking Systems I (Non-<br>ABS) |
| <b>AST-235</b><br>Steering Systems II  | <b>AST-240</b><br>Suspension Systems II | <b>AST-245</b><br>Braking Systems II |   |
| <b>DIAGNOSES AND REPAIRS RESTRAINT SYSTEMS, BODY COMPONENTS, ACCESSORIES AND TRIM</b>                          |   |                                      |   |
| <b>AST-170</b><br>Body Components and<br>Trim  | <b>AST-430</b><br>Restraint Systems     |                                      |   |
| <b>DIAGNOSES AND REPAIRS HYBRID AND ELECTRIC VEHICLES (EV)</b>   |   |                                      |   |
| <b>AST-445</b><br>Hybrid and Electric<br>Vehicle Systems   |   |                                      |   |

## Recommended Atlantic Level Structure

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### Level 1 – 8 Weeks

| Unit Code | Unit Title                             | Suggested Hours | Page Number |
|-----------|--|-----------------|-------------|
| AST-100   | Safety                                 | 9               | 20          |
| AST-105   | Tools and Equipment                    | 6               | 23          |
| AST-110   | Fasteners, Tubing, Hoses and Fittings  | 6               | 25          |
| AST-115   | Hoisting and Lifting                   | 9               | 26          |
| AST-120   | Communication                          | 3               | 28          |
| AST-125   | Technical Information                  | 3               | 30          |
| AST-130   | Tires, Wheels, Hubs and Wheel Bearings | 12              | 32          |
| AST-135   | Oxy-Acetylene Heating and Cutting      | 12              | 35          |
| AST-140   | Gas Metal Arc Welding (GMAW)           | 6               | 37          |
| AST-145   | Suspension Systems I                   | 12              | 39          |
| AST-150   | Steering Systems I                     | 18              | 41          |
| AST-155   | Drive Shafts and Axles                 | 9               | 43          |
| AST-160   | Braking Systems I (Non-ABS)            | 36              | 46          |
| AST-165   | Electrical and Electronic Principles   | 60              | 48          |
| AST-170   | Body Components and Trim               | 9               | 51          |
| AST-175   | Engine Principles                      | 24              | 54          |
| AST-180   | Vehicle Maintenance Inspection         | 3               | 56          |
| AST-185   | Pre-Delivery Inspection                | 3               | 57          |

### Level 2 – 8 Weeks

| Unit Code | Unit Title                          | Suggested Hours | Page Number |
|-----------|-------------------------------------|-----------------|-------------|
| AST-200   | Cooling Systems                     | 12              | 60          |
| AST-205   | Engine Lubrication Systems          | 12              | 63          |
| AST-210   | Accessory Drive Systems             | 12              | 65          |
| AST-215   | Engine Repair                       | 42              | 67          |
| AST-220   | Starting Systems                    | 12              | 69          |
| AST-225   | Charging Systems                    | 12              | 71          |
| AST-230   | Lighting and Wiper Systems          | 18              | 73          |
| AST-235   | Steering Systems II                 | 12              | 75          |
| AST-240   | Suspension Systems II               | 24              | 77          |
| AST-245   | Braking Systems II                  | 24              | 79          |
| AST-250   | Manual Transmissions and Transaxles | 36              | 81          |
| AST-255   | Clutches                            | 6               | 84          |
| AST-260   | Final Drive Assemblies              | 18              | 86          |

## Recommended Atlantic Level Structure (continued)

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### Level 3 – 7 Weeks

| Unit Code | Unit Title                                   | Suggested Hours | Page Number |
|-----------|--|-----------------|-------------|
| AST-300   | Transfer Cases                               | 24              | 90          |
| AST-305   | Gasoline Fuel Delivery and Injection Systems | 24              | 92          |
| AST-310   | Gasoline Ignition Systems                    | 24              | 94          |
| AST-315   | Vehicle Networking Systems                   | 60              | 97          |
| AST-320   | Gasoline Emission Control Systems            | 24              | 100         |
| AST-325   | Gasoline Intake and Exhaust Systems          | 18              | 103         |
| AST-330   | Electrical Options and Accessories           | 30              | 106         |
| AST-335   | Motor Vehicle Inspection                     | 6               | 108         |

### Level 4 – 8 Weeks

| Unit Code | Unit Title  | Suggested Hours | Page Number |
|-----------|---|-----------------|-------------|
| AST-400   | Mentoring   | 6               | 112         |
| AST-405   | Diesel Fuel Delivery and Injection Systems        | 18              | 114         |
| AST-410   | Diesel Emission Control Systems                   | 18              | 117         |
| AST-415   | Diesel Intake and Exhaust Systems                 | 6               | 120         |
| AST-420   | Entertainment Systems                             | 15              | 122         |
| AST-425   | Instrumentation and Information Displays          | 15              | 124         |
| AST-430   | Restraint Systems                                 | 24              | 126         |
| AST-435   | Automatic Transmissions and Transaxles            | 48              | 129         |
| AST-440   | Heating, Ventilation and Air Conditioning Systems | 30              | 132         |
| AST-445   | Hybrid and Electric Vehicle Systems               | 30              | 135         |
| AST-450   | Program Review                                    | 30              | 137         |

## 2016 RSOS Sub-Task to AACS Unit Comparison

| RSOS Sub-task  |  | AACS Unit |  |
|--|--|-----------|--|
| <b>Task A-1 Performs safety-related functions.</b>           |  |           |  |
| A-1.01   | Maintains safe work environment.                               | AST-100   | Safety                                       |
| A-1.02   | Uses personal protective equipment (PPE) and safety equipment. | AST-100   | Safety                                       |
| <b>Task A-2 Uses tools, equipment and documentation.</b>     |  |           |  |
| A-2.01   | Uses tools and equipment.                                      | AST-105   | Tools and Equipment                          |
|  |  | AST-135   | Oxy-Acetylene Heating and Cutting            |
|  |  | AST-140   | Gas Metal Arc Welding (GMAW)                 |
| A-2.02   | Uses fasteners, tubing, hoses and fittings.                    | AST-110   | Fasteners, Tubing, Hoses and Fittings        |
| A-2.03   | Uses hoisting and lifting equipment.                           | AST-115   | Hoisting and Lifting                         |
| A-2.04   | Uses technical information.                                    | AST-125   | Technical Information                        |
| <b>Task A-3 Uses communication and mentoring techniques.</b> |  |           |  |
| A-3.01   | Uses communication techniques.                                 | AST-120   | Communication                                |
| A-3.02   | Uses mentoring techniques.                                     | AST-400   | Mentoring                                    |
| <b>Task B-4 – Diagnoses engine systems.</b>                  |  |           |  |
| B-4.01   | Diagnoses cooling systems.                                     | AST-200   | Cooling Systems                              |
| B-4.02   | Diagnoses lubricating systems.                                 | AST-205   | Engine Lubrication Systems                   |
| B-4.03   | Diagnoses engine assembly.                                     | AST-175   | Engine Principles                            |
|  |  | AST-215   | Engine Repair                                |
| B-4.04   | Diagnoses accessory drive systems.                             | AST-210   | Accessory Drive Systems                      |
| <b>Task B-5 – Repairs engine systems.</b>                    |  |           |  |
| B-5.01   | Repairs cooling systems.                                       | AST-200   | Cooling Systems                              |
| B-5.02   | Repairs lubricating systems.                                   | AST-205   | Engine Lubrication Systems                   |
| B-5.03   | Repairs engine assembly.                                       | AST-175   | Engine Principles                            |
|  |  | AST-215   | Engine Repair                                |
| B-5.04   | Repairs accessory drive systems.                               | AST-210   | Accessory Drive Systems                      |
| <b>Task B-6 – Diagnoses gasoline engine support systems.</b> |  |           |  |
| B-6.01   | Diagnoses gasoline fuel delivery and injection systems.        | AST-305   | Gasoline Fuel Delivery and Injection Systems |
| B-6.02   | Diagnoses gasoline ignition systems.                           | AST-310   | Gasoline Ignition Systems                    |
| B-6.03   | Diagnoses gasoline intake/exhaust systems.                     | AST-325   | Gasoline Intake and Exhaust Systems          |
| B-6.04   | Diagnoses gasoline emission control systems.                   | AST-320   | Gasoline Emission Control Systems            |
| <b>Task B-7 – Repairs gasoline engine support systems.</b>   |  |           |  |
| B-7.01   | Repairs gasoline fuel delivery and injection systems.          | AST-305   | Gasoline Fuel Delivery and Injection Systems |



| RSOS Sub-task  |   | AACS Unit |  |
|--|---|-----------|--|
| B-7.02   | Repairs gasoline ignition systems.                    | AST-310   | Gasoline Ignition Systems                  |
| B-7.03   | Repairs gasoline intake / exhaust systems.            | AST-325   | Gasoline Intake and Exhaust Systems        |
| B-7.04   | Repairs gasoline emission control systems.            | AST-320   | Gasoline Emission Control Systems          |
| <b>Task B-8 – Diagnoses diesel engine support systems.</b> |   |           |  |
| B-8.01   | Diagnoses diesel fuel delivery and injection systems. | AST-405   | Diesel Fuel Delivery and Injection Systems |
| B-8.02   | Diagnoses diesel intake / exhaust systems.            | AST-415   | Diesel Intake and Exhaust Systems          |
| B-8.03   | Diagnoses diesel emission control systems.            | AST-410   | Diesel Emission Control Systems            |
| <b>Task B-9 – Repairs diesel engine support systems.</b>   |   |           |  |
| B-9.01   | Repairs diesel fuel delivery and injection systems.   | AST-405   | Diesel Fuel Delivery and Injection Systems |
| B-9.02   | Repairs diesel intake / exhaust systems.              | AST-415   | Diesel Intake and Exhaust Systems          |
| B-9.03   | Repairs diesel emission control systems.              | AST-410   | Diesel Emission Control Systems            |
| <b>Task C-10 – Diagnoses vehicle networking systems.</b>   |   |           |  |
| C-10.01  | Reads diagnostic trouble codes (DTCs).                | AST-315   | Vehicle Networking Systems                 |
| C-10.02  | Monitors data.  | AST-315   | Vehicle Networking Systems                 |
| C-10.03  | Interprets test results.                              | AST-315   | Vehicle Networking Systems                 |
| C-10.04  | Tests system circuitry and components.                | AST-315   | Vehicle Networking Systems                 |
| <b>Task C-11 – Repairs vehicle networking systems.</b>     |   |           |  |
| C-11.01  | Updates component software.                           | AST-315   | Vehicle Networking Systems                 |
| C-11.02  | Replaces components.                                  | AST-315   | Vehicle Networking Systems                 |
| C-11.03  | Verifies vehicle module communications system repair. | AST-315   | Vehicle Networking Systems                 |
| <b>Task D-12 – Diagnoses driveline systems.</b>            |   |           |  |
| D-12.01  | Diagnoses drive shafts and axles.                     | AST-155   | Drive Shafts and Axles                     |
| D-12.02  | Diagnoses manual transmissions / transaxles.          | AST-250   | Manual Transmissions and Transaxles        |
| D-12.03  | Diagnoses automatic transmissions / transaxles.       | AST-435   | Automatic Transmissions and Transaxles     |
| D-12.04  | Diagnoses clutches.                                   | AST-255   | Clutches                                   |
| D-12.05  | Diagnoses transfer cases.                             | AST-300   | Transfer Cases                             |
| D-12.06  | Diagnoses final drive assemblies.                     | AST-260   | Final Drive Assemblies                     |
| <b>Task D-13 – Repairs driveline systems.</b>              |   |           |  |
| D-13.01  | Repairs drive shafts and axles.                       | AST-155   | Drive Shafts and Axles                     |

| RSOS Sub-task  |  | AACS Unit |   |
|--|--|-----------|---|
| D-13.02  | Repairs manual transmissions / transaxles.           | AST-250   | Manual Transmissions and Transaxles               |
| D-13.03  | Repairs automatic transmissions / transaxles.        | AST-435   | Automatic Transmissions and Transaxles            |
| D-13.04  | Repairs clutches.                                    | AST-255   | Clutches  |
| D-13.05  | Repairs transfer cases.                              | AST-300   | Transfer Cases                                    |
| D-13.06  | Repairs final drive assemblies.                      | AST-260   | Final Drive Assemblies                            |
| <b>Task E-14 – Diagnoses electrical systems and components.</b>  |  |           |   |
| E-14.01  | Diagnoses basic wiring and electrical systems.       | AST-165   | Electrical and Electronic Principles              |
| E-14.02  | Diagnoses starting / charging systems and batteries. | AST-165   | Electrical and Electronic Principles              |
|  |  | AST-220   | Starting Systems                                  |
|  |  | AST-225   | Charging Systems                                  |
| E-14.03  | Diagnoses lighting and wiper systems.                | AST-230   | Lighting and Wiper Systems                        |
| E-14.04  | Diagnoses entertainment systems.                     | AST-420   | Entertainment Systems                             |
| E-14.05  | Diagnoses electrical options.                        | AST-330   | Electrical Options and Accessories                |
| E-14.06  | Diagnoses instrumentation and information displays.  | AST-425   | Instrumentation and Information Displays          |
| E-14.07  | Diagnoses electrical accessories.                    | AST-330   | Electrical Options and Accessories                |
| <b>Task E-15 – Repairs electrical systems and components.</b>  |  |           |   |
| E-15.01  | Repairs basic wiring and electrical systems.         | AST-165   | Electrical and Electric Principles                |
| E-15.02  | Repairs starting / charging systems and batteries.   | AST-165   | Electrical and Electric Principles                |
|  |  | AST-220   | Starting Systems                                  |
|  |  | AST-225   | Charging Systems                                  |
| E-15.03  | Repairs lighting and wiper systems.                  | AST-230   | Lighting and Wiper Systems                        |
| E-15.04  | Repairs entertainment systems.                       | AST-420   | Entertainment Systems                             |
| E-15.05  | Repairs electrical options.                          | AST-330   | Electrical Options and Accessories                |
| E-15.06  | Repairs instrumentation and information displays.    | AST-425   | Instrumentation and Information Displays          |
| E-15.07  | Installs electrical accessories.                     | AST-330   | Electrical Options and Accessories                |
| E-15.08  | Repairs electrical accessories.                      | AST-330   | Electrical Options and Accessories                |
| <b>Task E-16 –Diagnoses heating, ventilation and air-conditioning (HVAC) and comfort control systems</b> |  |           |   |
| E-16.01  | Diagnoses air flow control systems                   | AST-440   | Heating, Ventilation and Air Conditioning Systems |
| E-16.02  | Diagnoses refrigerant systems.                       | AST-440   | Heating, Ventilation and Air Conditioning Systems |
| E-16.03  | Diagnoses heating systems.                           | AST-440   | Heating, Ventilation and Air                      |

