PROGRAM OUTLINE

Automotive Service Technician 1, 2, 3, 4
PROGRAM OUTLINE

Automotive Service Technician 1
AUTOMOTIVE SERVICE TECHNICIAN 1

PROGRAM OUTLINE

MARCH 2015

BASED ON
NOA 2011

Developed by
Industry Training Authority
Province of British Columbia
# TABLE OF CONTENTS

**Section 1 INTRODUCTION** .......................................................... AST 1 - 4
- Foreword .......................................................................................... AST 1 - 5
- Acknowledgements ........................................................................... AST 1 - 6
- How to Use this Document .............................................................. AST 1 - 7

**Section 2 PROGRAM OVERVIEW** .............................................. AST 1 - 8
- Program Credentialing Model .......................................................... AST 1 - 9
- Occupational Analysis Chart ............................................................ AST 1 - 10
- Training Topics and Suggested Time Allocation ............................. AST 1 - 12

**Section 3 PROGRAM CONTENT** .................................................. AST 1 - 14
- Automotive Service Technician 1 .................................................... AST 1 - 15

**Section 4 TRAINING PROVIDER STANDARDS** .......................... AST 1 - 75
- Facility Requirements ........................................................................ AST 1 - 76
- Tools and Equipment .......................................................................... AST 1 - 77
- Reference Materials ............................................................................ AST 1 - 81
- Instructor Requirements ................................................................. AST 1 - 82

**Appendices** .................................................................................. AST 1 - 83
- APPENDIX A - Practical Assessment ................................................ AST 1 - 84
- APPENDIX B - Assessment Guidelines ............................................. AST 1 - 87
Section 1

INTRODUCTION

Automotive Service Technician 1
Foreword

This Program Outline is developed by the Automotive Training Standards Organization in accordance with the General Regulations made pursuant to the “Industry Training and Apprenticeship Act” of British Columbia. It reflects updated standards based on the 2011 Automotive Service Technician National Occupational Analysis. This Program Outline was prepared with the advice and assistance of an industry centered advisory committee in cooperation with the Automotive Training Standards Organization (ATSO). The Program Outline is intended as a guide for training providers, instructors, apprentices and their sponsors. This Program Outline is separated into four main sections which include:

**The Introduction** - Contains this Foreword; Acknowledgements that list all of the participants who were involved in the creation of this document; as well as, a section called “How to Use this Document” which provides an oversight on how this document can be used.

**The Program Overview** - Contains a Credentialing Model that shows the path and time requirements for the apprentice; an Occupational Analysis Chart that has the General Areas of Competency (GAC) and the individual competencies, and a Training Topics and Suggested Time Allocation which provides a suggested percentage of time for the theory and practical components for each GAC in this program.

**The Program Content** - Represents individual General Areas of Competencies, which are further separated into competencies defined by Learning Objectives, Learning Tasks and Content.

**The Training Provider Standards** - A guide on Automotive Service Technician teaching facilities which outlines the requirements needed to provide training for this program. The Facility Requirements section provides minimal requirements for facilities seeking designation and upgrade. The Tools and Equipment section lists the tools required to cover the competencies of this program. The Reference Material section is a collection of materials used for learning guides by the apprentice and instructors for the theory and at times the practical portion of the program. Finally, the Instructor Requirements section provides the level of knowledge and experience that each instructor must have to competently provide instruction in this program.

Practical instruction through demonstration and through student participation should be integrated within classroom sessions. Safe working practices, even though not always specified in each operation or topic, are an implied part of the program and should be stressed throughout the apprenticeship. It is the responsibility of employers to ensure safety training for the apprentices working on their work sites.

For more information please refer to the program profile document on the ITA website for the individual program.

**SAFETY ADVISORY**

Be advised that references to the WorkSafeBC safety regulations contained within these materials do not/may not reflect the most recent Occupational Health and Safety Regulation (the current Standards and Regulation in BC can be obtained on the following website: [http://www.worksafebc.com](http://www.worksafebc.com)). Please note that it is always the responsibility of any person using these materials to inform him/herself about the Occupational Health and Safety Regulation pertaining to his/her work.
Introduction

Acknowledgements

Industry Subject Matter Experts retained to review and update Program Outline content (February 2015):

Corey Bransfield  Instructor, Okanagan College
Dean Cadieux  Instructor, Vancouver Island University
Russ Hunter  Instructor, British Columbia Institute of Technology
Jeff Hoff  Manager, Napa Autopro, Prince George
Brian Yanda  Service Manager, Harris Mazda and Instructor, Malaspina College

Consultant/Facilitator (February 2015):

Dan McFaul  North Pacific Training & Performance Inc.
# How to Use this Document

This Program Outline has been developed for the use of individuals from several different audiences. The table below describes how each section can be used by each intended audience.

<table>
<thead>
<tr>
<th>Section</th>
<th>Training Providers</th>
<th>Employers/ Sponsors</th>
<th>Apprentices</th>
<th>Challengers</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Program Credentialing Model</strong></td>
<td>Communicate program length and structure, and all pathways to completion</td>
<td>Understand the length and structure of the program</td>
<td>Understand the length and structure of the program, and pathway to completion</td>
<td>Understand challenger pathway to Certificate of Qualification</td>
</tr>
<tr>
<td><strong>OAC</strong></td>
<td>Communicate the competencies that industry has defined as representing the scope of the occupation</td>
<td>Understand the competencies that an apprentice is expected to demonstrate in order to achieve certification</td>
<td>View the competencies they will achieve as a result of program completion</td>
<td>Understand the competencies they must demonstrate in order to challenge the program</td>
</tr>
<tr>
<td><strong>Training Topics and Suggested Time Allocation</strong></td>
<td>Shows proportionate representation of various GACs at each program level; should map to proportions of time spent on training, practical experience, and assessment</td>
<td>Understand the relative scope of various areas of the occupation, and areas in which the apprentice would require on-the-job experience</td>
<td>Understand the relative scope of various areas of the occupation, and areas in which on-the-job experience would be provided</td>
<td>Understand the relative weightings of various areas of the occupation on which assessment is based</td>
</tr>
<tr>
<td><strong>Program Content</strong></td>
<td>Defines the objectives, learning tasks, high level content that must be covered for each competency, as well as defining observable, measurable achievement criteria for objectives with a practical component</td>
<td>Identifies detailed program content and performance expectations for competencies with a practical component; may be used as a checklist prior to signing a recommendation for certification (RFC) for an apprentice</td>
<td>Provides detailed information on program content and performance expectations for demonstrating competency</td>
<td>Allows individual to check program content areas against their own knowledge and performance expectations against their own skill levels</td>
</tr>
<tr>
<td><strong>Training Provider Standards</strong></td>
<td>Defines the facility requirements, tools and equipment, reference materials (if any) and instructor requirements for the program</td>
<td>Identifies the tools and equipment an apprentice is expected to have access to; which are supplied by the training provider and which the student is expected to own</td>
<td>Provides information on the training facility, tools and equipment provided by the school and the student, reference materials they may be expected to acquire, and minimum qualification levels of program instructors</td>
<td>Identifies the tools and equipment a tradesperson is expected to be competent in using or operating; which may be used or provided in a practical assessment</td>
</tr>
</tbody>
</table>
Section 2

PROGRAM OVERVIEW

Automotive Service Technician 1
Program Overview

Program Credentialing Model

**Automotive Service Technician (AST 4)**
- Technical Training: 180 hours (6 weeks*)
- WBT: 6,000 hours
- ITA Standardized Written Exam
- Interprovincial Red Seal Exam

**Automotive Service Technician 3**
- Technical Training: 210 hours (7 weeks*)
- Accumulate work-based training hours
- ITA Certificate of Qualification Exam

**Automotive Service Technician 2**
- Technical Training: 180 hours (6 weeks*)
- Accumulate work-based training hours
- ITA Certificate of Qualification Exam

**Automotive Service Technician 1**
- Technical Training: 210 hours (7 weeks*)
- Accumulate work-based training hours
- ITA Certificate of Qualification Exam

**Automotive Service Technician Foundation Program**
- Technical Training: 30 weeks*

*Suggested duration based on 30-hour week

**CROSS-PROGRAM CREDITS**

- C of Q = Certificate of Qualification
- C of A = Certificate of Apprenticeship
- C of C = Certificate of Completion
- WBT = Work-Based Training