| RSOS Sub-task  |   | AACCS Unit |   |
|--|---|------------|---|
|  |   |            | Conditioning Systems                              |
| <b>Task E-17 – Repairs heating, ventilation and air conditioning (HVAC) and comfort control systems</b>                |   |            |   |
| E-17.01  | Repairs air flow control systems.                                 | AST-440    | Heating, Ventilation and Air Conditioning Systems |
| E-17.02  | Repairs refrigerant systems.                                      | AST-440    | Heating, Ventilation and Air Conditioning Systems |
| E-17.03  | Diagnoses heating systems.  | AST-440    | Heating, Ventilation and Air Conditioning Systems |
| <b>Task F-18 – Diagnoses steering and suspension, braking, control systems, tires, wheels, hubs and wheel bearings</b> |   |            |   |
| F-18.01  | Diagnoses steering, suspension and control systems.               | AST-145    | Suspension Systems I                              |
|  |   | AST-150    | Steering Systems I                                |
|  |   | AST-240    | Suspension Systems II                             |
|  |   | AST-235    | Steering Systems II                               |
| F-18.02  | Diagnoses braking and control systems.                            | AST-160    | Braking Systems I (Non-ABS)                       |
|  |   | AST-245    | Braking Systems II                                |
| F-18.03  | Diagnoses tires, wheels, hubs and wheel bearings.                 | AST-130    | Tires, Wheels, Hubs and Wheel Bearings            |
| <b>Task F-19 – Repairs steering and suspension, braking, control systems, tires, wheels, hubs and wheel bearings</b>   |   |            |   |
| F-19.01  | Repairs steering, suspension and control systems.                 | AST-145    | Suspension Systems I                              |
|  |   | AST-150    | Steering Systems I                                |
|  |   | AST-240    | Suspension Systems II                             |
|  |   | AST-235    | Steering Systems II                               |
| F-19.02  | Repairs braking and control systems.                              | AST-160    | Braking Systems I (Non-ABS)                       |
|  |   | AST-245    | Braking Systems II                                |
| F-19.03  | Repairs tires, wheels, hubs and wheel bearings.                   | AST-130    | Tires, Wheels, Hubs and Wheel Bearings            |
| <b>Task G-20 – Diagnoses restraint systems, body components, accessories and trim</b>                                  |   |            |   |
| G-20.01  | Diagnoses restraint systems.                                      | AST-430    | Restraint Systems                                 |
| G-20.02  | Diagnoses wind noises, rattles and water leaks.                   | AST-170    | Body Components and Trim                          |
| G-20.03  | Diagnoses interior and exterior components, accessories and trim. | AST-170    | Body Components and Trim                          |
| G-20.04  | Diagnoses latches, locks and movable glass.                       | AST-170    | Body Components and Trim                          |
| <b>Task G-21 – Repairs restraint systems, body components, accessories and trim</b>                                    |   |            |   |
| G-21.01  | Repairs restraint systems.  | AST-430    | Restraint Systems                                 |
| G-21.02  | Repairs wind noises, rattles and water leaks.                     | AST-170    | Body Components and Trim                          |
| G-21.03  | Repairs interior and exterior components, accessories and trim.   | AST-170    | Body Components and Trim                          |
| G-21.04  | Repairs latches, locks and movable glass.                         | AST-170    | Body Components and Trim                          |

| RSOS Sub-task  |   | AACS Unit |                                     |
|--|---|-----------|-------------------------------------|
| <b>Task H-22 – Diagnoses hybrid and electric vehicles (EV)</b> |   |           |                                     |
| H-22.01  | Implements specific safety protocols for hybrid and EV. | AST-100   | Safety                              |
|  |   | AST-445   | Hybrid and Electric Vehicle Systems |
| H-22.02  | Diagnoses hybrid and EV systems.                        | AST-445   | Hybrid and Electric Vehicle Systems |
| <b>Task H-23 – Repairs hybrid and EV</b>                       |   |           |                                     |
| H-23.01  | Repairs hybrid vehicle systems.                         | AST-445   | Hybrid and Electric Vehicle Systems |
| H-23.02  | Repairs EV systems.                                     | AST-445   | Hybrid and Electric Vehicle Systems |

# LEVEL 1

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| AST-110   | Fasteners, Tubing, Hoses and Fittings  | 6               | 25          |
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## AST-100            Safety

### Learning Outcomes:

- Demonstrate knowledge of safe work practices.
- Demonstrate knowledge of regulatory requirements pertaining to workplace safety.
- Demonstrate knowledge of personal protective equipment, their applications, limitations and procedures for use.
- Demonstrate knowledge of safety equipment, their applications and procedures for use.
- Demonstrate knowledge of handling refrigerant.
- Demonstrate knowledge of safety protocols for hybrid and electric vehicles (EV) systems.

### 2016 Red Seal Occupational Standard Reference:

- 1.01 Maintains safe work environment.
- 1.02 Uses personal protective equipment (PPE) and safety equipment.
- 17.02 Repairs refrigerant systems (safety awareness).
- 22.01 Implements specific safety protocols for hybrid and EV (safety awareness).

### Suggested Hours:

9 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Describe safe work practices to maintain a safe work environment.
  - i) personal
  - ii) shop/facility
    - fire
    - explosion
    - gases
  - iii) environmental awareness
  - iv) vehicle
    - refrigerant systems
    - restraint systems

- high voltage systems (hybrid and EV systems)
  - high pressure fuel systems
2. Identify and describe jurisdictional safety regulations to maintain a safe work environment.
    - i) Occupational Health and Safety (OHS)
      - right of refusal
      - reportable incidents
    - ii) Workplace Hazardous Material Information System (WHMIS)/Globally Harmonized System (GHS)
  3. Identify components of WHMIS/GHS.
    - i) safety data sheets
    - ii) labels
    - iii) training
  4. Identify and describe jurisdictional requirements for handling and disposing of hazardous materials.
    - i) supplemental restraint system components
    - ii) batteries
    - iii) automotive fluids and chemicals
    - iv) cleaning fluids and chemicals
  5. Identify types of PPE, and describe their applications, limitations and procedures for use.
    - i) work boots
    - ii) ear protection
    - iii) eye protection
    - iv) face shields
    - v) insulating gloves
    - vi) fire resistant clothing
    - vii) breathing apparatus
  6. Describe the care and maintenance of PPE.
  7. Identify types of safety equipment, and describe their applications.
    - i) jack stands
    - ii) exhaust ventilation fans
    - iii) fire extinguishers
    - iv) lock-out devices

v) respirators

8. Describe the care and maintenance of safety equipment.

*Practical Objectives*

N/A



## AST-105            Tools and Equipment

### Learning Outcomes:

- Demonstrate knowledge of hand and power tools, their applications, maintenance and procedures for use.
- Demonstrate knowledge of measuring and testing devices, their applications, maintenance and procedures for use.
- Demonstrate knowledge of shop tools and equipment, their applications, maintenance and procedures for use.
- Demonstrate knowledge of welding, cutting and heating equipment and their applications.

### 2016 Red Seal Occupational Standard Reference:

2.01    Uses tools and equipment.

### Suggested Hours:

6 Hours

### Objectives and Content:

#### Theoretical Objectives

1.    Identify types of hand tools, and describe their applications and procedures for use.
2.    Describe the procedures used to store and maintain hand tools.
3.    Identify types of power tools, and describe their applications and procedures for use.
  - i)    electric
  - ii)   pneumatic
  - iii)  hydraulic
4.    Describe the procedures used to store and maintain power tools.
5.    Describe safe operating procedures for hand and power tools.

6. Identify types of measuring and testing devices, and describe their applications and procedures for use.
  - i) micrometers
  - ii) vernier callipers
  - iii) pressure gauges
  - iv) torque wrenches
7. Identify types of scan tools and digital multimeters (DMM), and describe their applications.
8. Describe the procedures used to store and maintain measuring and testing devices.
9. Identify types of shop tools and equipment, and describe their applications and procedures for use.
  - i) brake lathe
  - ii) tire changing machine
  - iii) wheel balancer
  - v) battery chargers
  - vi) vices
  - vii) presses
10. Describe the procedures used to store and maintain shop tools and equipment.
11. Identify types of welding, cutting and heating equipment, and describe their applications.
  - i) oxy-acetylene heating and cutting
  - ii) gas metal arc welding (GMAW)
  - iii) metal inert gas welding (MIG)
  - iv) shielded metal arc welding (SMAW)

Practical Objectives

N/A

## **AST-110            Fasteners, Tubing, Hoses and Fittings**

### **Learning Outcomes:**

- Demonstrate knowledge of fasteners, tubing, hoses and fittings, their applications and procedures for use.

### **2016 Red Seal Occupational Standard Reference:**

2.02 Uses fasteners, tubing, hoses and fittings.

### **Suggested Hours:**

6 Hours

### **Objectives and Content:**

#### Theoretical Objectives

1. Identify types of fasteners, and describe their characteristics, applications and procedures for use.
2. Identify types of tubing and hoses, and describe their applications and procedures for use.
3. Identify types of fittings and flares, and describe their applications and procedures for use.

#### Practical Objectives

N/A

## **AST-115            Hoisting and Lifting**

### **Learning Outcomes:**

- Demonstrate knowledge of vehicle hoisting and lifting equipment, their applications and procedures for use.
- Demonstrate knowledge of shop lifting equipment, their applications and procedures for use.

### **2016 Red Seal Occupational Standard Reference:**

2.03    Uses hoisting and lifting equipment.

### **Suggested Hours:**

9 Hours

### **Objectives and Content:**

#### Theoretical Objectives

1. Identify safety considerations pertaining to hoisting and lifting.
  - i) occupational health and safety (OHS) regulations
  - ii) safe work practices
  
2. Identify types vehicle hoisting and lifting equipment and accessories and describe their applications and procedures for use.
  - i) chain falls
  - ii) overhead cranes
  - iii) hydraulic jacks
  - iv) engine hoists
  - v) vehicle hoists
  - vi) jack stands
  
3. Describe the procedures for use of vehicle hoisting and lifting equipment.
  
4. Describe the procedures used to inspect, store and maintain hoisting and lifting equipment.

Practical Objectives

N/A

## AST-120            Communication

### Learning Outcomes:

- Demonstrate knowledge of trade terminology.
- Demonstrate knowledge of effective communication practices.
- Demonstrate knowledge of available technical resources.
- Demonstrate knowledge of various learning styles.
- Demonstrate knowledge and benefits of a productive team environment.
- Demonstrate knowledge of policies and procedures regarding harassment and discrimination.

### 2016 Red Seal Occupational Standard Reference:

3.01    Uses communication techniques.

### Suggested Hours:

3 Hours

### Objectives and Content:

#### Theoretical Objectives

1.        Define terminology used in the trade.
  
2.        Describe the importance of using effective verbal and non-verbal communication with people in the workplace.
  - i)        other tradespeople
  - ii)       colleagues
  - iii)      journeypersons/apprentices
  - iv)      supervisors
  - v)        clients
  - vi)      manufacturers
  
3.        Identify sources of information to effectively communicate.
  - i)        regulations
  - ii)      occupational health and safety requirements
  - iii)     diagrams

- iv) schematics
  - v) specifications
  - vi) manufacturer and shop documentation
  - vii) on-line resources
4. Identify communication and learning styles.
5. Identify personal responsibilities and attitudes that contribute to on-the-job success.
- i) asking questions
  - ii) working safely
  - iii) accepting constructive feedback
  - iv) time management and punctuality
  - v) respect for authority
  - vi) efficient work practice
  - vii) good stewardship of materials, tools and property
6. Identify communication that constitutes harassment and discrimination.

Practical Objectives

N/A

## AST-125            Technical Information

### Learning Outcomes:

- Demonstrate knowledge of trade documents and their use.
- Demonstrate knowledge of preparing and interpreting trade documents.

### 2016 Red Seal Occupational Standard Reference:

2.04 Uses technical information.

### Suggested Hours:

3 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Locate and interpret identification codes found on the vehicle and vehicle components.
  - i) vehicle identification number (VIN)
  - ii) component identification codes
  - iii) diagnostic indicators
  
2. Identify and interpret types of trade documents.
  - i) repair orders
  - ii) estimates
  - iii) history
  - iv) preventative maintenance reports and schedules
  - v) work orders
  - vi) schematics and service information
  - vii) technical service bulletins (TSB)
  - viii) industry standard labour guides
  - ix) pre-delivery inspection reports
  
3. Describe the procedures used to prepare and complete documentation.
  - i) work orders
  - ii) estimates



- iii) pre-delivery inspection reports
- iv) preventative maintenance reports

Practical Objectives

N/A

## AST-130

## Tires, Wheels, Hubs and Wheel Bearings

### Learning Outcomes:

- Demonstrate knowledge of tires, wheels, hubs, wheel bearings, their components and operation.
- Demonstrate knowledge of the procedures used to diagnose tires, wheels, hubs and wheel bearings.
- Demonstrate knowledge of the procedures used to repair tires, wheels, hubs and wheel bearings.