- C of Q = Certificate of Qualification
- C of A = Certificate of Apprenticeship
- C of C = Certificate of Completion
- WBT = Work-Based Training

- C of Q = Certificate of Qualification
- C of A = Certificate of Apprenticeship
- C of C = Certificate of Completion
- WBT = Work-Based Training

- C of Q = Certificate of Qualification
- C of A = Certificate of Apprenticeship
- C of C = Certificate of Completion
- WBT = Work-Based Training

- C of Q = Certificate of Qualification
- C of A = Certificate of Apprenticeship
- C of C = Certificate of Completion
- WBT = Work-Based Training

- C of Q = Certificate of Qualification
- C of A = Certificate of Apprenticeship
- C of C = Certificate of Completion
- WBT = Work-Based Training

*Individuals who are holders of both certificates will only be awarded credit for 1,500 WBT hours total
**Program Overview**

**Occupational Analysis Chart**

**AUTOMOTIVE SERVICE TECHNICIAN 1**

**Occupation Description:** "Automotive Service Technician 1" means a person who repairs, adjusts and replaces mechanical, electrical and electronic parts of automobiles and light trucks in a retail automotive business. “Retail automotive business” means a business whose primary mechanical repair work is repairing and adjusting vehicles whose gross vehicle weight is less than 5,500 kg.

<table>
<thead>
<tr>
<th>Workplace Safety</th>
<th>Describe WorkSafeBC regulations</th>
<th>Describe WHMIS regulations</th>
<th>Describe safe vehicle operation</th>
<th>Demonstrate safe work practices</th>
</tr>
</thead>
<tbody>
<tr>
<td>A A1</td>
<td></td>
<td>A2</td>
<td>A3</td>
<td>A4</td>
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<table>
<thead>
<tr>
<th>Employability Skills</th>
<th>Describe business practices</th>
<th>Demonstrate communication skills</th>
</tr>
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<tbody>
<tr>
<td>B B1</td>
<td></td>
<td>B2</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Tools and Equipment</th>
<th>Use hand tools</th>
<th>Use measuring instruments</th>
<th>Use power tools</th>
<th>Use fasteners</th>
<th>Use shop tools and equipment</th>
<th>Use reference resources</th>
</tr>
</thead>
<tbody>
<tr>
<td>C C1</td>
<td></td>
<td>C2</td>
<td>C3</td>
<td>C4</td>
<td>C5</td>
<td>C6</td>
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</table>

<table>
<thead>
<tr>
<th>General Automotive Maintenance</th>
<th>Select lubricants and fluids</th>
<th>Describe belts and hoses</th>
<th>Describe exterior lamps</th>
<th>Describe body trim and hardware</th>
<th>Service tires and wheels</th>
<th>Service non-friction bearings</th>
</tr>
</thead>
<tbody>
<tr>
<td>D D1</td>
<td></td>
<td>D2</td>
<td>D3</td>
<td>D4</td>
<td>D5</td>
<td>D6</td>
</tr>
</tbody>
</table>

Service spindles and hubs

D7
## Program Overview

### GENERAL AUTOMOTIVE PRACTICES
- **E1.** Describe diagnostic procedures
- **E2.** Demonstrate welding safety

### BASIC ELECTRICAL SYSTEMS
- **F1.** Describe principles of electricity
- **F2.** Use electrical test equipment
- **F3.** Service wiring systems
- **F4.** Service 12-volt batteries
- **F5.** Use scan tools

### BRAKE SYSTEMS
- **G1.** Service brake tubing and fittings
- **G2.** Service brake hydraulic systems
- **G3.** Service drum brake systems
- **G4.** Service disc brake systems
- **G5.** Inspect power assist systems
- **G6.** Service anti-lock brake systems

### STEERING SYSTEMS
- **H1.** Service steering gears
- **H2.** Service passenger restraint systems
- **H3.** Inspect steering columns
- **H4.** Service steering linkage
- **H5.** Service power steering systems
- **H6.** Perform wheel alignment

### SUSPENSION SYSTEMS
- **I1.** Describe frame types
- **I2.** Describe suspension geometry
- **I3.** Describe suspension components
- **I4.** Service suspension systems
- **I5.** Describe electronic suspension systems
## Training Topics and Suggested Time Allocation

### AUTOMOTIVE SERVICE TECHNICIAN 1

<table>
<thead>
<tr>
<th>Line</th>
<th>Category</th>
<th>% of Time Allocated to:</th>
<th>% of Time</th>
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<th>Practical</th>
<th>Total</th>
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<td></td>
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<td>Describe WHMIS regulations</td>
<td>√</td>
<td></td>
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</tr>
<tr>
<td>A3</td>
<td>Describe safe vehicle operation</td>
<td>√</td>
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<td>Describe business practices</td>
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<tr>
<td>B2</td>
<td>Demonstrate communication skills</td>
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<td>Line C</td>
<td>TOOLS AND EQUIPMENT</td>
<td>8%</td>
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<td>20%</td>
<td>80%</td>
<td>100%</td>
</tr>
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<td>Use hand tools</td>
<td>√</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>C2</td>
<td>Use measuring instruments</td>
<td>√</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C3</td>
<td>Use power tools</td>
<td>√</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C4</td>
<td>Use fasteners</td>
<td>√</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>C5</td>
<td>Use shop tools and equipment</td>
<td>√</td>
<td></td>
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<td>C6</td>
<td>Use reference resources</td>
<td>√</td>
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<td>Select lubricants and fluids</td>
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<td>D2</td>
<td>Describe belts and hoses</td>
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<td></td>
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</tr>
<tr>
<td>D3</td>
<td>Describe exterior lamps</td>
<td>√</td>
<td></td>
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<td>D4</td>
<td>Describe body trim and hardware</td>
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<tr>
<td>D5</td>
<td>Service tires and wheels</td>
<td>√</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D6</td>
<td>Service non-friction bearings</td>
<td>√</td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>D7</td>
<td>Service spindles and hubs</td>
<td>√</td>
<td></td>
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<tr>
<td>Line E</td>
<td>GENERAL AUTOMOTIVE PRACTICES</td>
<td>6%</td>
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<td>70%</td>
<td>100%</td>
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<tr>
<td>E1</td>
<td>Describe diagnostic procedures</td>
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<td>E2</td>
<td>Demonstrate welding safety</td>
<td>√</td>
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<td>Line F</td>
<td>BASIC ELECTRICAL SYSTEMS</td>
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<td>100%</td>
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<tr>
<td>F2</td>
<td>Use electrical test equipment</td>
<td>√</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F3</td>
<td>Service wiring systems</td>
<td>√</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>F4</td>
<td>Service 12-volt batteries</td>
<td>√</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F5</td>
<td>Use scan tools</td>
<td>√</td>
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</table>
Program Overview

% of Time Allocated to:

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<thead>
<tr>
<th>Time Distribution</th>
<th>Theory</th>
<th>Practical</th>
<th>Total</th>
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<tbody>
<tr>
<td>G1 G2 G3 G4 G5 G6</td>
<td>20%</td>
<td>80%</td>
<td>100%</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Line</th>
<th>Category</th>
<th>Time</th>
<th>Theory</th>
<th>Practical</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>G</td>
<td>BRAKE SYSTEMS</td>
<td>20%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>G1</td>
<td>Service brake tubing and fittings</td>
<td>√</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>G2</td>
<td>Service brake hydraulic systems</td>
<td>√</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>G3</td>
<td>Service drum brake systems</td>
<td>√</td>
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<td></td>
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<tr>
<td>G4</td>
<td>Service disc brake systems</td>
<td>√</td>
<td></td>
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<tr>
<td>G5</td>
<td>Inspect power assist systems</td>
<td>√</td>
<td></td>
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<td></td>
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<tr>
<td>G6</td>
<td>Service anti-lock brake systems</td>
<td>√</td>
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<tr>
<td>H</td>
<td>STEERING SYSTEMS</td>
<td>20%</td>
<td></td>
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</tr>
<tr>
<td>H1</td>
<td>Service steering gears</td>
<td>√</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H2</td>
<td>Service passenger restraint systems</td>
<td>√</td>
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<td></td>
</tr>
<tr>
<td>H3</td>
<td>Inspect steering columns</td>
<td>√</td>
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<tr>
<td>H4</td>
<td>Service steering linkage</td>
<td>√</td>
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<tr>
<td>H5</td>
<td>Service power steering systems</td>
<td>√</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H6</td>
<td>Perform wheel alignment</td>
<td>√</td>
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<td></td>
</tr>
<tr>
<td>I</td>
<td>SUSPENSION SYSTEMS</td>
<td>12%</td>
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<tr>
<td>I1</td>
<td>Describe frame types</td>
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<tr>
<td>I2</td>
<td>Describe suspension geometry</td>
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<td>I3</td>
<td>Describe suspension components</td>
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<td>I4</td>
<td>Service suspension systems</td>
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<tr>
<td>I5</td>
<td>Describe electronic suspension systems</td>
<td>√</td>
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</tr>
</tbody>
</table>