### 2016 Red Seal Occupational Standard Reference:

18.03 Diagnoses tires, wheels, hubs and wheel bearings.

19.03 Repairs tires, wheels, hubs, and wheel bearings.

### Suggested Hours:

12 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Identify safety considerations pertaining to tires, wheels, hubs and wheel bearings.
  - i) tire inflation
  - ii) mounting
  - iii) pinch points
  - iv) lifting and support procedures
  
2. Identify types of tires, and describe their construction.
  - i) snow
  - ii) run flats
  - iii) radials
  - iv) bias
  - v) passenger
  - vi) light truck

3. Interpret tire codes and sidewall markings.
4. Describe the importance of tire rotation, balance and pressure.
5. Identify types of wheels, and describe their components and construction.
  - i) steel
  - ii) alloy
  - iii) offset
  - iv) drop zone
  - v) deep flange
  - vi) hub surface
6. Identify types of hubs and bearing assemblies, and describe their components and operation.
  - i) pressed in
  - ii) integral
  - iii) tapered roller
7. Identify types of tire pressure monitoring systems, and describe their applications.
  - i) passive
  - ii) active
8. Identify types of lubricants, and describe their applications and procedures for use.
9. Describe the relationship between the steering, suspension system and wheel assemblies.
10. Identify types of diagnostic and repair tools and equipment, and describe their applications and procedures for use.
  - i) diagnostic
    - measuring tools
    - pressure gauges
    - chassis ears
    - stethoscopes
    - vibration analyzers
    - Tire Pressure Monitoring Systems (TPMS) equipment
  - ii) repair

- hand tools
- air tools
- scan tools
- wheel balancers
- tire changing machines
- tire pressure monitoring tools
- presses
- pullers
- tire inflation cage

11. Describe the procedures used to diagnose tires, wheels, hubs and wheel bearings.
  - i) verify concern
  - ii) perform sensory inspection
  - iii) retrieve diagnostic codes
  - iv) access service information
  - v) conduct tests and measurements
  - vi) isolate problem and identify root cause
12. Describe the procedures used to remove and reinstall tires, wheels, hubs and wheel bearings.
13. Describe the procedures to repair and replace tires, wheels, hubs and wheel bearings.
14. Describe the procedures used to verify the repair.

Practical Objectives

N/A

## AST-135            Oxy-Acetylene Heating and Cutting

### Learning Outcomes:

- Demonstrate knowledge of oxy-acetylene heating and cutting equipment, accessories and their applications.
- Demonstrate knowledge of the procedures to heat and cut using oxy-acetylene.

### 2016 Red Seal Occupational Standard Reference:

2.01 Uses tools and equipment.

### Suggested Hours:

12 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Define and explain terminology associated with oxy-acetylene heating and cutting equipment.
2. Identify safety considerations pertaining to oxy-acetylene heating and cutting.
  - i) personal
  - ii) shop/facility
  - iii) equipment
3. Identify oxy-acetylene heating and cutting equipment and accessories, and describe their applications.
4. Describe the procedures used to set-up, adjust and shut-down oxy-acetylene equipment.
5. Describe the procedures used to inspect, store and maintain oxy-acetylene equipment.
6. Describe the procedures used to heat and cut using oxy-acetylene.

Practical Objectives

1. Setup, adjust, use and shutdown oxy-acetylene equipment.

## AST-140            Gas Metal Arc Welding (GMAW)

### Learning Outcomes:

- Demonstrate knowledge of gas metal arc welding (GMAW) equipment, accessories and applications.
- Demonstrate knowledge of the procedures used to weld using GMAW equipment.

### 2016 Red Seal Occupational Standard Reference:

2.01    Uses tools and equipment.

### Suggested Hours:

6 Hours

### Objectives and Content:

#### Theoretical Objectives

1.    Define and explain terminology associated with gas metal arc welding (GMAW) welding.
2.    Identify safety considerations pertaining to GMAW.
  - i)    personal
  - ii)   shop/facility
  - iii)  equipment
3.    Identify types of GMAW processes, and describe their applications.
4.    Identify GMAW welding equipment and accessories, and describe their applications.
5.    Describe the procedures used to set-up, adjust and shut-down GMAW equipment.
6.    Describe the procedures used to inspect, maintain and store GMAW equipment.
7.    Describe the procedures used to weld using GMAW equipment.

8. Describe weld defects, their causes and the procedures used to prevent and correct them.

Practical Objectives

1. Setup, adjust, use and shutdown GMAW equipment.



## AST-145            Suspension Systems I

### Learning Outcomes:

- Demonstrate knowledge of conventional suspension systems, their components and operation.
- Demonstrate knowledge of the procedures used to diagnose and repair conventional suspension systems.

### 2016 Red Seal Occupational Standard Reference:

18.01 Diagnoses steering, suspension and control systems.

19.01 Repairs steering, suspension and control systems.

### Suggested Hours:

12 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Identify safety considerations pertaining to conventional suspension systems.
  - i) loaded components
    - ball joints
    - springs
2. Identify types of conventional suspension systems, and describe their components and operation.
  - i) MacPherson strut
  - ii) leaf spring
  - iii) independent
  - iv) monobeam
  - v) electronic
3. Identify types of springs, and describe their purpose and operation.
  - i) coil
  - ii) leaf
  - iii) torsion bar

- iv) air
- 4. Identify types of dampers, and describe their components and operation.
  - i) struts
  - ii) shocks
- 5. Identify types of diagnostic and repair tools and equipment, and describe their applications and procedures for use.
- 6. Describe the procedures used to diagnose conventional suspension systems.
  - i) verify concern
  - ii) perform sensory inspection
  - iii) retrieve diagnostic codes
  - iv) access service information
  - v) conduct tests and measurements
  - vi) isolate problem and identify root cause
- 7. Describe the procedures used to repair conventional suspension systems.
- 8. Describe the procedures used to remove and reinstall conventional suspension system components.
- 9. Describe the procedures used to adjust, repair and/or replace conventional suspension system components.
- 10. Describe the procedures used to verify the repair.

Practical Objectives

- 1. Inspect conventional suspension system to ensure it meets manufacturing specifications.

## AST-150            Steering Systems I

### Learning Outcomes:

- Demonstrate knowledge of conventional steering systems, their components and operation.
- Demonstrate knowledge of the procedures used to diagnose and repair conventional steering systems.

### 2016 Red Seal Occupational Standard Reference:

18.01 Diagnoses steering, suspension and control systems.

19.01 Repairs steering, suspension and control systems.

### Suggested Hours:

18 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Identify safety considerations pertaining to conventional steering systems.
  - i) accidental deployment of passive restraints
    - air bags
    - clock springs
  - ii) collapsible columns
2. Identify types of conventional steering columns, and describe their components and operation.
  - i) tilt
  - ii) telescopic
  - iii) collapsible
3. Identify types of steering systems, and describe their components and operation.
  - i) rack-and-pinion
  - ii) recirculating ball (steering box)
4. Introduce steering geometry.

5. Identify types of conventional steering assist systems, and describe their components and operation.
  - i) electric
  - ii) hydraulic
6. Identify types of power steering pumps, and describe their components and operation.
7. Identify types of fluids, lubricants, fasteners, tubing, hoses, gaskets and seals, and describe their applications.
8. Identify types of diagnostic and repair tools and equipment, and describe their applications and procedures for use.
9. Describe the procedures used to disarm passive restraints.
10. Describe the procedures used to diagnose conventional steering systems.
  - i) verify concern
  - ii) perform sensory inspection
  - iii) retrieve diagnostic codes
  - iv) access service information
  - v) conduct tests and measurements
  - vi) isolate problem and identify root cause
11. Describe the procedures used to remove and reinstall conventional steering system components.
12. Describe the procedures used to adjust, repair and replace conventional steering system components.
13. Describe the procedures used to verify the repair.

### Practical Objectives

1. Inspect conventional steering system to ensure it meets manufacturing specifications.

## AST-155            Drive Shafts and Axles

### Learning Outcomes:

- Demonstrate knowledge of drive shafts and axles, their components and operation.
- Demonstrate knowledge of the procedures used to diagnose and repair drive shafts and axles.

### 2016 Red Seal Occupational Standard Reference:

12.01 Diagnoses drive shafts and axles.

13.01 Repairs drive shafts and axles.

### Suggested Hours:

9 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Identify safety considerations pertaining to drive shafts and axles.
  - i) exposed rotating parts
  - ii) pinch points
  - iii) lifting and support procedures
2. Identify types of drive shafts, and describe their composition.
  - i) 1-piece
  - ii) 2-piece
  - iii) steel/aluminum
3. Identify types of drive shaft components, and describe their purpose and operation.
  - i) slip yokes and flanges
  - ii) flex joints
  - iii) single cardan joints
  - iv) double cardan joints
  - v) support bearing

- vi) viscous coupling
  - vii) constant velocity joints
4. Identify types of axles, and describe their components and operation.
    - i) half shafts
    - ii) floating
    - iii) semi-floating
  5. Describe axle disconnects, locking hubs and their purpose.
  6. Describe the importance of multiple piece drive shaft phasing, indexing and driveline angles.
  7. Identify types of lubricants, fasteners, gaskets, seals and sealants, and describe their applications.
  8. Identify diagnostic and repair tools and equipment, and describe their applications and procedures for use.
    - i) diagnostic
      - electronic vibration analyzers
      - inclinometers
      - dial indicators
      - scan tools
    - ii) repair
      - pullers
      - presses
  9. Describe the procedures used to diagnose drive shafts and axle systems.
    - i) verify concern
    - ii) perform sensory inspection
    - iii) retrieve diagnostic codes
    - iv) access service information
    - v) conduct tests and measurements
    - vi) measure drive line angles
    - vii) isolate problem and identify root cause
  10. Describe the procedures used to adjust, repair and/or replace drive shafts and axles and their related components.
  11. Describe the procedures used to verify the repair.

Practical Objectives

N/A

## AST-160                      Braking Systems I (Non-ABS)

### Learning Outcomes:

- Demonstrate knowledge of braking systems, their components and operation.
- Demonstrate knowledge of the procedures used to diagnose and repair braking systems.

### 2016 Red Seal Occupational Standard Reference:

18.02 Diagnoses braking and control systems.

19.02 Repairs braking and control systems.

### Suggested Hours:

36 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Identify safety considerations pertaining to braking systems.
  - i) hydraulic pressure
  - ii) airborne contaminants
2. Explain hydraulic principles related to braking systems.
  - i) Pascal's law
3. Identify types of braking systems, and describe their components and operation.
  - i) hydraulic
  - ii) electric
  - iii) park brake
4. Identify types of power assists, and describe their components and operation.
  - i) vacuum
  - ii) hydraulic
  - iii) electric



5. Identify types of brake fluids, and describe their applications and procedures for use.
6. Identify types of fittings, flaring, tubing and hoses, and describe their applications and procedures for use.
7. Identify types of diagnostic and repair tools and equipment, and describe their applications and procedures for use.
8. Describe the procedures used to diagnose braking systems.
  - i) verify concern
  - ii) perform sensory inspection
  - iii) retrieve diagnostic codes
  - iv) access service information
  - v) conduct tests and measurements
  - vi) isolate problem and identify root cause
9. Describe the procedures used to flush and bleed hydraulic brakes.
10. Describe the procedures used to measure and machine components.
11. Describe the procedures used to adjust, repair and/or replace braking system components.
12. Describe the procedures used to verify the repair.

Practical Objectives

1. Flaring a line.

## AST-165

## Electrical and Electronic Principles

### Learning Outcomes:

- Demonstrate knowledge of basic electrical and electronic principles.
- Demonstrate knowledge of batteries, their characteristics and procedures to replace.
- Demonstrate knowledge of electrical circuits, their components and operation.
- Demonstrate knowledge of the procedures used to diagnose and repair electrical circuits and components.

### 2016 Red Seal Occupational Standard Reference:

- 14.01 Diagnoses basic wiring and electrical systems.
- 14.02 Diagnoses starting / charging systems and batteries (batteries only).
- 15.01 Repairs basic wiring and electrical systems.
- 15.02 Repairs starting / charging systems and batteries (batteries only).

### Suggested Hours:

60 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Interpret diagnostic flow charts and schematics.
2. Explain basic electrical theory.
  - i) conventional theory
  - ii) electron theory
  - iii) Ohm's Law
  - iv) Watt's Law
  - v) magnetism
  - vi) induced voltages
3. Explain basic computer operation.
  - i) inputs
  - ii) processing

- iii) outputs
4. Describe the application of Ohm's Law to electrical circuits.
    - i) series circuit
    - ii) parallel circuit
    - iii) series-parallel circuits
  5. Identify types of batteries, and describe their characteristics.
  6. Identify types of tools and equipment used to test batteries, and describe their applications and procedures for use.
  7. Describe the procedures used to test and/or charge batteries.
  8. Identify types of wire, and describe their characteristics, composition and applications.
  9. Identify types of electrical components, and describe their purpose and operation.
    - i) circuit protection
    - ii) control devices
    - iii) load devices
  10. Identify types of electronic components, and describe their purpose and operation.
    - i) diodes
    - ii) transistors
    - iii) resistors
    - iv) integrated circuits
  11. Identify types of tools and equipment used to diagnose and repair electrical circuits and components, and describe their applications and procedures for use.
    - i) diagnostic
      - digital multi-meters (DMM)s
      - scan tools
      - circuit testers
      - battery testers
    - ii) repair
      - soldering equipment

12. Identify electrical circuit problems.
  - i) open
  - ii) shorts to voltage
  - iii) shorts to ground
  
13. Describe the procedures used to diagnose circuits and components.
  - i) verify concern
  - ii) perform inspection
  - iii) retrieve diagnostic codes
  - iv) access service information
  - v) conduct tests and measurements
  - vi) isolate problem and identify root cause
  
14. Identify methods of wire repair, and describe their associated procedures.
  - i) splicing
  - ii) terminal replacement
  - iii) soldering
  - iv) crimping
  
15. Describe the procedures used to repair circuits and components.
  
16. Describe the procedures used to verify the repair.

Practical Objectives

1. Test battery.
2. Perform a wire/connector repair.

## AST-170            **Body Components and Trim**

### **Learning Outcomes:**

- Demonstrate knowledge of body components and trim and their applications.
- Demonstrate knowledge of the procedures used to diagnose and repair body components and trim.