Total Percentage for Automotive Service Technician 1 (AST 1) 100%

The theory and practical weighting distribution for AST 1 is _42_ % theory and _58_ % practical
Section 3

PROGRAM CONTENT

Automotive Service Technician 1
Automotive Service Technician 1
**Program Content**

**LINE (GAC):** A WORKPLACE SAFETY

**Competency:** A1 Describe WorkSafeBC regulations

### Objectives

To be competent in this area, the individual must be able to:

- Describe the application and definition of the Worker’s Compensation Act outlined in the Occupational Health and Safety Regulations.
- Describe the application of the Occupational Health and Safety Regulations and how to find requirements applicable to the Automotive Service Technician’s workplace.

### LEARNING TASKS

1. Define terms used in the Worker’s Compensation Act
2. Describe the conditions under which compensation will be paid
3. State the general duties of employers, employees and others
4. State the Worker’s Compensation Act requirements for the reporting of accidents
5. State the “Core Requirements” of the Occupational Health and Safety Regulation
6. State the “General Hazard Requirements” of the Occupational Health and Safety Regulation

### CONTENT

- Definitions, section 1 of the Act
- Part 1, division 2 of the Act
- Part 2, division 3, sections 115-124 of the Act
- Part 1, division 5 sections 53 and 54 of the Act
- Definitions
- Application
- Rights and Responsibilities
  - Health and safety programs
  - Investigations and reports
  - Workplace inspections
  - Right to refuse work
- General conditions
  - Building and equipment safety
  - Emergency preparedness
  - Preventing violence
  - Working alone
  - Ergonomics
  - Illumination
  - Indoor air quality
  - Smoking and lunchrooms
- Chemical and biological substances
- Substance specific requirements
- Noise, vibration, radiation and temperature
- Personal protective clothing and equipment
- De-energize and lockout
- Tools, machinery and equipment
- Cranes and hoists
- Electrical safety
LINE (GAC): A WORKPLACE SAFETY
Competency: A2 Describe Workplace Hazardous Materials Information System (WHMIS) regulations

Objectives
To be competent in this area, the individual must be able to:

- Describe the purpose of the Workplace Hazardous Materials Information System (WHMIS) Regulations.
- Explain the contents of Material Safety Data Sheets (MSDS).
- Explain the contents of a WHMIS label.

LEARNING TASKS

1. State the legislation that requires suppliers of hazardous materials to provide MSDS and label products as a condition of sale and importation
   - Hazardous Product Act
   - Controlled Products Regulations
   - Ingredient Disclosure List
   - Hazardous Materials Information Review Act
   - Hazardous Materials Information Review Regulations

2. State the purpose of the Workplace Hazardous Materials Information System (WHMIS)
   - Protection of Canadian workers from the adverse effects of hazardous materials through the provision of relevant information while minimizing the economic impact on industry and the discretion of trade
     - Recognition of rights
     - Workers
     - Employers
     - Suppliers
     - Regulators

3. Describe the key elements of WHMIS
   - Material Safety Data Sheets (MSDS)
   - Labeling of containers of hazardous materials
   - Worker education programs

4. Describe the responsibilities of suppliers under WHMIS
   - Provide
     - MSDS
     - Labels

5. Describe the responsibilities of employers under WHMIS
   - Provide
     - MSDS
     - Labels
     - Workplace education programs
Program Content

LEARNING TASKS

6. State the “General Hazard Requirements” of the Occupational Health and Safety Regulation

- Hazardous ingredients
- Preparation information
- Product information
- Physical data
- Fire from explosion
- Reactivity data
- Toxicological properties
- Preventive measures
- First-aid measures

7. Identify symbols found on WHMIS labels and their meanings

- Compressed gases
- Flammable and combustible materials
- Oxidizing materials
- Poisonous and infection materials
  - Acute toxic effects
  - Other toxic effects
  - Bio-hazardous infections materials
- Corrosive materials
- Dangerously reactive materials

8. Demonstrate how WHMIS applies to hazardous materials used in the shop

- Use, storage and disposal of
  - Solvents
  - Caustic cleaners
  - Cleaning solutions
  - Gasoline
  - Diesel fuel
  - L.P.G.
  - C.N.G.
  - Asbestos
  - Battery acid
  - Refrigerants
  - Brake fluid
  - Antifreeze
  - Lubricants
  - Tracer dyes
Program Content

LINE (GAC): A WORKPLACE SAFETY
Competency: A3 Describe safe vehicle operation

Objectives
To be competent in this area, the individual must be able to:
• Perform a walk around inspection prior to operating a vehicle.
• Describe safe vehicle operation.

LEARNING TASKS

1. Describe licensing pre-requirements
   • Driver’s license requirements
   • Use of repair plates

2. Perform vehicle safety inspection requirements
   • Walk around
     o Tires and wheels
     o Area clear
     o Tools put away
   • Brakes
   • Steering
   • Final check on work completed

3. Describe shop driving safety rules
   • Right of ways
   • Etiquette

4. Discuss safe vehicle operation in a shop
   • Speed limit
   • Safety considerations
   • Parking on hoist
   • Road tests
## PROGRAM CONTENT

**LINE (GAC):** A  
**COMPETENCY:** A4  
**WORKPLACE SAFETY**

### Objectives
To be competent in this area, the individual must be able to:
- Apply personal safety measures.
- Identify and use shop emergency equipment.
- Prevent, identify and extinguish various classes of fires.

### LEARNING TASKS

<table>
<thead>
<tr>
<th>LEARNING TASKS</th>
<th>CONTENT</th>
</tr>
</thead>
</table>
| 1. Apply personal safety precautions and procedures | - Personal apparel  
  - Clothing  
  - Hair and beards  
  - Jewellery  
  - Personal protection  
  - Head  
  - Hands  
  - Lungs  
  - Eyes  
  - Ears  
  - Feet  
- Housekeeping  
- Ventilation systems  
- Clear head  
- Horseplay  
- Respect for others’ safety  
- Constant awareness of surroundings  
- Lifting |
| 2. Locate shop emergency equipment and means of exit | - Emergency shutoffs  
- Fire control systems  
- Eye-wash facilities  
- Emergency exits  
- First aid facilities  
- Emergency contact / phone numbers  
- Outside meeting place  
- Disaster meeting place |
## LEARNING TASKS

### 3. Describe the conditions and classifications of fires

**CONTENT**
- Conditions to support fire
  - Air
  - Fuel
  - Heat
- Classes of fires
  - A - combustibles
  - B - liquids
  - C - electrical
  - D – metals
- Symbols and colours

### 4. Describe fire safety precautions when working near, handling or storing flammables

**CONTENT**
- Fuels
  - Diesel
  - Gasoline
  - Propane
  - Natural gas
- Lubricants
- Oily rags
- Combustible metals
- Aerosols

### 5. Describe the considerations and procedures to extinguishing a fire

**CONTENT**
- Warning others and fire department
- Evacuation of others
- Fire containment and prevention of spreading
- Method of exit
- Training
- P.A.S.S.
  - Point
  - Aim
  - Squeeze
  - Sweep

## Achievement Criteria:
Given a written and/or a practical assessment on safe work practices the learner will be able to demonstrate knowledge of the trade by achieving 70% or better based on a summative total of Instructor assessment. For suggested practical assessments see Appendix A.
Program Content

LINE (GAC):  B EMPLOYABILITY SKILLS
Competency: B1 Describe business practices

Objectives
To be competent in this area, the individual must be able to:
- Describe effective methods of shop management and recycling programs.
- Describe the career path of an automotive technician.