### **2016 Red Seal Occupational Standard Reference:**

- 20.02 Diagnoses wind noises, rattles and water leaks.
- 20.03 Diagnoses interior and exterior components, accessories and trim.
- 20.04 Diagnoses latches, locks and movable glass.
- 21.02 Repairs wind noises, rattles, and water leaks.
- 21.03 Repairs interior and exterior components, accessories and trim.
- 21.04 Repairs latches, locks and movable glass.

### **Suggested Hours:**

9 Hours

### **Objectives and Content:**

#### Theoretical Objectives

1. Identify safety considerations related to body components and trim.
  - i) restraint components
  - ii) pinch points
  - iii) handling of glass
  
2. Identify body components and accessories, and describe their purpose and operation.
  - i) interior
    - doors
    - seats
    - dashes
  - ii) exterior
    - bumpers
    - mirrors

- add-on accessories
  - mounts
  - hitches and secondary safety attachment devices
3. Identify flaws related to interior and exterior components, accessories and trim.
    - i) fit
    - ii) finish
    - iii) form
    - iv) function
  4. Identify types of latches, locks and movable glass, and their applications.
  5. Explain the principles of basic aerodynamics related to body design.
  6. Identify types and sources of noise, vibration and harshness (NVH).
    - i) chuckles
    - ii) rattles
    - iii) knocks and whines
    - iv) offensive noises
  7. Identify materials used to dampen or interrupt vibration.
    - i) tapes
    - ii) adhesives
    - iii) insulators
  8. Identify types and sources of wind and water leaks and their causes.
    - i) missing sealant and adhesive
    - ii) loose fasteners
    - iii) panel misalignment
    - iv) incorrect clearances
    - v) exterior accessories
  9. Identify types of seals, adhesives, sealing materials and fasteners, and describe their applications and procedures for use.
  10. Identify diagnostic and repair tools and equipment, and describe their applications and procedures for use.
  11. Describe the procedures used to diagnose body components and trim.
    - i) verify concern

- ii) perform sensory inspection
  - iii) retrieve diagnostic codes
  - iv) access service information
  - v) conduct tests and measurements
  - vi) isolate problem and identify root cause
12. Describe the procedures used to repair wind noises, rattles and water leaks.
13. Describe the procedures used to adjust, repair or replace interior and exterior components, accessories and trim.
14. Describe the procedures used to repair latches, locks and movable glass.
15. Describe the procedures used to verify the repair.

Practical Objectives

N/A

## AST-175            Engine Principles

### Learning Outcomes:

- Demonstrate knowledge of engine theory.
- Demonstrate knowledge of engine assemblies, their components and operation.

### 2016 Red Seal Occupational Standard Reference:

- 4.03 Diagnose Engine Assembly (engine theory)
- 5.03 Repairs Engine Assembly (engine theory)

### Suggested Hours:

24 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Define and explain terminology associated with engines.
2. Explain internal combustion principles.
3. Identify types of engine classifications, and describe their construction.
  - i) fuel
    - diesel
    - gasoline
    - alternate fuels
  - ii) two-stroke and four- stroke
  - iii) cooling systems
    - air
    - liquid
4. Identify types of engine configurations, and describe their construction.
  - i) inline
  - ii) rotary
  - iii) opposed
  - iv) V



5. Identify types of valve train configurations, and describe their construction.
  - i) push rod
  - ii) overhead cam
  - iii) multi-valve
  - iv) solenoid operated valve
6. Describe variable valve control systems.
7. Identify engine assembly components, and describe their design, purpose and operation.
  - i) crankshafts
  - ii) camshafts
  - iii) bearings
  - iv) pistons and rings
  - v) engine block
  - vi) cylinder head assemblies
  - vii) gaskets
  - viii) variable valve actuators
8. Describe engine displacement, compression ratios, horsepower and torque.
9. Identify related components and describe their relationship to engine assembly.
  - i) engine oil coolers
  - ii) lines
  - iii) hoses
  - iv) pulleys

Practical Objectives

1. Calculate engine displacement, compression ratios, and horsepower.

## AST-180            Vehicle Maintenance Inspection

### Learning Outcomes:

- Demonstrate knowledge of vehicle maintenance inspections and their purpose.
- Demonstrate knowledge of the procedures used to perform vehicle maintenance inspections.

### 2016 Red Seal Occupational Standard Reference:

N/A

### Suggested Hours:

3 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Describe the importance of regular vehicle maintenance inspections.
2. Identify vehicle components and accessories requiring operational checks.
  - i) brakes
  - ii) tires
  - iii) lights and wipers
  - iv) steering linkage
  - v) belts and filters
  - vi) exhaust
3. Identify lubricants and fluids requiring service checks.
4. Identify tools and equipment used to perform vehicle maintenance inspections.
5. Describe the procedures used to perform vehicle maintenance inspections.

#### Practical Objectives

1. Perform vehicle operational checks.

## **AST-185          Pre-Delivery Inspection**

### **Learning Outcomes:**

- Demonstrate knowledge of the procedures used to perform pre-delivery inspections.

### **2016 Red Seal Occupational Standard Reference:**

N/A

### **Suggested Hours:**

3 Hours

### **Objectives and Content:**

#### *Theoretical Objectives*

1. Explain the purpose of a pre-delivery inspection.
2. Identify pre-delivery inspection procedures and requirements.
3. Describe the procedures used to perform pre-delivery inspections.

#### *Practical Objectives*

N/A



# LEVEL 2

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## AST-200            Cooling Systems

### Learning Outcomes:

- Demonstrate knowledge of cooling systems, their components and operation.
- Demonstrate knowledge of the procedures used to diagnose and repair cooling systems.

### 2016 Red Seal Occupational Standard Reference:

4.01 Diagnoses cooling systems.

5.01 Repairs cooling systems.

### Suggested Hours:

12 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Identify types of cooling systems, and describe their purpose, characteristics and applications.
  - i) liquid
  - ii) air cooled
  
2. Identify cooling system components, and describe their purpose and operation.
  - i) radiators
  - ii) hoses
  - iii) thermostats
  - iv) water pumps
  
3. Identify warning systems and indicators, and describe their purpose and operation.
  - i) lights
  - ii) gauges
  - iii) audible

4. Identify types of fan systems, and describe their components and operation.
  - i) mechanical
  - ii) electric
  - iii) hydraulic
5. Identify related systems, and describe their relationship to cooling systems.
  - i) heating, ventilation and air conditioning (HVAC)
  - ii) coolers and auxiliary coolers
  - iii) coolant heaters
6. Identify types of coolants and chemical additives, and describe their characteristics and applications.
7. Describe the procedures used to bleed, flush and dispose of coolants according to jurisdictional regulations.
8. Identify types of hoses, tubing, belts, gaskets, seals and sealants, and describe their applications.
9. Identify types of diagnostic and repair tools and equipment, and describe their applications and procedures for use.
  - i) diagnostic
    - pressure testers
    - coolant strength testers
    - infrared temperature guns
    - scan tools
  - ii) repair
    - automated refill devices
    - tension gauges
10. Describe the procedures used to diagnose and repair cooling systems.
  - i) verify concern
  - ii) perform sensory inspection
  - iii) retrieve diagnostic codes
  - iv) access service information
  - v) conduct tests and measurements
  - vi) isolate problem and identify root cause
11. Describe the procedures used to remove and reinstall cooling system components.

12. Describe the procedures used repair cooling systems.
13. Describe the procedures used to verify the repair.

*Practical Objectives*

1. Perform a coolant system pressure test.



## AST-205            Engine Lubrication Systems

### Learning Outcomes:

- Demonstrate knowledge of engine lubrication systems, their components and operation.
- Demonstrate knowledge of the procedures used to diagnose and repair engine lubrication systems.

### 2016 Red Seal Occupational Standard Reference:

- 4.02 Diagnoses lubricating systems.
- 5.02 Repairs lubricating systems.

### Suggested Hours:

12 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Identify types of engine lubricants, and describe their characteristics and applications.
  - i) grades and classifications
  - ii) synthetics
  - iii) additives
2. Identify types of oil pumps, and describe their purpose and operation.
  - i) rotor
  - ii) vane
  - iii) gear
3. Identify types of oil coolers, and describe their purpose and operation.
  - i) oil-to-air
  - ii) oil-to-coolant
4. Identify types of hoses, tubing, gaskets, seals and sealants and describe their applications.

5. Describe oil flow, filtration and pressure regulation.
6. Identify types of warning systems and indicators, and describe their purpose and operation.
  - i) lights
  - ii) gauges
  - iii) audible
7. Identify testing procedures for checking oil contaminants.
8. Identify lubrication requirements related to superchargers and turbochargers.
9. Identify related systems and describe the relationship to lubrication systems.
  - i) engine assembly
  - ii) galleries and clearances
10. Describe the procedures used to diagnose engine lubrication systems.
  - i) verify concern
  - ii) perform sensory inspection
  - iii) retrieve diagnostic codes
  - iv) access service information
  - v) conduct tests and measurements
  - vi) isolate problem and identify root cause
11. Describe the procedures used to repair engine lubrication systems.
12. Describe the procedures used to verify the repair.

Practical Objectives

N/A

## AST-210            Accessory Drive Systems

### Learning Outcomes:

- Demonstrate knowledge of accessory drive systems, their components and operation.
- Demonstrate knowledge of the procedures used to diagnose and repair accessory drive systems.

### 2016 Red Seal Occupational Standard Reference:

- 4.04 Diagnoses accessory drive systems.
- 5.04 Repairs accessory drive systems.

### Suggested Hours:

12 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Identify types of accessory drive systems, and describe their components and operation.
  - i) belt tension/tensioners
  - ii) belts
  - iii) drives
    - electric
    - hydraulic
    - gear
    - pulley
  
2. Identify related components, and describe their relationship to accessory drive systems.
  - i) water pumps
  - ii) alternators
  - iii) AC compressors
  - iv) power steering pumps
  - v) supercharger

3. Identify types of diagnostic and repair tools and equipment, and describe their applications and procedures for use.
  - i) diagnostic
    - pyrometer
    - laser alignment
    - straight edges
    - electronic vibration analyzers
    - stethoscopes
  - ii) repair
    - tension relief devices
    - pullers
    - belt installers
4. Describe the procedures used to diagnose and repair accessory drive systems and components.
  - i) verify concern
  - ii) perform sensory inspection
  - iii) retrieve diagnostic codes
  - iv) access service information
  - v) conduct tests and measurements
  - vi) isolate problem and identify root cause
5. Describe the procedures used to reinstall and adjust accessory drive systems and their components.
6. Describe the procedures used to verify the repair.

Practical Objectives

N/A

## AST-215            Engine Repair

### Learning Outcomes:

- Demonstrate knowledge of the procedures to diagnose and repair engines.

### 2016 Red Seal Occupational Standard Reference:

- 4.03 Diagnoses engine assembly.
- 5.03 Repairs engine assembly.

### Suggested Hours:

42 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Identify safety considerations pertaining to engine repair.
2. Identify types and sources of engine problems.
  - i) low power
  - ii) smoke
  - iii) oil consumption
  - iv) fluid contamination
  - v) rough running
  - vi) internal/external leaks
  - vii) noises
  - viii) vibrations
3. Identify types of engine mounts, and describe their construction and applications.
4. Identify types of fasteners, gaskets, seals and sealants, and describe their applications and procedures for use.

5. Identify types of diagnostic and repair tools and equipment, and describe their applications and procedures for use.
  - i) diagnostic
    - vacuum gauges
    - compression gauges
    - straight edges
    - stethoscopes
    - scan tools
    - plastic precision clearance gauges
  - ii) repair
    - torque angle gauge
6. Describe the procedures used to diagnose engine problems.
  - i) verify concern
  - ii) perform sensory inspection
  - iii) retrieve diagnostic codes
  - iv) access service information
  - v) conduct tests and measurements
  - vi) isolate problem and identify root cause
7. Describe the procedures used to remove, repair and reassemble engines.
8. Describe the procedures used to adjust, repair and/or replace engine components.
9. Describe the procedures used to verify the repair.

Practical Objectives

1. Diagnose mechanical engine problems.

## AST-220            Starting Systems

### Learning Outcomes:

- Demonstrate knowledge of starting systems, their components and operation.
- Demonstrate knowledge of the procedures to diagnose and repair starting systems.

### 2016 Red Seal Occupational Standard Reference:

14.02 Diagnoses starting/charging system and batteries.

15.02 Repairs starting/charging system and batteries.

### Suggested Hours:

12 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Identify safety considerations pertaining to starting systems.
  - i) battery explosions
  - ii) corrosive materials
  - iii) high voltage
2. Identify types of starting systems, and describe their components and operation.
3. Identify types of control systems, and describe their components and operation.
  - i) anti-theft/immobilizer
  - ii) safety interlock devices
4. Identify types of diagnostic and repair tools and equipment, and describe their applications and procedures for use.
5. Describe the procedures used to diagnose starting systems.
  - i) verify concern
  - ii) perform sensory inspection
  - iii) retrieve diagnostic codes

- iv) access service information
  - v) conduct tests and measurements
  - vi) isolate problem and identify root cause
6. Describe the procedures used to remove and reinstall starting system components.
  7. Describe the procedures used to adjust, repair and/or replace starting system components.
  8. Describe the procedures used to verify the repair.

Practical Objectives

N/A



## AST-225            Charging Systems

### Learning Outcomes:

- Demonstrate knowledge of charging systems, their components and operation.
- Demonstrate knowledge of the procedures to diagnose and repair charging systems.

### 2016 Red Seal Occupational Standard Reference:

14.02 Diagnoses starting/charging system and batteries.

15.02 Repairs starting/charging system and batteries.

### Suggested Hours:

12 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Identify safety considerations pertaining to charging systems.
2. Identify types of charging systems, and describe their components and operation.
3. Identify types of control systems, and describe their components and operation.
4. Identify warning indicators.
5. Describe the relationship of charging system to the vehicle networking system.
6. Identify types of diagnostic and repair tools and equipment, and describe their applications and procedures for use.
7. Describe the procedures used to diagnose charging systems.
  - i) verify concern
  - ii) perform sensory inspection
  - iii) retrieve diagnostic codes

- iv) access service information
  - v) conduct tests and measurements
  - vi) isolate problem and identify root cause
8. Describe the procedures used to remove and reinstall charging system components.
  9. Describe the procedures used to adjust, repair and/or replace charging system components.
  10. Describe the procedures used to verify the repair.

Practical Objectives

1. Perform a charging system test.

## AST-230            Lighting and Wiper Systems

### Learning Outcomes:

- Demonstrate knowledge of lighting and wiper systems, their components and operation.
- Demonstrate knowledge of the procedures to diagnose and repair lighting and wiper systems.

### 2016 Red Seal Occupational Standard Reference:

14.03 Diagnoses lighting and wiper systems.

15.03 Repairs lighting and wiper systems.

### Suggested Hours:

18 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Identify safety considerations pertaining to lighting and wiper systems.
  - i) lamps (high intensity discharge (HID))
  - ii) pinch points
2. Identify jurisdictional requirements pertaining to lighting and wiper systems.
3. Identify types of lighting systems, and describe their components and operation.
  - i) electrically-controlled
  - ii) electronically-controlled
4. Identify types of wiper systems, and describe their components and operation.
  - i) electrically-controlled
  - ii) electronically-controlled
5. Describe the relationship of lighting and wiper systems to the vehicle networking system.

6. Identify types of diagnostic and repair tools and equipment, and describe their applications and procedures for use.
  - i) diagnostic
    - digital multimeters
    - scan tools
    - circuit testers
  - ii) repair
    - reprogramming equipment
  
7. Describe the procedures used to diagnose lighting and wiper systems.
  - i) verify concern
  - ii) perform sensory inspection
  - iii) retrieve diagnostic codes
  - iv) access service information
  - v) conduct tests and measurements
  - vi) isolate problem and identify root cause
  
8. Describe the procedures used to remove and reinstall lighting and wiper system components.
  
9. Describe the procedures used to adjust, repair and/or replace lighting and wiper system components.
  
10. Describe the procedures used to verify the repair.

Practical Objectives

N/A

## AST-235            Steering Systems II

### Learning Outcomes:

- Demonstrate knowledge of electronically-controlled steering systems, their components and operation.
- Demonstrate knowledge of the procedures used to diagnose and repair electronically-controlled steering systems.
- Demonstrate knowledge of wheel alignment and steering geometry.

### 2016 Red Seal Occupational Standard Reference:

- 18.01 Diagnoses steering, suspension and control systems.  
19.01 Repairs steering, suspension and control systems.

### Suggested Hours:

12 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Identify safety considerations pertaining to electronically-controlled steering systems.
  - i) accidental deployment of passive restraints
    - air bags
    - clock springs
  - ii) collapsible columns
2. Identify types of electronic control steering systems, and describe their components and operation.
3. Identify related systems, and describe their relationship to steering systems.
  - i) lane departures
  - ii) park-assist
  - iii) collision avoidance

4. Identify types of variable-assist steering systems, and describe their components and operation.
5. Describe steering geometry.
  - i) alignment angles
  - ii) Ackerman principle
6. Describe the procedures used to diagnose and perform wheel alignment.
7. Identify types of diagnostic and repair tools and equipment, and describe their applications and procedures for use.
8. Describe the procedures used to diagnose electronically-controlled steering systems.
  - i) verify concern
  - ii) perform sensory inspection
  - iii) retrieve diagnostic codes
  - iii) access service information
  - v) conduct tests and measurements
  - vi) isolate problem and identify root cause
9. Describe the procedures used to remove and reinstall electronically-controlled steering system components.
10. Describe the procedures used to adjust, repair and/or replace electronically-controlled steering system components.
11. Describe the procedures used to verify the repair.

Practical Objectives

N/A

## AST-240                      Suspension Systems II

### Learning Outcomes:

- Demonstrate knowledge of wheel alignment and suspension geometry.
- Demonstrate knowledge of electronically-controlled suspension systems, their components and operation.
- Demonstrate knowledge of the procedures used to repair wheel alignments and electronically-controlled suspension systems.
- Demonstrate knowledge of the procedures used to diagnose and perform wheel alignments.

### AST 2016 Red Seal Occupational Standard Reference:

18.01 Diagnoses steering, suspension and control systems.

19.01 Repairs steering, suspension and control systems.

### Suggested Hours:

24 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Identify types of electronically-controlled suspension systems, and describe their components and operation.
  - i) ride control
  - ii) height control
2. Describe suspension geometry.
  - i) alignment angles
  - ii) Ackerman principle
3. Describe the procedures used to diagnose electronically-controlled suspension systems.
  - i) verify concern
  - ii) perform sensory inspection
  - iii) retrieve diagnostic codes

- iv) access service information
  - v) conduct tests and measurements
  - vi) isolate problem and identify root cause
4. Describe the procedures used to diagnose wheel alignment.
    - i) verify concern
    - ii) perform sensory inspection
    - iii) retrieve diagnostic codes
  5. Describe the procedures used to remove and reinstall electronically-controlled suspension systems components.
  6. Describe the procedures used to adjust, repair and/or replace electronically-controlled suspension systems components.
  7. Describe the procedures used to perform wheel alignment
  8. Describe the procedures used to reset steering sensors.
  9. Describe the procedures used to verify the repair.

Practical Objectives

1. Perform a wheel alignment.



## AST-245            Braking Systems II

### Learning Outcomes:

- Demonstrate knowledge of anti-lock braking systems (ABS), their components and operation.
- Demonstrate knowledge of the procedures used to diagnose and repair anti-lock braking systems (ABS).
- Demonstrate knowledge of the procedures used to diagnose and repair control systems.

### 2016 Red Seal Occupational Standard Reference:

18.02 Diagnoses braking and control systems.

19.02 Repairs braking and control systems.

### Suggested Hours:

24 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Identify safety considerations pertaining to anti-lock braking systems (ABS) and their components.
  - i) hydraulic pressure
  - ii) airborne contaminants
  - iii) high voltage systems
2. Identify types of anti-lock braking systems (ABS), and describe their components and operation.
3. Identify types of braking systems in hybrid and electric vehicles (EV).
4. Identify types of trailer brakes and controls, and describe their components and operation.
  - i) surge
  - ii) electric

- iii) electric-hydraulic
5. Identify types of control systems, and describe their components and operation.
    - i) traction control system (TCS)
    - ii) anti-lock brake system (ABS)
    - iii) stability control
    - iv) adaptive cruise control
  6. Identify types of diagnostic and repair tools and equipment, and describe their applications and procedures for use.
  7. Describe the procedures used to diagnose anti-lock braking systems (ABS).
    - i) verify concern
    - ii) perform sensory inspection
    - iii) retrieve diagnostic codes
    - iv) access service information
    - v) conduct tests and measurements
    - vi) isolate problem and identify root cause
  8. Describe the procedures used to flush and bleed anti-lock brakes.
  9. Describe the procedures used to adjust, repair and/or replace anti-lock braking system (ABS) components.
  10. Describe the procedures used to verify the repair.

Practical Objectives

N/A

## AST-250

## Manual Transmissions and Transaxles

### Learning Outcomes:

- Demonstrate knowledge of manual transmissions and transaxles, their components and operation.
- Demonstrate knowledge of the procedures used to diagnose and repair manual transmissions and transaxles.

### 2016 Red Seal Occupational Standard Reference:

12.02 Diagnoses manual transmissions and transaxles.

13.02 Repairs manual transmissions and transaxles.

### Suggested Hours:

36 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Identify safety considerations pertaining to manual transmissions and transaxles.
  - i) exposed rotating parts
  - ii) pinch points
  - iii) lifting and support procedures
2. Identify types of manual transmissions and transaxles and describe their components and operation.
3. Explain manual transmissions and transaxles power flow.
4. Describe gear ratios, their purpose and calculation.
5. Identify types of lubricants, fasteners, gaskets, seals and sealants, and describe their applications.
6. Identify types of engine and driveline mounts, their construction and applications.

7. Identify related systems, and describe their relationship to manual transmissions and transaxles.
  - i) clutches
  - ii) flywheels
    - single mass
    - dual mass
  - iii) mounts
  
8. Identify types of diagnostic and repair tools and equipment, and describe their applications and procedures for use.
  - i) diagnostic
    - chassis ears
    - stethoscopes
    - scan tools
  - ii) repair
    - measuring tools
    - presses
    - pullers
    - lifting and support equipment
  
9. Describe the procedures used to diagnose manual transmissions and transaxles.
  - i) verify concern
  - ii) perform sensory inspection
  - iii) retrieve diagnostic codes
  - iv) access service information
  - v) conduct tests and measurements
  - vi) isolate problem and identify root cause
  
10. Describe the procedures used to remove and reinstall manual transmissions and transaxles.
  
11. Describe the procedures used to replace engine and driveline mounts.
  
12. Describe the procedures used to adjust, repair and/or replace manual transmissions and transaxles and their related components.
  
13. Describe the procedures used to verify the repair.

Practical Objectives

N/A

## AST-255            Clutches

### Learning Outcomes:

- Demonstrate knowledge of clutches, their components and operation.
- Demonstrate knowledge of the procedures used to diagnose and repair clutches.

### 2016 Red Seal Occupational Standard Reference:

12.04 Diagnoses clutches.

13.04 Repairs clutches.

### Suggested Hours:

6 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Identify safety considerations pertaining to clutch systems.
  - i) airborne contaminants
  - ii) pinch points
  - iii) exposed rotating parts
  - iv) lifting and support procedures
2. Identify types of clutches, and describe their components and operation.
3. Identify types of flywheels, and describe their components and operation.
4. Identify mechanical and hydraulic clutch actuating systems, and describe their components and operation.
5. Identify types of fluids, fasteners, tubing, hoses and seals, and describe their applications.
6. Describe clutch system power flow.

7. Identify related systems, and describe their relationship to clutch systems.
  - i) engine
  - ii) manual transmission
  - iii) drive shaft and axles
  
8. Identify diagnostic and repair tools and equipment, and describe their applications and procedures for use.
  - i) diagnostic
    - measuring tools
  - ii) repair
    - alignment
    - pullers
    - lifting and support equipment
  
9. Describe the procedures used to diagnose clutches.
  - i) verify concern
  - ii) perform sensory inspection
  - iii) retrieve diagnostic codes
  - iv) access service information
  - v) conduct tests and measurements
  - vi) isolate problem and identify root cause
  
10. Describe the procedures used to remove and reinstall clutches.
  
11. Describe the procedures used to adjust, repair and/or replace clutches and flywheels and their related components.
  
12. Describe the procedures used to verify the repair.

Practical Objectives

N/A

## AST-260            Final Drive Assemblies

### Learning Outcomes:

- Demonstrate knowledge of final drive assemblies, their components and applications.
- Demonstrate knowledge of the procedures used to diagnose and repair final drive assemblies.

### 2016 Red Seal Occupational Standard Reference:

12.06 Diagnoses final drive assemblies.

13.06 Repairs final drive assemblies.

### Suggested Hours:

18 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Identify safety considerations pertaining to final drive assemblies.
  - i) exposed rotating parts
  - ii) pinch points
  - iii) lifting and supporting procedures
  
2. Identify types of final drive assemblies, and describe their components and operation.
  - i) locking
  - ii) all wheel drive
  - iii) integral
  - iv) removable
  - v) limited slip
  - vi) torque distribution
  
3. Identify related systems, and describe their relationship to final drive assembly.
  - i) transmissions
  - ii) drivelines



- iii) mounts
4. Identify types of control systems, and describe their components and operation.
    - i) electronically-controlled/electric
    - ii) vacuum
    - iii) mechanical
  5. Describe final drive assembly power flow.
  6. Describe gear ratios, their purpose and calculations.
  7. Identify types of lubricants, fasteners, gaskets, seals and sealants, and describe their applications.
  8. Identify diagnostic and repair tools and equipment pertaining to final drive assemblies, and describe their applications and procedures for use.
    - i) diagnostic
      - scan tools
      - measuring tools
      - chassis ears
    - ii) repair
      - presses
      - pullers
      - lifting and support equipment
      - gear marking compound
  9. Describe the procedures used to diagnose final drive assembly.
    - i) verify concern
    - ii) perform sensory inspection
    - iii) retrieve diagnostic codes
    - iv) access service information
    - v) conduct tests and measurements
    - vi) isolate problem and identify root cause
  10. Identify tests used to diagnose final drive assembly.
    - i) road test
    - ii) sensory inspection
    - iii) bearing inspection
    - iv) gear tooth patterns
    - v) backlash

11. Describe the procedures used to remove and reinstall final drive assemblies.
12. Describe the procedures used to adjust, repair and/or replace final drive assemblies and their related components.
13. Describe the procedures used to verify the repair.