LEARNING TASKS

1. Describe the hierarchy of control within an automotive repair shop
   - Owner
   - Service manager
   - Service advisor
   - Foreman
   - Journey person
   - Apprentice
   - Lube person
   - Detailer

2. Describe shop efficiency and shop management methods
   - Flat rate
   - Hourly
   - Salary
   - Personal productivity
   - Incentive programs

3. Describe recycling programs
   - Material costs
   - Minimizing waste
   - Most cost effective method
   - Disposal of hazardous materials
   - Billing requirements
**Program Content**

**LINE (GAC):** B  **EMPLOYABILITY SKILLS**

**Competency:** B2  Demonstrate communication skills

**Objectives**

To be competent in this area, the individual must be able to clearly demonstrate both oral and written communication using trade terminology.

<table>
<thead>
<tr>
<th>LEARNING TASKS</th>
<th>CONTENT</th>
</tr>
</thead>
</table>
| 1. Explain the importance of learning and using correct trade terminology | • Taking instructions  
• Giving instructions  
• Ordering parts  
• Explaining concepts  
• Locate required information by category and keyword searches |
| 2. Use and maintain record keeping | • Service/work order  
• Parts requisition  
• Purchase order  
• Technical reports  
• Time card  
• Vehicle maintenance log  
• Maintenance  
• Shop Maintenance schedule records  
• Cost estimating procedures |
| 3. Use written reports | • Service  
• Instructional  
• Technical |
LINE (GAC): C TOOLS AND EQUIPMENT
Competency: C1 Use hand tools

Objectives
To be competent in this area, the individual must be able to:
• Select the appropriate hand tool for a task.
• Demonstrate the safe use of automotive hand tools.

LEARNING TASKS

1. Describe various general hand tools
   • General
     o Purchase quality
     o Insurance
     o Orderly storage
     o Cleaning and maintenance
     o Used for intended purpose
     o Proximity to other people
     o Personal Protective Equipment (PPE)
     o Ventilation
     o Storage
     o Organizing
   • Wrenches
   • Socket wrenches
   • Screwdrivers
   • Pliers
   • Hammers

2. Describe special application hand tools
   • Punches
   • Chisels
   • Pry bars
   • Files
   • Saws
   • Vices and clamps
   • Scrapers and brushes
   • Pickup tools and mirrors
   • Pullers and slide hammers
   • Fender / seat covers

3. Use various general hand tools
   • Wrenches
   • Socket wrenches
   • Screwdrivers
   • Pliers
   • Hammers
Achievement Criteria:
Given a written and/or a practical assessment on hand tools the learner will be able to demonstrate knowledge of the trade by achieving 70% or better based on a summative total of Instructor assessment. For suggested practical assessments see Appendix A.
Program Content

**Line (GAC):** C  **TOOLS AND EQUIPMENT**

**Competency:** C2  **Use measuring instruments**

**Objectives**
To be competent in this area, the individual must be able to:
- Select appropriate measuring instruments.
- Use measuring instruments with required speed and accuracy.

**LEARNING TASKS**

1. Describe measuring tools
   - Steel rules
   - Tapes
   - Calipers and dividers
     - Inside
     - Outside
     - Dividers
     - Vernier
   - Micrometers
     - Inside
     - Outside
     - Depth
   - Feeler gauges
   - Dial indicator
   - Torque wrenches and torque sticks
   - Calibration schedule

2. Use measuring tools
   - Micrometer
   - Vernier caliper
   - Torque wrench
   - Dial indicator
   - Feeler gauge

**Achievement Criteria:**
Given a written and/or a practical assessment on measuring instruments the learner will be able to demonstrate knowledge of the trade by achieving 70% or better based on a summative total of Instructor assessment. For suggested practical assessments see Appendix A.
Program Content

LINE (GAC): C TOOLS AND EQUIPMENT
Competency: C3 Use power tools

Objectives

To be competent in this area, the individual must be able to select and demonstrate the safe use of power tools.

LEARNING TASKS

1. Describe power tools

CONTENT

• General
  - Purchase quality
  - Insurance
  - Orderly storage
  - Cleaning and maintenance
  - Used for intended purpose
  - Proximity to other people
  - Personal protective equipment
  - Ventilation
  - Storage

• Air tools
  - Maintenance and safety
  - Water filters
  - Lubricators
  - Pressure regulators
  - Air hose
  - Impact wrenches
  - Ratchets
  - Impact sockets and extensions
  - Air hammers
  - Blow guns
  - Drills
  - Rotary brushes
  - Grinders

• Electric tools
  - Grounded or double insulated
  - Maintenance and safety
  - Portable drills
  - Impact wrenches
  - Saws
  - Grinders
  - Work lights
  - Soldering irons and guns
  - Battery chargers
**Program Content**

<table>
<thead>
<tr>
<th>LEARNING TASKS</th>
<th>CONTENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Use air-powered tools</td>
<td>• Ratchet</td>
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<tr>
<td></td>
<td>• Gun</td>
</tr>
<tr>
<td></td>
<td>• Butterfly</td>
</tr>
<tr>
<td></td>
<td>• Air grinder</td>
</tr>
<tr>
<td></td>
<td>• Blow nozzle</td>
</tr>
<tr>
<td></td>
<td>• Drill</td>
</tr>
<tr>
<td></td>
<td>• Lubrication and care</td>
</tr>
<tr>
<td>3. Use electric-powered tools</td>
<td>• Hand drill</td>
</tr>
<tr>
<td></td>
<td>• Angle grinder</td>
</tr>
<tr>
<td></td>
<td>• Heat gun</td>
</tr>
<tr>
<td></td>
<td>• Work light</td>
</tr>
</tbody>
</table>

**Achievement Criteria:**
Given a written and/or a practical assessment on power tools the learner will be able to demonstrate knowledge of the trade by achieving 70% or better based on a summative total of Instructor assessment.
Program Content

LINE (GAC): C  TOOLS AND EQUIPMENT
Competency: C4  Use fasteners

Objectives
To be competent in this area, the individual must be able to:
• Select threaded and non-threaded fasteners.
• Remove and replace fasteners.
• Identify causes of fasteners failure.
• Remove broken fasteners and repair threads.

LEARNING TASKS

1. Describe threaded fastener terminology
   • Nominal sizes
   • Major and minor diameter
   • Head markings and tensile strength
   • Pitch and thread angle
   • Thread series
     o Unified National Coarse (UNC)
     o Unified National Fine (UNF)
     o National Pipe Thread (NPT)
     o Metric
   • Right and left hand threads
   • Classes or fits

2. Select and use threaded fasteners
   • Fastener materials
   • Bolts
   • Studs
   • Nuts
     o Hex
     o Castle
     o Slotted hex
     o Self-locking
     o Wing
     o Speed
   • Self tapping screws
   • Sheet metal screws
   • Set screws
### LEARNING TASKS

<table>
<thead>
<tr>
<th>Task</th>
<th>Content</th>
</tr>
</thead>
</table>
| 3. Torque fasteners to specifications | - Torque definition  
- Tension  
- Elastic limit  
- Distortion  
- Tensile strength  
- Torque wrenches  
  - Extensions  
- Torque to yield  
- Torque sequence  
- Torquing in steps |
| 4. Repair damaged threads | - Taps and wrenches  
  - Taper  
  - Plug  
  - Bottoming  
- Drill and tap size charts  
- Tapping internal threads  
- Broken tap removal  
- Dies and stocks  
- Cutting external threads  
- Thread chasers  
- Helicoils |
| 5. Select and use non-threaded fasteners | - Washers  
  - Flat  
  - Bevel  
  - Lock  
- Pins  
  - Cotter clevis  
  - Spring or roll  
  - Shear  
  - Taper  
  - Dowel  
- Keys  
  - Woodruff  
  - Tapered  
- Spines  
- Locking plates  
- Safety wire  
- Snap rings  
- Pop rivets |
## Program Content

### LEARNING TASKS

6. Describe removal of damaged nuts, bolts or studs

### CONTENT

- Shaping a protruding end for grip
- Broken stud extractors
- Nut splitters
- Chisels or punches
- Hacksaws
- Penetrating oil
- Heat

**Achievement Criteria:**
Given a written and/or a practical assessment on fasteners the learner will be able to demonstrate knowledge of the trade by achieving 70% or better based on a summative total of Instructor assessment.
## Program Content

**LINE (GAC):** C  
**TOOLS AND EQUIPMENT**

**Competency:** C5  
**Use shop tools and equipment**

### Objectives
To be competent in this area, the individual must be able to select, use and maintain shop tools and equipment.

### LEARNING TASKS

<table>
<thead>
<tr>
<th>LEARNING TASKS</th>
<th>CONTENT</th>
</tr>
</thead>
</table>
| 1. Discuss hoist safety procedures | • Capacities  
| | • Operation  
| | • Maintenance |
| 2. Select and use lifting and jacking equipment | • Mechanical jacks  
| | • Hydraulic jacks  
| | • Transmission jacks  
| | • Hoists  
| | • Stands  
| | • Portable cranes  
| | • Care and inspection of lifting and blocking equipment  
| | • Creepers  
| | • Determine vehicle lifting points  
| | • Required adapters and extensions |
| 3. Select and use presses and pullers | • Hydraulic presses and pullers  
| | • Arbor press  
| | • Slide hammers  
| | • Pullers  
| | • Bearing  
| | • Steering component |
| 4. Maintain air compressors | • Construction  
| | • Tank  
| | • Compressor  
| | • Motor / engine  
| | • Drives, belts, couplings  
| | • Water filter / traps  
| | • Lubricators  
| | • Pressure regulators  
| | • Piping and hoses |
### Program Content

<table>
<thead>
<tr>
<th>LEARNING TASKS</th>
<th>CONTENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>5. Select and use cleaning equipment</td>
<td>• Solvent and chemical cleaning facilities</td>
</tr>
<tr>
<td></td>
<td>• Pressure washers</td>
</tr>
<tr>
<td></td>
<td>• Steam cleaners</td>
</tr>
<tr>
<td></td>
<td>• Abrasive blast machines</td>
</tr>
<tr>
<td></td>
<td>• Brake cleaning equipment</td>
</tr>
<tr>
<td></td>
<td>• Flush machines</td>
</tr>
</tbody>
</table>

**Achievement Criteria:**
Given a written and/or a practical assessment on shop tools and equipment the learner will be able to demonstrate knowledge of the trade by achieving 70% or better based on a summative total of Instructor assessment. For suggested practical assessments see Appendix A.
Objectives
To be competent in this area, the individual must be able to locate information from a variety of sources necessary to maintain, troubleshoot and service vehicles.

LEARNING TASKS

1. Use service manuals to locate information
   - Maintenance
   - Repair procedures
   - Torque requirements
   - Technical service bulletins
   - Vacuum diagrams
   - Wiring diagrams
   - Calculate total estimated cost

2. Use parts manuals to locate information
   - Exploded diagrams
   - Part number
   - Part quantity
   - Superseding of parts
   - Labour estimating guides
   - Calculate total estimated cost

3. Use computers to locate information
   - Vehicle Identification Number (VIN)
   - Vehicle identification information
     - Paint codes
     - Gross vehicle weight
     - Options
   - Locate required information by category and keyword searches
   - Maintenance
   - Repair procedures
   - Torque requirements
   - Technical service bulletins
   - Vacuum diagrams
   - Wiring diagrams

Achievement Criteria:
Given a written and/or a practical assessment on reference resources the Learner will be able to demonstrate knowledge of the trade by achieving 70% or better based on a summative total of Instructor assessment. For suggested practical assessments see Appendix A.
Program Content

LINE (GAC): D

GENERAL AUTOMOTIVE MAINTENANCE

Competency: D1  Select lubricants and fluids

Objectives
To be competent in this area, the individual must be able to select the correct lubricants and fluids necessary to maintain and service automobiles.

LEARNING TASKS

1. Describe and identify lubricants

   • Synthetic or mineral
   • Additives
   • Greases
   • Engine oil
     - API classifications S/C
   • Aerosols

2. Describe and identify fluids

   • Replacement intervals
   • Antifreeze
     - Ethylene glycol
     - Propylene glycol based
     - Additives
   • Brake fluid
   • Power steering fluid
   • Windshield washer fluid

3. Describe and identify shop fluids

   • Engine shampoo
   • Floor cleaner
   • General cleaners
   • Solvent
   • Wheel acid
   • Car wash

4. Select lubricants and fluids for specific purposes

   • Greases
   • Antifreeze
   • Brake fluid
   • Power steering fluid
   • Windshield washer fluid
   • Shop fluids
Program Content

LINE (GAC): D GENERAL AUTOMOTIVE MAINTENANCE
Competency: D2 Describe belts and hoses

Objectives
To be competent in this area, the individual must be able to:
- Select the correct belts and hoses necessary to maintain and service automobiles.
- Describe how to inspect belts and hoses.

LEARNING TASKS

1. Describe and identify drive belts
   - Non metallic
     - V
     - Serpentine
     - Gilmer (toothed)
     - Stretch

2. Describe drive belt inspection and replacement
   - Diagnose wear and defects
   - Replacement
   - Tension adjustment
   - Pulley alignment
   - Bearings
   - Manufacturer’s specifications

3. Describe and identify hoses and clamps
   - Construction
     - Pressure
     - Vacuum
     - Reinforced
     - Material compatibility
       - Fuel
       - Oil
       - Coolant
       - Air / vacuum
       - Turbo
       - Brake
     - Flexibility
     - Molded
LINE (GAC): D GENERAL AUTOMOTIVE MAINTENANCE
Competency: D3 Describe exterior lamps

Objectives
To be competent in this area, the individual must be able to describe numerous types of exterior lamps.

LEARNING TASKS
1. Describe exterior lamps

CONTENT
- Headlamps
  - HID
  - Halogen
  - Sealed beam
- Driving lights
- Tail lights
- Brake lights
- Marker lights
- Turn signals
- License plate lights
- Reverse lights
- Directional headlamps
- Government regulations
Program Content

LINE (GAC): D  GENERAL AUTOMOTIVE MAINTENANCE
Competency: D4  Describe body trim and hardware

Objectives
To be competent in this area, the individual must be able to:
• Describe how to identify body trim and hardware.
• Describe the design and operation of body trim and hardware.

LEARNING TASKS
1. Describe components of body trim and hardware
   • Windows
   • Mirrors
   • Bumpers
   • Moldings and trim
   • Door hardware
   • Body panels
   • Windshield wiper systems
     o Blades
     o Linkage
   • Interior components
     o Seats
     o Carpet
     o Dashboard
     o Headliners

2. Describe the design and operation of body trim and hardware
   • Wind noise
     o Basic aerodynamics
   • Water leaks
   • Sealants
   • Noise, vibration and harshness (NVH)
   • Select and use diagnostic tools such as scan tool, DVOM, trim panel tools and hand tools
   • Interpret and analyze results of inspections and functional tests to determine required repair
   • Inspect latches, locks and movable glass for form, fit and function

3. Describe wind noise, rattles and water leaks
   • Diagnostic tools
     o Smoke machine
     o Chassis ears
     o Water hose
LEARNING TASKS

4. Describe interior and exterior components and trim repair

CONTENT

- Manufacturer’s safety precautions and protocols
  - Repair parts and materials
    - Adhesives
    - Gaskets
    - Sealants
    - Fastening devices
  - Tools
    - Trim tools
    - Hand tools
  - Removal
  - Replace
  - Adjust
  - Verify fit, function and performance
Program Content

LINE (GAC): D GENERAL AUTOMOTIVE MAINTENANCE
Competency: D5 Service tires and wheels

Objectives
To be competent in this area, the individual must be able to:
- Select and install tires and wheels.
- Inspect tires and wheels for defects or damage.
- Repair tires.