Practical Objectives

N/A

# LEVEL 3

| <b>Unit Code</b> | <b>Title</b>                                 | <b>Suggested Hours</b> | <b>Page Number</b> |
|------------------|--|------------------------|--------------------|
| AST-300          | Transfer Cases                               | 24                     | 90                 |
| AST-305          | Gasoline Fuel Delivery and Injection Systems | 24                     | 92                 |
| AST-310          | Gasoline Ignition Systems                    | 24                     | 94                 |
| AST-315          | Vehicle Networking Systems                   | 60                     | 97                 |
| AST-320          | Gasoline Emission Control Systems            | 24                     | 100                |
| AST-325          | Gasoline Intake and Exhaust Systems          | 18                     | 103                |
| AST-330          | Electrical Options and Accessories           | 30                     | 106                |
| AST-335          | Motor Vehicle Inspection                     | 6                      | 108                |

## AST-300            Transfer Cases

### Learning Outcomes:

- Demonstrate knowledge of transfer cases, their components and operation.
- Demonstrate knowledge of the procedures used to diagnose and repair transfer cases.

### 2016 Red Seal Occupational Standard Reference:

12.05 Diagnoses transfer cases.

13.05 Repairs transfer cases.

### Suggested Hours:

24 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Identify safety considerations pertaining to transfer cases.
  - i) pinch points
  - ii) exposed rotating components
  - iii) lifting and support procedures
2. Identify types of transfer cases/power transfer unit, and describe their components and operation.
  - i) part-time
  - ii) full-time
  - iii) automatic
3. Identify types of all-wheel drive (AWD) systems, their components and operation.
4. Identify related systems, and describe their relationship to transfer cases.
  - i) transmissions
  - ii) locking hubs
  - iii) axle disconnects

5. Identify types of control systems, and describe their components and operation.
  - i) vacuum
  - ii) manual
  - iii) electronic
6. Describe transfer case power flow.
7. Describe gear ratios, their purpose and calculations.
8. Identify types of lubricants, fasteners, gaskets, seals and sealants, and describe their applications.
9. Identify types of diagnostic and repair tools and equipment, and describe their applications and procedures for use.
10. Describe the procedures used to diagnose transfer cases.
  - i) verify concern
  - ii) perform sensory inspection
  - iii) retrieve diagnostic codes
  - iv) access service information
  - v) conduct tests and measurements
  - vi) isolate problem and identify root cause
11. Describe the procedures used to remove and reinstall transfer cases.
12. Describe the procedures used to adjust, repair and/or replace transfer cases and their related components.
13. Describe the procedures used to verify the repair.

Practical Objectives

N/A

## AST-305

## Gasoline Fuel Delivery and Injection Systems

### Learning Outcomes:

- Demonstrate knowledge of gasoline fuel delivery and injection systems, their components and operation.
- Demonstrate knowledge of the procedures used to diagnose and repair gasoline fuel delivery and injection systems.

### 2016 Red Seal Occupational Standard Reference:

- 6.01 Diagnoses gasoline fuel delivery and injection systems.
- 7.01 Repairs gasoline fuel delivery and injection systems.

### Suggested Hours:

24 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Identify safety precautions pertaining to gasoline fuel delivery and injection systems.
  - i) high pressure
  - ii) flammability
2. Identify the types of gasoline fuel delivery and injection systems, and describe their components and operation.
  - i) fuel pumps and supply systems
  - ii) gasoline direct injection
  - iii) port injection systems
3. Identify types of tubing, hoses, gaskets, seals and sealants, and describe their applications.
4. Identify types of diagnostic and repair tools and equipment, and describe their applications and procedures for use.
  - i) diagnostic

- fuel pressure gauges
  - scan tools
  - vacuum gauges
  - DMMs
  - oscilloscope
- ii) repair
- fuel transfer and storage equipment
  - fuel injector cleaning equipment
5. Describe the procedures used to diagnose and repair gasoline fuel delivery and injection systems, and their components.
- i) verify concern
  - ii) perform sensory inspection
  - iii) retrieve diagnostic codes
  - iv) access service information
  - v) conduct tests and measurements
  - vi) isolate problem and identify root cause
6. Describe the procedures used to remove and reinstall gasoline fuel delivery and injection system components.
7. Describe the procedures used to adjust, calibrate, repair and/or replace gasoline fuel delivery and injection system components.
8. Describe the procedures used to verify the repair.

Practical Objectives

1. Perform fuel pressure check.

## AST-310            Gasoline Ignition Systems

### Learning Outcomes:

- Demonstrate knowledge of ignition systems, their components and operation.
- Demonstrate knowledge of the procedures used to diagnose and repair ignition systems.

### 2016 Red Seal Occupational Standard Reference:

- 6.02 Diagnoses gasoline ignition systems.
- 7.02 Repairs gasoline ignition systems.

### Suggested Hours:

24 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Identify safety considerations pertaining to ignition systems.
  - i) high voltage
  - ii) high temperature
2. Identify types of ignition systems, and describe their components and operation.
  - i) distributor
  - ii) distributor-less
3. Identify the types of ignition circuits, and describe their purpose and operation.
  - i) primary
  - ii) secondary
  - iii) control
4. Identify related systems, and describe their relationship to ignition systems and their components.
  - i) fuel
  - ii) exhaust
  - iii) air intake



- iv) engine
5. Identify warning systems and indicators.
    - i) check engine light
    - ii) driver information centre (DICs)
  6. Identify ignition concerns.
    - i) hesitation
    - ii) misfire
    - iii) lag
    - iv) timing
    - v) detonation
    - vi) pre-ignition
  7. Identify types of diagnostic and repair tools and equipment, and describe their applications and procedures for use.
    - i) diagnostic
      - oscilloscopes
      - digital multimeters (DMMs)
      - scan tools
      - spark testers
    - ii) repair
      - scan tools
      - gauges
      - timing light
  8. Describe the procedures used to diagnose and repair ignition systems.
    - i) verify concern
    - ii) perform sensory inspection
    - iii) retrieve diagnostic codes
    - iv) access service information
    - v) conduct tests and measurements
    - vi) isolate problem and identify root cause
  9. Describe the procedures used to remove and reinstall ignition system components.
  10. Describe the procedures used to adjust, calibrate, repair and/or replace ignition system components.

11. Describe the procedures used to verify the repair.

Practical Objectives

N/A

## AST-315            Vehicle Networking Systems

### Learning Outcomes:

- Demonstrate knowledge of vehicle networking systems, their components and operation.
- Demonstrate knowledge of the procedures used to diagnose and repair vehicle networking system components.
- Demonstrate knowledge of reprogramming software.

### 2016 Red Seal Occupational Standard Reference:

- 10.01 Reads diagnostic trouble codes (DTC).
- 10.02 Monitors data.
- 10.03 Interprets test results.
- 10.04 Tests system circuitry and components.
- 11.01 Updates component software.
- 11.02 Replaces components.
- 11.03 Verifies vehicle modular communication system repair.

### Suggested Hours:

60 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Explain basic computer operation and its relationship to vehicle networking systems.
2. Identify on-board diagnostic (OBD) systems, and describe their components and operation.
3. Identify types of network protocols, and describe their purpose.
  - i) International Standards Organization (ISO)
  - ii) high speed (HS)
  - iii) controller area network (CAN)

4. Describe the networking of modules and multiplexing.
  - i) wiring designs
  - ii) wireless
5. Identify and interpret data.
  - i) inputs
  - ii) processing
  - iii) outputs
6. Identify and interpret diagnostic trouble codes (DTC).
7. Identify the parameters of inputs and outputs, and describe their relationships.
8. Identify methods used to access, transfer and reprogram software, and describe their associated procedures.
  - i) CD/DVD
  - ii) internet
  - iii) scan tool
  - iv) programmable read only memory (PROM)
9. Identify types of diagnostic and repair tools and equipment used to diagnose network and electronic circuitry, and describe their applications and procedures for use.
  - i) digital multimeters (DMM)
  - ii) scopes
  - iii) probes
  - iv) break out boxes
  - v) scan tools
10. Describe the procedures used to diagnose vehicle networking systems and components.
  - i) verify concern
  - ii) perform sensory inspection
  - iii) retrieve diagnostic codes
  - iv) access service information
  - v) conduct tests and measurements
  - vi) isolate problem and identify root cause

11. Describe the procedures used to repair and/or replace vehicle networking systems and their components.
12. Describe the procedures used to verify the repair.

Practical Objectives

N/A

**Learning Outcomes:**

- Demonstrate knowledge of emission control systems, their components and operation.
- Demonstrate knowledge of the procedures used to diagnose and repair emission control systems.

**2016 Red Seal Occupational Standard Reference:**

6.04 Diagnoses gasoline emission control systems.

7.04 Repairs gasoline emission control systems.

**Suggested Hours:**

24 Hours

**Objectives and Content:***Theoretical Objectives*

1. Identify types of on-board diagnostic systems and describe their applications.
2. Identify types of emission gases and how they are formed.
  - i) carbon monoxide (CO)
  - ii) carbon dioxide (CO<sub>2</sub>)
  - iii) oxides of nitrogen (NO<sub>x</sub>)
  - iv) hydro carbon (HC)
  - v) oxygen (O<sub>2</sub>)
3. Identify emission control systems, and describe their components and operation.
  - i) exhaust gas recirculation (EGR)
  - ii) evaporative emission control systems (EVAP)
  - iii) secondary air injection
  - iv) exhaust system
  - v) positive crankcase ventilation (PCV)
  - vi) induction system
  - vii) variable cam-timing (VCT)

- viii) engine temperature (thermostat)
- 4. Identify emission control system monitors, and describe their components and operation.
- 5. Identify related systems, and describe their relationship to emission control systems.
  - i) exhaust
  - ii) intake
  - iii) fuel
- 6. Identify warning systems and indicators.
  - i) check engine light
  - ii) driver information centre (DIC)
- 7. Identify types of fasteners, tubing, hoses, gaskets, seals and sealants, and describe their applications.
- 8. Identify types of diagnostic and repair tools and equipment, and describe their applications and procedures for use.
  - i) diagnostic
    - scan tools
    - smoke generators
    - EVAP leak detectors
    - gas analyzers
    - digital multimeters (DMM)
  - ii) repair
    - cleaning and service tools
    - reprogramming equipment
- 9. Describe the procedures used to diagnose emission control systems.
  - i) verify concern
  - ii) perform sensory inspection
  - iii) retrieve diagnostic codes
  - iv) access service information
  - v) conduct tests and measurements
  - vi) isolate problem and identify root cause
- 10. Describe the procedures used to repair and service emission control systems.

11. Describe the procedures used to remove and reinstall emission control system components.
12. Describe the procedures used to adjust, repair and/or replace emission control system components.
13. Describe the procedures used to verify the repair.

Practical Objectives

N/A



## AST-325            Gasoline Intake and Exhaust Systems

### Learning Outcomes:

- Demonstrate knowledge of gasoline intake and exhaust systems, their components and operation.
- Demonstrate knowledge of the procedures used to diagnose and repair gasoline intake and exhaust systems.

### 2016 Red Seal Occupational Standard Reference:

- 6.03 Diagnoses gasoline intake/exhaust systems.
- 7.03 Repairs gasoline intake/exhaust systems.

### Suggested Hours:

18 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Identify safety considerations related to intake and exhaust systems.
2. Identify types of intake air systems, and describe their components and operation.
  - i) forced air
  - ii) naturally aspirated (NA)
3. Identify the types of exhaust systems, and describe their components and operation.
  - i) single
  - ii) dual
4. Identify types and sources of intake and exhaust system problems.
  - i) leaks
  - ii) blockages
  - iii) noise
  - iv) vibration

5. Identify the types of fasteners, tubing, hoses, gaskets, seals and sealants, and describe their applications.
6. Identify related systems, and describe their relationship to intake and exhaust systems.
  - i) emissions
  - ii) lubricating
  - iii) fuel delivery
7. Identify types of diagnostic and repair tools and equipment, and describe their applications and procedures for use.
  - i) diagnostic
    - scan tools
    - vacuum gauges
    - exhaust back pressure gauges
    - smoke generators
    - gas analyzers
  - ii) repair
    - torches
    - welders
    - timing light
8. Describe the procedures used to diagnose and repair intake and exhaust systems and their components.
  - i) verify concern
  - ii) perform sensory inspection
  - iii) retrieve diagnostic codes
  - iv) access service information
  - v) conduct tests and measurements
  - vi) isolate problem and identify root cause
9. Describe the procedures used to remove and reinstall intake and exhaust system components.
10. Describe the procedures used to adjust/calibrate, repair and/or replace intake and exhaust system components.
11. Describe the procedures used to perform oil changes and clean supercharger and turbocharger systems.

12. Describe the procedures used to verify the repair.

Practical Objectives

N/A

## AST-330            Electrical Options and Accessories

### Learning Outcomes:

- Demonstrate knowledge of electrical options and accessories, their components and operation
- Demonstrate knowledge of the procedures used to diagnose and repair electrical options and accessories.
- Demonstrate knowledge of the procedures used to install electrical accessories.

### 2016 Red Seal Occupational Standard Reference:

- 14.05 Diagnoses electrical options.
- 14.07 Diagnoses electrical accessories.
- 15.05 Repairs electrical options.
- 15.07 Installs electrical accessories.
- 15.08 Repairs electrical accessories.

### Suggested Hours:

30 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Identify safety considerations pertaining to electrical options and accessories.
2. Identify types of electrical options and accessories, and describe their component and operation.
  - i) power options
    - windows
    - mirrors
    - seats
    - door locks
  - ii) theft deterrents
  - iii) remote starter
  - iv) seat heating and/or cooling
  - v) cruise control

3. Describe the relationship of vehicle options to the vehicle networking system.
4. Identify types of diagnostic and repair tools and equipment, and describe their applications and procedures for use.
5. Describe the procedures used to diagnose electrical options and accessories.
  - i) verify concern
  - ii) perform sensory inspection
  - iii) retrieve diagnostic codes
  - iv) access service information
  - v) conduct tests and measurements
  - vi) isolate problem and root cause
6. Describe the procedures used to install, adjust, calibrate, repair and/or replace electrical options and accessories.
7. Describe the procedures used to verify the repair.

Practical Objectives

N/A

## AST-335            Motor Vehicle Inspection

### Learning Outcomes:

- Demonstrate knowledge of jurisdictional motor vehicle inspections and their purpose.
- Demonstrate knowledge of the procedures used to perform provincial motor vehicle inspections.

### 2016 Red Seal Occupational Standard Reference:

N/A

### Suggested Hours:

6 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Explain the purpose of a provincial motor vehicle inspection.
2. Identify individuals and authorities involved with provincial motor vehicle inspections, and explain their role, responsibilities and liabilities.
  - i) vehicle owner
  - ii) journey person
  - iii) shop owner
  - iv) government
3. Identify jurisdictional requirements pertaining to motor vehicle inspections.
  - i) inspection instructions
  - ii) specifications and tolerances
  - iii) documentation
    - inspection forms
    - rejection stickers
    - inspection stickers

4. Describe the procedures used to perform a provincial motor vehicle inspection.
  - i) vehicles
  - ii) trailers

Practical Objectives

N/A





# LEVEL 4

| <b>Unit Code</b> | <b>Unit Title</b>                                 | <b>Suggested Hours</b> | <b>Page Number</b> |
|------------------|---|------------------------|--------------------|
| AST-400          | Mentoring   | 6                      | 112                |
| AST-405          | Diesel Fuel Delivery and Injection Systems        | 18                     | 114                |
| AST-410          | Diesel Emission Control Systems                   | 18                     | 117                |
| AST-415          | Diesel Intake and Exhaust Systems                 | 6                      | 120                |
| AST-420          | Entertainment Systems                             | 15                     | 122                |
| AST-425          | Instrumentation and Information Displays          | 15                     | 124                |
| AST-430          | Restraint Systems                                 | 24                     | 126                |
| AST-435          | Automatic Transmissions and Transaxles            | 48                     | 129                |
| AST-440          | Heating, Ventilation and Air Conditioning Systems | 30                     | 132                |
| AST-445          | Hybrid and Electric Vehicle Systems               | 30                     | 135                |
| AST-450          | Program Review                                    | 30                     | 137                |

## AST-400            Mentoring

### Learning Outcomes:

- Identify, explain and demonstrate strategies for learning skills in the workplace.
- Identify, explain and demonstrate strategies for teaching workplace skills.

### 2016 Red Seal Occupational Standard Reference:

3.02 Uses mentoring techniques.

### Suggested Hours:

6 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Describe the importance of individual experience.
2. Describe the shared responsibilities for workplace learning.
3. Identify different ways of learning and determine one's own learning preferences, and explain how these relate to learning new skills.
4. Describe the importance of different types of skills in the workplace.
5. Describe the importance of essential skills in the workplace.
6. Identify different ways of learning.
7. Identify different learning needs and strategies to meet learning needs.
  - i) learning disabilities
  - ii) learning preferences
  - iii) language proficiency
8. Identify strategies to assist in learning a skill.
  - i) understanding the basic principles of instruction

- ii) developing coaching skills
  - iii) being mature and patient
  - iv) providing feedback
9. Identify different roles played by a workplace mentor.
  10. Describe the steps involved in teaching skills.
  11. Explain the importance of identifying the point of a lesson.
  12. Identify how to choose the effective time to present a lesson.
  13. Explain the importance of linking the lessons.
  14. Identify the components of the skill (the context).
  15. Describe considerations in setting up opportunities for skill practice.
  16. Explain the importance of providing feedback.
  17. Identify techniques for giving effective feedback.
  18. Describe a skills assessment.
  19. Identify methods of assessing progress.
  20. Explain how to adjust a lesson to different situations.

Practical Objectives

N/A

## AST-405

## Diesel Fuel Delivery and Injection Systems

### Learning Outcomes:

- Demonstrate knowledge of diesel fuel delivery and injection systems, their components and operation.
- Demonstrate knowledge of the procedures used to diagnose and repair diesel fuel delivery and injection systems.

### 2016 Red Seal Occupational Standard Reference:

- 8.01 Diagnoses diesel fuel delivery and injection systems.
- 9.01 Repairs diesel fuel delivery and injection systems.

### Suggested Hours:

18 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Identify safety considerations pertaining to diesel fuel delivery systems.
  - i) high pressure fuel
  - ii) high injector voltage
  - iii) diesel fuel contamination (bacteria)
  
2. Identify types of diesel fuel delivery and injection systems, and describe their components and operation.
  - i) direct injection
  - ii) indirect injection
  - iii) mechanical
  - iv) hydraulic
  - v) electronic
  - vi) common rail systems
  
3. Explain hydraulic principles related to diesel fuel injection systems.
  - i) Pascal's Law

4. Identify types of tubing, hoses, gaskets, seals and sealants, and describe their applications.
5. Identify the types of starting aids, and describe their purpose and operation.
  - i) glow plugs
  - ii) intake heaters
  - iii) coolant heaters
  - iv) fuel heaters
6. Identify methods to test fuel quality, and describe their associated procedures.
7. Identify related systems, and describe their relationship to diesel fuel delivery and injection systems.
8. Identify types of diagnostic and repair tools and equipment, and describe their applications and procedures for use.
  - i) diagnostic
    - fuel pressure gauges
    - scan tools
    - vacuum gauges
    - digital multimeters (DMM)
    - injector test bench
    - fuel pressure gauges
  - ii) repair
    - fuel transfer
    - storage equipment
    - reprogramming equipment
9. Describe the procedures used to diagnose and repair diesel fuel delivery and injection systems.
  - i) verify concern
  - ii) perform sensory inspection
  - iii) retrieve diagnostic codes
  - iv) access service information
  - v) conduct tests and measurements
  - vi) isolate problem and identify root cause
10. Describe the procedures used to remove and reinstall diesel fuel delivery and injection system components.

11. Describe the procedures used to adjust, repair and/or replace diesel fuel delivery and injection system components.
12. Describe the procedures used to verify the repair.

Practical Objectives

N/A

## AST-410 Diesel Emission Control Systems

### Learning Outcomes:

- Demonstrate knowledge of diesel emission control systems, their components and operation.
- Demonstrate knowledge of the procedures used to diagnose and repair diesel emission control systems.

### 2016 Red Seal Occupational Standard Reference:

- 8.03 Diagnoses diesel emission control systems.
- 9.03 Repairs diesel emission control systems.

### Suggested Hours:

18 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Identify safety considerations related to diesel emission control systems.
  - i) corrosive diesel exhaust fluid
  - ii) high temperature
2. Identify diesel emissions and how they are formed.
  - i) carbon monoxide (CO)
  - ii) carbon dioxide (CO<sub>2</sub>)
  - iii) oxides of nitrogen (NO<sub>x</sub>)
  - iv) hydro carbon (HC)
  - v) oxygen (O<sub>2</sub>)
  - vi) sulfur dioxide (SO<sub>2</sub>)
  - vii) particulates
3. Identify warning systems and indicators.
  - i) check engine light
  - ii) air filter restriction indicator
  - iii) water in fuel light

- iv) driver information centre
4. Identify diesel emission control systems, and describe their components and operation.
- i) exhaust gas recirculation (EGR)
  - ii) evaporative emission control systems (EVAP)
  - iii) positive crankcase ventilation (PCV)
  - iv) variable cam-timing (VCT)
  - v) exhaust emissions
    - selective catalyst reduction (SCR)
    - diesel emission fluid (DEF)
    - diesel oxidation catalyst (DOC)
    - diesel particulate filter (DPF)
    - diesel regeneration process
5. Identify types of fasteners, tubing, hoses, gaskets, seals and sealants, and describe their applications.
6. Identify types of diagnostic and repair tools and equipment, and describe their applications and procedures for use.
- i) diagnostic
    - scan tools
    - manometer
    - smoke generators
    - leak detectors
    - digital multimeters (DMM)
    - opacity meter
    - refractometer
  - ii) repair
    - reprogramming equipment
7. Describe the procedures used to diagnose diesel emission control systems.
- i) verify concern
  - ii) perform sensory inspection
  - iii) retrieve diagnostic codes
  - iv) access service information
  - v) conduct tests and measurements
  - vi) isolate problem and identify root cause
8. Describe the procedures used to repair and service emission control systems.



9. Describe the procedures used to remove and reinstall diesel emission control system components.
10. Describe the procedures used to adjust, repair and/or replace diesel emission control system components.
11. Describe the procedures used to verify the repair.

Practical Objectives

N/A

## AST-415 Diesel Intake and Exhaust Systems

### Learning Outcomes:

- Demonstrate knowledge of diesel intake and exhaust systems, their components and operation.
- Demonstrate knowledge of the procedures used to diagnose and repair diesel intake and exhaust systems.

### 2016 Red Seal Occupational Standard Reference:

- 8.02 Diagnoses diesel intake/exhaust systems.
- 9.02 Repairs diesel intake/exhaust systems.

### Suggested Hours:

6 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Identify safety considerations related to diesel intake and exhaust systems.
  - i) extreme temperature
  - ii) exhaust fumes
2. Identify types of diesel intake and exhaust systems, and describe their components and operation.
  - i) turbocharged
  - ii) supercharged
3. Identify types and sources of intake and exhaust system problems.
  - i) leaks
  - ii) blockages
  - iii) noise
  - iv) vibration
4. Identify the types of fasteners, tubing, hoses, gaskets, seals and sealants, and describe their applications.

5. Identify types of diagnostic and repair tools and equipment, and describe their applications and procedures for use.
  - i) diagnostic
    - scan tools
    - vacuum gauges
    - exhaust back pressure gauges
    - smoke generators
    - pyrometers
  - ii) repair
    - reprogramming equipment
6. Describe the procedures used to diagnose and repair diesel intake and exhaust systems and their components.
  - i) verify concern
  - ii) perform sensory inspection
  - iii) retrieve diagnostic codes
  - iv) access service information
  - v) conduct tests and measurements
  - vi) isolate problem and identify root cause
7. Describe the procedures used to remove and reinstall diesel intake and exhaust system components.
8. Describe the procedures used to adjust, repair and/or replace diesel intake and exhaust system components.
9. Describe the procedures used to perform decarbonization of turbocharger systems.
10. Describe the procedures used to verify the repair.

Practical Objectives

N/A

## AST-420            Entertainment Systems

### Learning Outcomes:

- Demonstrate knowledge of entertainment systems their components and operation.
- Demonstrate knowledge of the procedures used to diagnose and repair entertainment systems.

### 2016 Red Seal Occupational Standard Reference:

14.04 Diagnoses entertainment systems.

15.04 Repairs entertainment systems.

### Suggested Hours:

15 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Identify safety considerations pertaining to entertainment systems.
  - i) accidental restraint system deployment
  - ii) electro static discharge
2. Identify types of entertainment systems, and describe their components of operation.
  - i) audio
  - ii) video
  - iii) wireless/handsfree/Bluetooth
3. Describe the relationship of the entertainment system to the vehicle networking system.
4. Identify types of diagnostic and repair tools and equipment, and describe their applications and procedures for use.
  - i) diagnostic
    - digital multimeters (DMM)

- scan tools
  - circuit testers
  - ii) repair
    - scan tools
    - specialized tools
5. Describe the procedures used to diagnose entertainment systems.
- i) verify concern
  - ii) perform sensory inspection
  - iii) retrieve diagnostic codes
  - iv) access service information
  - v) conduct tests and measurements
  - vi) isolate problem and identify root cause
6. Describe the procedures used to adjust, repair and/or replace entertainment systems.
7. Describe the procedures used to verify the repair.

Practical Objectives

N/A

## AST-425

## Instrumentation and Information Displays

### Learning Outcomes:

- Demonstrate knowledge of instrumentation and information displays, their components and operation.
- Demonstrate knowledge of the procedures used to diagnose and repair instrumentation and information displays.

### 2016 Red Seal Occupational Standard Reference:

14.06 Diagnoses instrumentation and information displays.

15.06 Repairs instrumentation and information displays.

### Suggested Hours:

15 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Identify safety considerations pertaining to instrumentation and information displays.
  - i) accidental restraint deployment
  - ii) electric static discharge
2. Identify jurisdictional requirements pertaining to instrumentation and information displays.
  - i) odometer servicing
3. Identify types of instrumentation displays, and describe their components and operation.
  - i) gauges
  - ii) warning indicators
  - iii) digital
  - iv) analogue

4. Identify types of information systems, and describe their purpose and operation.
  - i) back-up camera
  - ii) navigation systems
  - iii) driver information centre (DIC)
  - iv) heads-up display
  - v) adaptive cruise control
5. Describe the relationship of instrumentation and information displays to the vehicle networking system.
6. Identify types of diagnostic and repair tools and equipment, and describe their applications and procedures for use.
  - i) diagnostic
    - digital multimeters
    - scan tools
    - circuit testers
  - ii) repair
    - reprogramming equipment
7. Describe the procedures used to diagnose instrumentation and information displays.
  - i) verify concern
  - ii) perform sensory inspection
  - iii) retrieve diagnostic codes
  - iv) access service information
  - v) conduct tests and measurements
  - vi) isolate problem and identify root cause
8. Describe the procedures used to remove and reinstall instrumentation and information displays and their related components.
9. Describe the procedures used to adjust, repair and/or replace instrumentation and information displays and their related components.
10. Describe the procedures used to verify the repair.

Practical Objectives

N/A

## AST-430            Restraint Systems

### Learning Outcomes:

- Demonstrate knowledge of restraint systems, their components and operation.
- Demonstrate knowledge of the procedures used to diagnose and repair restraint systems.