LEARNING TASKS
1. Describe radial tire construction
   - Materials
   - Belts
   - Side walls
   - Sizing
   - Department of Transportation (DOT) number
   - Ratings
     - Uniform Tire Quality Grading (UTQG)
     - Load
     - Pressure
   - Tread design
     - Directional
     - Asymmetric
     - Conventional
   - Space saver spare

2. Service tires
   - Inspection
     - Wear patterns
     - Damage
   - Rotation
   - Mounting
   - Balance
   - Road force
   - Nitrogen

3. Repair tires
   - Rubber Manufacturer’s Association guidelines
     - Plug patches
     - Plugs
     - Patches
   - Sealing tires
Program Content

**LEARNING TASKS**

4. Describe wheel construction

<table>
<thead>
<tr>
<th>CONTENT</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Alloy</em></td>
</tr>
<tr>
<td><em>Steel</em></td>
</tr>
<tr>
<td><em>Directional</em></td>
</tr>
<tr>
<td><em>Offset</em></td>
</tr>
<tr>
<td><em>Sizing</em></td>
</tr>
<tr>
<td><em>Bolt pattern</em></td>
</tr>
<tr>
<td><em>Types and operation of Tire Pressure Monitoring System (TPMS)</em></td>
</tr>
</tbody>
</table>

5. Inspect wheels

<table>
<thead>
<tr>
<th>CONTENT</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Curb damage</em></td>
</tr>
<tr>
<td><em>Run out</em></td>
</tr>
<tr>
<td><em>Fatigue damage</em></td>
</tr>
<tr>
<td><em>Lug nut torque</em></td>
</tr>
</tbody>
</table>

6. Describe Tire Pressure Monitoring System (TPMS)

<table>
<thead>
<tr>
<th>CONTENT</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Types</em></td>
</tr>
<tr>
<td><em>Direct</em></td>
</tr>
<tr>
<td><em>Indirect</em></td>
</tr>
<tr>
<td><em>Sensor replacement</em></td>
</tr>
<tr>
<td><em>System service</em></td>
</tr>
<tr>
<td><em>Reset</em></td>
</tr>
<tr>
<td><em>Reprogram</em></td>
</tr>
<tr>
<td><em>Calibrate</em></td>
</tr>
</tbody>
</table>

**Achievement Criteria:**

Given a written and/or a practical assessment on tires and wheels the learner will be able to demonstrate knowledge of the trade by achieving 70% or better based on a summative total of Instructor assessment. For suggested practical assessments see Appendix A.
Program Content

LINE (GAC): D GENERAL AUTOMOTIVE MAINTENANCE
Competency: D6 Service non-friction bearings

Objectives
To be competent in this area, the individual must be able to:
• Identify and select non-friction bearings.
• Remove, replace and adjust non-friction bearings.
• Identify causes of non-friction bearing failure.

LEARNING TASKS CONTENT
1. Describe non-friction bearings
   • Ball
   • Tapered roller
   • Needle
   • Dimensions
   • Load capacity

2. Service non-friction bearings
   • Removal and installation techniques
   • Lubrication / repacking
     ○ Cleaning
   • Adjustment
   • Selection
   • Axial and radial play

3. Identify non-friction bearing failure
   • Causes of failure
     ○ Contamination
       – Seal failure
       – Boot tear
     ○ Spalling
       – Fatigue
       – Surface
     ○ Seizing
     ○ Overheat
     ○ Electrolysis

Achievement Criteria:
Given a written and/or a practical assessment on non-friction bearings the learner will be able to demonstrate knowledge of the trade by achieving 70% or better based on a summative total of Instructor assessment. For suggested practical assessments see Appendix A.
Program Content

LINE (GAC): D GENERAL AUTOMOTIVE MAINTENANCE
Competency: D7 Service spindles and hubs

Objectives
To be competent in this area, the individual must be able to:
• Identify spindles, hubs and related components.
• Remove, replace and adjust spindles, hubs and related components.
• Diagnose spindle and hub problems.

LEARNING TASKS

1. Describe spindle and hub design and construction
   • Front-wheel drive
   • Rear-wheel drive
   • Construction materials
   • Bearing types
   • Disc or drum brake system

2. Inspect and service spindles and hubs
   • Lubrication
   • Inspection
     o Visual
     o Audible
     o Measurements
   • Bearing adjustment
   • Alignment
   • Removal and installation
   • Axial and radial play
   • Speedy sleeves

3. Diagnose spindle and hub problems
   • Test drive
   • Sound detection under load
   • Sound detection with tools
   • Hub heat

Achievement Criteria:
Given a written and/or a practical assessment on spindles and hubs the learner will be able to demonstrate knowledge of the trade by achieving 70% or better based on a summative total of Instructor assessment. For suggested practical assessments see Appendix A.
LINE (GAC): E GENERAL AUTOMOTIVE PRACTICES
Competency: E1 Describe diagnostic procedures

Objectives
To be competent in this area, the individual must be able to:
- Describe the importance of following a diagnostic process.
- Describe diagnostic procedures used for troubleshooting.

LEARNING TASKS

1. Describe the importance of following a diagnostic process
   - Productivity
   - Time management
   - Efficiency
   - Damage to components

2. Describe general diagnostic procedures
   - Understand system
   - Understand concern
     - Communicate with operator
     - Operational test
     - Visual inspection
   - Form all possible conclusions
   - Test conclusions
   - System component isolation
   - Pre/post test drive

3. Describe the importance of following manufacturer’s diagnostic procedures where available
   - Time saving
   - Warranty requirement
   - Diagnosis may not be possible any other way

4. Describe the importance of failure analysis
   - Repeat failure
   - Extended life
   - Cost
   - Customer satisfaction
Program Content

LINE (GAC): E GENERAL AUTOMOTIVE PRACTICES
Competency: E2 Demonstrate welding safety

Objectives
To be competent in this area, the individual must be able to:
- Demonstrate welding safety procedures.
- Demonstrate basic heating and cutting.
- Demonstrate MIG (GMAW) welding procedures.

<table>
<thead>
<tr>
<th>LEARNING TASKS</th>
<th>CONTENT</th>
</tr>
</thead>
</table>
| 1. Describe oxyacetylene components | • Safety  
• Gases  
• Cylinders, regulators and hoses  
• Torches |
| 2. Demonstrate oxyacetylene procedures | • Set up  
• Lighting  
• Heating and cutting  
• Shut down  
• Storage  
• Maintenance  
• Inspection  
• Heating  
• Cutting |
| 3. Describe MIG (GMAW) welding components and methods | • Gas Metal Arc Welding (GMAW)  
• Safety  
• Gas  
• Cylinders, regulator and hose  
• Ground terminal |
| 4. Demonstrate MIG (GMAW) welding procedures | • Set up  
• Weld  
• Shut down  
• Storage  
• Maintenance  
• Inspection |

Achievement Criteria:
Given a written and/or a practical assessment on welding safety the learner will be able to demonstrate knowledge of the trade by achieving 70% or better based on a summative total of Instructor assessment. For suggested practical assessments see Appendix A.
Program Content

LINE (GAC): F  BASIC ELECTRICAL SYSTEMS
Competency: F1  Describe principles of electricity

Objectives
To be competent in this area, the individual must be able to:
- Describe the principles of electricity and magnetism.
- Describe circuit components and their operation.
- Describe the use of electrical test equipment.

LEARNING TASKS

1. Define electrical terminology
   - Electrical quantities
     - Units and prefixes
     - Voltage
     - Current
     - Resistance
     - Power
   - Types of circuits
     - Series circuit
     - Parallel circuit
     - Series parallel circuit
   - Circuit terminology
     - Open circuit
     - Short circuit
     - Continuity
     - Ground
     - Power

2. Describe basic electrical concepts and circuits
   - Electron theory
   - Conventional theory
   - Basic circuit construction
     - Power source
     - Load
     - Control
     - Complete path
   - Electrical relationships
   - Ohm’s law
   - Watt’s law
   - Series circuits
   - Parallel circuits
   - Series parallel circuits
### LEARNING TASKS

<table>
<thead>
<tr>
<th>CONTENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>3. Describe electrical components</td>
</tr>
<tr>
<td>• Wire</td>
</tr>
<tr>
<td>• Devices</td>
</tr>
<tr>
<td>• Circuit protection devices</td>
</tr>
<tr>
<td>• Actuators</td>
</tr>
<tr>
<td>• Resistors</td>
</tr>
<tr>
<td>• Switches</td>
</tr>
<tr>
<td>• Conductors</td>
</tr>
<tr>
<td>• Insulators</td>
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<tr>
<td>• Relays</td>
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<tr>
<td>• Types of magnets</td>
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<td>o Permanent</td>
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<td>o Electromagnet</td>
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<th>CONTENT</th>
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<tbody>
<tr>
<td>4. Describe magnetic theory</td>
</tr>
<tr>
<td>• Properties of magnetic lines of force</td>
</tr>
<tr>
<td>• Terminology</td>
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<tr>
<td>o Flux</td>
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<tr>
<td>o Flux density</td>
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</tbody>
</table>

**Achievement Criteria:**

Given a written and/or a practical assessment on principles of electricity the learner will be able to demonstrate knowledge of the trade by achieving 70% or better based on a summative total of Instructor assessment.
Program Content

LINE (GAC): F  BASIC ELECTRICAL SYSTEMS
Competency: F2  Use electrical test equipment

Objectives
To be competent in this area, the individual must be able to:
- Describe the types of electrical test equipment.
- Select and use electrical test equipment to measure electrical signals.

LEARNING TASKS

1. Describe the different types of electrical test equipment
   - Digital Volt Ohm Meter (DVOM)
   - Test light
   - Logic probe
   - High impedance test light

2. Use DVOM to test electrical circuits
   - Measure electrical signals
     o Voltage
     o Amperage
     o Resistance
   - Auto range feature
   - Units of measurement
   - Sample rate
   - Internal fuse
   - Testing
     o Voltage drop

Achievement Criteria:
Given a written and/or a practical assessment on electrical test equipment the learner will be able to demonstrate knowledge of the trade by achieving 70% or better based on a summative total of Instructor assessment.
LINE (GAC): F BASIC ELECTRICAL SYSTEMS
Competency: F3 Service wiring systems

Objectives
To be competent in this area, the individual must be able to:
• Interpret wiring diagrams and symbols.
• Diagnose wiring harness problems.
• Repair or remove and replace wiring harnesses.

LEARNING TASKS CONTENT
1. Describe wiring harnesses
   • Purpose
   • Routing
   • Support
   • Wire
     o Gauge
     o Identification
     o Composition
     o Connectors
     o Twisted pairs

2. Interpret electrical wiring diagrams
   • Symbols
   • Conventions
   • Abbreviations
   • Power flow
   • Connectors

3. Inspect and repair wiring harnesses
   • Visual
   • Connectors
   • Soldering
   • Crimping
   • Insulation
   • Supports
   • Removal and installation
   • Testing

Achievement Criteria:
Given a written and/or a practical assessment on wiring systems the learner will be able to demonstrate knowledge of the trade by achieving 70% or better based on a summative total of Instructor assessment. For suggested practical assessments see Appendix A.
Program Content

LINE (GAC): F  BASIC ELECTRICAL SYSTEMS
Competency: F4  Service 12-volt batteries

Objectives
To be competent in this area, the individual must be able to:
- Describe battery design and operation.
- Select, test, and maintain batteries.
- Remove and replace batteries.
- Diagnose causes of battery failure.

LEARNING TASKS

1. Describe safety considerations when working with automotive batteries
   - Hydrogen gassing
   - Acid
   - Personal protective equipment
   - Frozen batteries
   - Handling
   - Environmental considerations

2. Describe the design and construction of a lead acid battery
   - Plates
   - Plate straps
   - Separators
   - Electrolyte
   - Case
   - Terminals

3. Describe the chemical action that takes place in a lead acid battery during charging and discharging
   - Charging cycle
   - Discharging cycle

4. Describe the various types of automotive batteries
   - Low maintenance
   - Maintenance free
   - Deep cycle
   - Absorbed glass mat
   - Gel cell

5. Select automotive batteries
   - Battery rating methods
   - Physical dimensions
     - Terminal design
LEARNING TASKS

6. Perform battery tests
   - Open circuit
   - Load test
   - Conductance
   - Leakage test
   - Hydrometer test
   - Analysing test results
   - Parasitic draw

7. Perform battery charging
   - Safety
   - Battery type
   - Battery size
   - Charge rate

Achievement Criteria:
Given a written and/or a practical assessment on 12 volt batteries the learner will be able to demonstrate knowledge of the trade by achieving 70% or better based on a summative total of Instructor assessment. For suggested practical assessments see Appendix A.
LINE (GAC):  F  BASIC ELECTRICAL SYSTEMS
Competency:  F5  Use scan tools

Objectives
To be competent in this area, the individual must be able to:
• Use a scan tool to retrieve diagnostic fault codes from a vehicle computer.
• Use a scan tool to access vehicle data stream information from a vehicle computer.
• Use a scan tool to clear diagnostic fault codes from a vehicle computer.

LEARNING TASKS

1. Describe scan tool types
   • Generic
   • Manufacturer specific
   • Types of fault codes
     o Hard
     o Soft
     o Pending
     o Intermittent
     o History

2. Describe On-Board Diagnostics (OBD)
   • Generic
   • Manufacturer specific
   • OBD I
   • OBD II

3. Describe data stream information
   • Purpose
   • Fault tracing application
   • Sample rate
   • Frozen values
   • Movies
   • Snap shots

4. Use scan tool to access computer data
   • Code retrieval
   • Access data stream information
   • Clear fault codes

Achievement Criteria:
Given a written and/or a practical assessment on scan tools the learner will be able to demonstrate knowledge of the trade by achieving 70% or better based on a summative total of Instructor assessment. For suggested practical assessments see Appendix A.
Line (GAC): G BRAKE SYSTEMS
Competency: G1 Service brake tubing and fittings

Objectives
To be competent in this area, the individual must be able to:
• Select brake tubing and fittings.
• Cut, bend and flare brake tubing.

Learning Tasks
1. Select and use brake tubing and fittings

<table>
<thead>
<tr>
<th>CONTENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tubing</td>
</tr>
<tr>
<td>• Sizing</td>
</tr>
<tr>
<td>• Material</td>
</tr>
<tr>
<td>• Application</td>
</tr>
<tr>
<td>Fittings</td>
</tr>
<tr>
<td>Flaring</td>
</tr>
<tr>
<td>SAE</td>
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<tr>
<td>ISO</td>
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<td>Cutting</td>
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<td>Reaming</td>
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<td>Bending</td>
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</tbody>
</table>

Achievement Criteria:
Given a written and/or a practical assessment on brake tubing and fitting the learner will be able to demonstrate knowledge of the trade by achieving 70% or better based on a summative total of Instructor assessment. For suggested practical assessments see Appendix A.
Program Content

LINE (GAC): G BRAKE SYSTEMS
Competency: G2 Service brake hydraulic systems

Objectives
To be competent in this area, the individual must be able to:
- Identify brake hydraulic system components.
- Remove and replace brake hydraulic system components.
- Diagnose causes of brake hydraulic system failure.

LEARNING TASKS CONTENT

1. Describe hydraulic principles
   - Pascal's law
     - Force
     - Pressure
     - Area

2. Describe components of the brake hydraulic system
   - Master cylinder
   - Wheel cylinder
   - Calipers
   - Valves
     - Residual pressure
     - Metering
     - Proportioning
     - Combination
   - Switches
     - Reservoir fluid level
     - Pressure differential
   - Hoses
   - Hardware
   - Fluid

3. Service the brake hydraulic system
   - Inspect
   - Diagnose
   - Repair / replace
     - Master cylinder
     - Wheel cylinder
     - Calipers
     - Valves
     - Hoses
     - Tubing
   - Flush
   - Bleed
     - Pressure
     - Manual
     - Gravity
Program Content

**Achievement Criteria:**
Given a written and/or a practical assessment on brake hydraulic systems the learner will be able to demonstrate knowledge of the trade by achieving 70% or better based on a summative total of Instructor assessment. For suggested practical assessments see Appendix A.
LINE (GAC): G BRAKE SYSTEMS
Competency: G3 Service drum brake systems

Objectives
To be competent in this area, the individual must be able to:
- Describe the principles of friction.
- Identify drum brake system components.
- Remove, replace and adjust drum brake system components.
- Diagnose causes of drum brake system failure.