### 2016 Red Seal Occupational Standard Reference:

20.01 Diagnoses restraint systems.

21.01 Repairs restraint systems.

### Suggested Hours:

24 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Identify safety considerations related to restraint systems.
  - i) handling
  - ii) storage
  - iii) disposal
  - iv) manufacturers' protocols
2. Identify jurisdictional requirements pertaining to restraint systems.
  - i) recycle and disposal
  - ii) repair
  - iii) motor vehicle inspection
3. Identify types of restraint systems, and describe their operation.
  - i) active
  - ii) passive
4. Identify restraint system components, and describe their purpose and operation.
  - i) seatbelts
  - ii) steering column (collapsible)



- iii) clock spring
  - iv) occupant classification system (OCS)
  - v) airbags (pyrotechnic and hybrid)
  - vi) crash sensor
  - vii) control modules
  - viii) safing sensor (accelerometer)
  - ix) buckles
  - x) retractors
  - xi) pre-tensioner systems
  - xii) seat belt track
  - xiii) seat belt covers
5. Identify types of restraint system monitoring and warning systems and describe their purpose.
- i) chimes
  - ii) lights
  - iii) driver information centre (DIC)
6. Identify types of diagnostic and repair tools and equipment, and describe their applications and procedures for use.
- i) diagnostic
    - scan tools
    - simulators
    - digital multimeters (DMM)
  - ii) repair
    - scan tools
7. Describe the procedures used to diagnose and repair restraint systems.
- i) verify concern
  - ii) perform sensory inspection
  - iii) retrieve diagnostic codes
  - iv) access service information
  - v) conduct tests and measurements
  - vi) isolate problem and identify root cause
8. Describe the procedures to remove and reinstall restraint systems.
9. Describe the procedures to adjust, repair and/or replace restraint systems.
10. Describe the procedures used to verify the repair.

Practical Objectives

N/A

## AST-435

## Automatic Transmissions and Transaxles

### Learning Outcomes:

- Demonstrate knowledge of automatic transmissions and transaxles, their components and operation.
- Demonstrate knowledge of the procedures used to diagnose and repair automatic transmissions and transaxles.

### 2016 Red Seal Occupational Standard Reference:

12.03 Diagnoses automatic transmissions/transaxles.

13.03 Repairs automatic transmissions/transaxles.

### Suggested Hours:

48 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Identify safety considerations pertaining to automatic transmissions and transaxles.
  - i) exposed rotating parts
  - ii) pinch points
  - iii) lifting and support procedures
2. Identify types of automatic transmissions and transaxles, and describe their components and operation.
3. Identify types of alternate transmissions and transaxle designs.
  - i) constant variable transmission (CVT)
  - ii) dual clutch transmission (DCT)
4. Explain hydraulic principles related to automatic transmissions and transaxles.
  - i) Pascal's law
5. Explain automatic transmissions and transaxles power flow.

6. Interpret electric and hydraulic schematics.
7. Describe gear ratios, their purpose and perform calculations.
8. Describe gear designs, and explain their purpose and operation.
  - i) simple planetary gear set
  - ii) compound planetary gear set
9. Identify types of lubricants, fasteners, tubing, hoses, gaskets, seals and sealants, and describe their applications.
10. Identify warning systems and indicators.
  - i) driver information centre (DIC)
  - ii) instrument panel cluster (IPC)
  - iii) check engine light
  - iv) transmission control module light
11. Identify types of diagnostic and repair tools and equipment, and describe their applications and procedures for use.
  - i) diagnostic
    - pressure gauges
    - scan tools
    - reprogramming equipment
    - measuring tools
  - ii) repair
    - reprogramming equipment
    - measuring tools
    - presses
    - pullers
    - lifting and support equipment
12. Describe the procedures used to diagnose automatic transmissions and transaxles.
  - i) verify concern
  - ii) perform sensory inspection
  - iii) retrieve diagnostic codes
  - iv) access service information
  - v) conduct tests and measurements
  - vi) isolate problem and identify root cause

13. Describe the procedures used to remove and reinstall automatic transmissions and transaxles.
14. Describe the procedures used to adjust, repair and/or replace automatic transmissions and transaxles and their related components.
15. Describe the procedures used to replace engine and driveline mounts.
16. Describe the procedures used to verify the repair.

Practical Objectives

N/A

## AST-440 Heating, Ventilation and Air Conditioning Systems

### Learning Outcomes:

- Demonstrate knowledge of air flow control systems, their components and operation.
- Demonstrate knowledge of the procedures used to diagnose and repair air flow control systems.
- Demonstrate knowledge of refrigerant systems, their components and operation.
- Demonstrate knowledge of the procedures used to diagnose and repair refrigerant systems.
- Demonstrate knowledge of heating systems, their components and operation.
- Demonstrate knowledge of the procedures used to diagnose and repair heating systems.

### 2016 Red Seal Occupational Standard Reference:

- 16.01 Diagnoses air flow control systems.
- 16.02 Diagnoses refrigerant systems.
- 16.03 Diagnoses heating systems.
- 17.01 Repairs air flow systems.
- 17.02 Repairs refrigerant systems.
- 17.03 Repairs heating systems.

### Suggested Hours:

30 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Identify safety considerations pertaining heating, ventilation, and air conditioning (HVAC) systems.
  - i) airborne contaminants
  - ii) mould spores
  - iii) handling of refrigerants
  - iv) pinch points

2. Identify jurisdictional requirements pertaining to refrigerants and lubricants.
  - i) handling and disposal
  - ii) storing and recycling
  - iii) heating
  - iv) Heating, Refrigeration and Air Conditioning Institute of Canada (HRAI) licensing and certification
3. Explain the principles of the refrigeration cycle.
4. Identify air flow control systems, their components and operation.
5. Identify types of refrigerants and lubricants, and describe their applications and procedures for use.
6. Identify refrigerant systems, and describe their components and operation.
  - i) orifice tube
  - ii) thermal expansion valve
7. Describe refrigerant systems specific to hybrid and electric vehicles.
8. Identify heating systems, and describe their components and operation.
9. Identify related systems, and describe their relationship to HVAC systems.
10. Identify types of fasteners, tubing, hoses, gaskets, seals and sealants, and describe their applications.
11. Identify types of diagnostic and repair tools and equipment, and describe their applications and procedures for use.
  - i) diagnostic
    - scan tool
    - manifold gauge set
    - charging station
    - pyrometer
  - ii) repair
    - reprogramming equipment
12. Describe the procedures used to identify, recover, recycle, evacuate and recharge refrigerant systems.

13. Describe the procedures used to diagnose HVAC systems.
  - i) verify concern
  - ii) perform sensory inspection
  - iii) retrieve diagnostic codes
  - iv) access service information
  - v) conduct tests and measurements
  - vi) isolate problem and identify root cause
14. Describe the procedures used to remove and reinstall air flow control system components.
15. Describe the procedures used to repair air flow control systems.
16. Describe the procedures used to remove and reinstall refrigerant system components.
17. Describe the procedures used to repair refrigerant systems.
18. Describe the procedures used to remove and reinstall heating system components.
19. Describe the procedures used to fill and bleed heating systems.
20. Describe the procedures used to repair heating systems.
21. Describe the procedures used to verify the repair.

Practical Objectives

1. Conduct a performance test of an air conditioning (A/C) system.



## AST-445            Hybrid and Electric Vehicle Systems

### Learning Outcomes:

- Demonstrate knowledge of safety protocols for hybrid and electric vehicle systems.
- Demonstrate knowledge of operations of hybrid and electric vehicle systems.
- Demonstrate knowledge of diagnosing hybrid and electric vehicle systems.
- Demonstrates knowledge of repairing hybrid vehicle systems.
- Demonstrate knowledge of repairing electric vehicle systems.

### 2016 Red Seal Occupational Standard Reference:

- 22.01 Implements specific safety protocols for hybrid and electric vehicles.
- 22.02 Diagnoses hybrid and electric vehicle systems.
- 23.01 Repairs hybrid vehicle systems.
- 23.02 Repairs electric vehicle systems.

### Suggested Hours:

30 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Identify safety protocols pertaining to hybrid and electric vehicle (EV) systems.
  - i) high pressure
  - ii) flammability
  - iii) high voltage
  - iv) extreme cold temperatures
  
2. Identify types of alternate fuels and describe their characteristics and properties.
  - i) flex
  - ii) hydrogen
  - iii) bio-diesel
  - iv) liquid propane gas (LPG)
  - v) compressed natural gas (CNG)

3. Identify types of hybrid and alternate fuel vehicles and their related components.
  - i) hybrid
  - ii) electric
  - iii) fuel cell
4. Identify the function of hybrid and EV systems.
5. Identify methods for diagnosing hybrid and EV systems.
6. Identify methods for repairing hybrid vehicle systems.
7. Identify methods for repairing EV systems.

Practical Objectives

N/A

## AST-450            Program Review

### Learning Outcomes:

- Demonstrate knowledge of the Red Seal Occupational Standard (RSOS) and its relationship to the Interprovincial Examination.
- Demonstrate knowledge of overall comprehension of the trade in preparation for the Interprovincial Examination.

### 2016 National Occupational Analysis:

Entire Red Seal Occupational Standard

### Suggested Hours:

30 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Define and explain terminology associated with an RSOS.
  - i) blocks
  - ii) tasks
  - iii) sub-tasks
  
2. Explain how an RSOS is developed and the link it has with the Interprovincial Red Seal Examination.
  - i) development
  - ii) validation
  - iii) block and task weighting
  - iv) examination breakdown (pie-chart)
  
3. Identify Red Seal products and describe their use for preparing for the Interprovincial Red Seal Examination.
  - i) Red Seal website
  - ii) examination preparation guide
  - iii) sample questions
  - iv) examination counselling sheets

4. Explain the relationship between the RSOS and the Atlantic Apprenticeship Curriculum Standard (AACS).
5. Review common occupational skills for the Automotive Service Technician trade as identified in the RSOS.
  - i) safety
  - ii) tools and equipment
  - iii) fasteners, tubing, hoses and fittings
  - iv) hoisting and lifting
  - v) communication
  - vi) technical information
  - vii) communication and mentoring techniques
  - viii) vehicle maintenance inspection
6. Review process to diagnose and repair engine and engine support systems for the Automotive Service Technician trade as identified in the RSOS.
  - i) engines
  - ii) cooling systems
  - iii) engine lubrication systems
  - iv) accessory drive systems
  - v) gasoline and diesel fuel delivery and injection systems
  - vi) gasoline ignition systems
  - vii) gasoline and diesel emission control systems
  - viii) gasoline and diesel intake and exhaust systems
7. Review process to diagnose and repair vehicle module communications systems for the Automotive Service Technician trade as identified in the RSOS.
  - i) vehicle networking systems
8. Review process to diagnose and repair drive line systems for the Automotive Service Technician trade as identified in the RSOS.
  - i) drive shafts and axles
  - ii) manual transmissions and transaxles
  - iii) automatic transmissions and transaxles
  - iv) clutches and flywheels
  - v) final drive assemblies
  - vi) transfer cases

9. Review process to diagnose and repair electrical and comfort control systems for the Automotive Service Technician trade as identified in the RSOS.
  - i) electrical and electronic principles
  - ii) starting systems
  - iii) charging systems
  - iv) lighting and wiper systems
  - v) electrical options and accessories
  - vi) entertainment systems
  - vii) instrumentation and information displays
  - viii) heating, ventilation and air conditioning systems
  
10. Review process to diagnose and repair steering and suspension, braking, control systems, tires, hubs and wheel bearings for the Automotive Service Technician trade as identified in the RSOS.
  - i) tires, wheels, hubs and wheel bearings
  - ii) conventional and electronically-controlled steering systems
  - iii) conventional and electronically-controlled suspension systems
  - iv) ABS and non-ABS braking systems
  
11. Review process to diagnose and repair restraint systems, body components, accessories and trim for the Automotive Service Technician trade as identified in the RSOS.
  
12. Review process to diagnose and repair hybrid and electric vehicles (EV) for the Automotive Service Technician trade as identified in the RSOS.

Practical Objectives

N/A

## Feedback and Revisions

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This AACCS will be amended periodically; comments or suggestions for improvements should be directed to:

**New Brunswick:**

Apprenticeship and Occupational  
Certification  
Post-Secondary Education, Training and  
Labour  
470 York St., Rm. 110, PO Box 6000  
Fredericton, NB E3B 5H1  
Tel: 506-453-2260  
Toll Free in NB: 1-855-453-2260  
[www.gnb.ca](http://www.gnb.ca)

**Prince Edward Island:**

Apprenticeship, Training and  
Certification  
Workforce and Advanced Learning  
176 Great George St., PO Box 2000  
Charlottetown, PE C1A 7N8  
Tel: 902-368-4460  
[www.apprenticeship.pe.ca](http://www.apprenticeship.pe.ca)

**Newfoundland and Labrador:**

Apprenticeship and Trades Certification  
Advanced Education, Skills and Labour  
Confederation Building, West Block  
Prince Philip Dr., PO Box 8700  
St. John's, NL A1B 4J6  
Toll Free: 877-771-3737  
[www.aes.gov.nl.ca/app](http://www.aes.gov.nl.ca/app)

**Nova Scotia:**

Nova Scotia Apprenticeship Agency  
1256 Barrington Street, 3rd Floor  
PO Box 578  
Halifax, NS B3J 2S9  
Tel: 902-424-5651  
Toll Free in NS: 1-800-494-5651  
[www.nsapprenticeship.ca](http://www.nsapprenticeship.ca)

Any comments or suggestions received will be reviewed and considered to determine the course of action required. If the changes are deemed to be minor, they will be held for implementation during the next review cycle. If immediate change is deemed appropriate and approved by the Atlantic Trade Advisory Committee, it will result in a revision to this version of the AACCS and will be detailed in the following section.

### Version Changes

| Revision Date | Section | Description of Change |
|---------------|---------|-----------------------|
|               |         |                       |
|               |         |                       |