<table>
<thead>
<tr>
<th>LEARNING TASKS</th>
<th>CONTENT</th>
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<tbody>
<tr>
<td>1. Describe friction principle</td>
<td>• Coefficient of friction</td>
</tr>
<tr>
<td></td>
<td>• Factors affecting friction</td>
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<tr>
<td></td>
<td>o Material composition</td>
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<tr>
<td></td>
<td>o Surface area</td>
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<td></td>
<td>o Heat</td>
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<tr>
<td></td>
<td>o Applied pressure</td>
</tr>
<tr>
<td>2. Describe drum brake components</td>
<td>• Drum</td>
</tr>
<tr>
<td></td>
<td>o Fixed</td>
</tr>
<tr>
<td></td>
<td>o Floating</td>
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<tr>
<td></td>
<td>• Shoes</td>
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<td>• Springs</td>
</tr>
<tr>
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<td>• Attaching hardware</td>
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<td>• Backing plate</td>
</tr>
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<td>• Adjusters</td>
</tr>
<tr>
<td></td>
<td>• Parking brake mechanism</td>
</tr>
<tr>
<td></td>
<td>• Wheel cylinder</td>
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<tr>
<td>3. Describe drum brake design and operation</td>
<td>• Non-energizing and self-energizing</td>
</tr>
<tr>
<td></td>
<td>o Servo-action</td>
</tr>
<tr>
<td></td>
<td>• Parking</td>
</tr>
<tr>
<td>4. Inspect and service drum brakes</td>
<td>• Inspection</td>
</tr>
<tr>
<td></td>
<td>o Measurement</td>
</tr>
<tr>
<td></td>
<td>o Fluid leakage</td>
</tr>
<tr>
<td></td>
<td>o Wheel seals</td>
</tr>
<tr>
<td></td>
<td>o Hardware condition</td>
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<tr>
<td></td>
<td>o Parking brake cable and mechanism</td>
</tr>
<tr>
<td></td>
<td>• Shoe replacement / adjustment</td>
</tr>
<tr>
<td></td>
<td>• Drum service</td>
</tr>
<tr>
<td></td>
<td>o Machining</td>
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<tr>
<td></td>
<td>o Cleaning</td>
</tr>
<tr>
<td></td>
<td>• Parking brake adjustment</td>
</tr>
<tr>
<td></td>
<td>• Road test</td>
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</tbody>
</table>
Achievement Criteria: Given a written and/or a practical assessment on drum brake systems the learner will be able to demonstrate knowledge of the trade by achieving 70% or better based on a summative total of Instructor assessment. For suggested practical assessments see Appendix A.
LINE (GAC): G  BRAKE SYSTEMS

Competency: G4  Service disc brake systems

Objectives
To be competent in this area, the individual must be able to:
• Describe friction principle.
• Identify disc brake system components.
• Remove, replace and adjust disc brake system components.
• Diagnose causes of disc brake system failure.

LEARNING TASKS

1. Describe friction principle
   • Coefficient of friction
   • Factors affecting friction
     o Material composition
     o Surface area
     o Heat
     o Applied pressure

2. Describe disc brake components
   • Rotor
     o Fixed
     o Floating
   • Caliper
   • Pistons
   • Pads
   • Parking brake mechanism

3. Describe disc brake design and operation
   • Rotor
     o Solid
     o Vented
     o Cross drilled
     o Grooved
   • Caliper
     o Fixed
     o Floating
   • Parking brake
     o Drum in hat
     o Caliper style
   • Pads
LEARNING TASKS

4. Inspect and repair disc brakes

CONTENT

- Inspection
  - Measurement
  - Fluid leakage
  - Wheel seals
  - Hardware condition
  - Parking brake cable and mechanism
- Pad replacement
- Rotor service
  - Machining
    - On car
    - Off car
- Parking brake adjustment
- Road test

Achievement Criteria:
Given a written and/or a practical assessment on disc brake systems the learner will be able to demonstrate knowledge of the trade by achieving 70% or better based on a summative total of Instructor assessment. For suggested practical assessments see Appendix A.
LINE (GAC): G  BRAKE SYSTEMS
Competency: G5  Inspect power assist systems

Objectives
To be competent in this area, the individual must be able to:
• Identify power assist system components.
• Diagnose causes of power assist system failure.

LEARNING TASKS

1. Describe the components of power assist systems
   • Hydro boost
     ○ Power steering fluid
     ○ Brake fluid
   • Vacuum booster layout
   • Common control valve designs
   • Vacuum pumps
     ○ Electrical
     ○ Mechanical

2. Describe the design and operation of power assist systems
   • Vacuum booster layout
   • Common control valve designs
   • Vacuum pumps
     ○ Electrical
     ○ Mechanical
   • Emergency brake assist

3. Inspect power assist systems
   • Test vacuum circuit
   • Test power assist function

Achievement Criteria:
Given a written and/or a practical assessment on power assist systems the learner will be able to demonstrate knowledge of the trade by achieving 70% or better based on a summative total of Instructor assessment. For suggested practical assessments see Appendix A.
**Program Content**

**LINE (GAC): G BRAKE SYSTEMS**

**Competency: G6 Service anti-lock brake systems**

**Objectives**
To be competent in this area, the individual must be able to:
- Identify anti-lock brake system (ABS) components.
- Remove, replace and adjust anti-lock brake system components.
- Diagnose causes of power assist system failure.

**LEARNING TASKS**

<table>
<thead>
<tr>
<th>TASK</th>
<th>CONTENT</th>
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</table>
| 1. Describe the benefits and limitations of anti-lock braking systems | - Improved steering control while braking  
- Improved braking in most situations  
- Foundation for traction control  
- Foundation for dynamic stability control |
| 2. Describe the design and construction of anti-lock braking systems | - Two wheel vs. four wheel  
- Three / four channel  
- Hydraulic  
  - Pump  
  - Valves  
  - Accumulators  
  - Fluid  
- Electrical  
  - Sensors  
  - Computer  
  - Controller  
- Electronic brake force distribution |
| 3. Inspect and repair anti-lock braking systems | - Safety  
- Diagnostic fault codes  
- Bleeding procedures  
- System self check  
- Pinpoint testing  
- Speed sensor signal testing  
- Road testing  
- Component replacement  
- Diagnostic flow chart |

**Achievement Criteria:**
Given a written and/or a practical assessment on anti-lock brake systems the learner will be able to demonstrate knowledge of the trade by achieving 70% or better based on a summative total of Instructor assessment. For suggested practical assessments see Appendix A.
**LINE (GAC):**  H  STEERING SYSTEMS

**Competency:**  H1  Service steering gears

### Objectives

To be competent in this area, the individual must be able to:

- Identify steering gear components.
- Remove, replace and adjust steering gears.
- Diagnose causes of steering gear failure.
- Describe the components of the rack and pinion steering gears.
- Describe the design and operation of the rack and pinion steering gears.

### LEARNING TASKS

<table>
<thead>
<tr>
<th>Learning Task</th>
<th>Content</th>
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</table>
| 1. Describe the components of conventional steering gears | Recirculating ball steering box design  
  - Ball nut assembly  
  - Sector shaft  
  - Thrust bearings  
  - Seals  
  - Lubrication |
| 2. Describe the design and construction of conventional steering gears | Steering box ratio  
  - Materials  
  - Mounting |
| 3. Service conventional steering gears | Seal leakage  
  - Shaft wear  
  - Gear tooth wear  
  - Pitman arm spline wear or damage  
  - Sequence of adjustments  
    - Bearing preload  
    - Gear tooth lash  
    - Over centre adjustment |
| 4. Describe the components of rack and pinion steering gears | Housing and seals  
  - Rack and pinion  
  - Bearings  
  - Tie rod ends  
  - Bellows (dust boots) |
| 5. Describe the design and operation of rack and pinion steering | Steering gear ratio  
  - Materials  
  - Lubrication  
  - Mounting |
LEARNING TASKS

6. Service rack and pinion steering gears
   - Tie rod ends
   - Pinion shaft and bearing wear
   - Leaks
   - Mounting
   - Condition of bellows

7. Describe the design and operation of electronic steering systems
   - Electronic rack & pinion types
     - Column
     - Rack
     - Pinion
   - Sensor types
     - Steering wheel
     - Torque
   - Service procedures
     - Zeroing
     - Relearning

Achievement Criteria:
Given a written and/or a practical assessment on steering gears the learner will be able to demonstrate knowledge of the trade by achieving 70% or better based on a summative total of Instructor assessment. For suggested practical assessments see Appendix A.
Program Content

LINE (GAC):        H  STEERING SYSTEMS
Competency:        H2  Service passenger restraint systems

Objectives
To be competent in this area, the individual must be able to:
- Identify passenger restraint system components.
- Safely disarm and rearm passenger restraint systems.
- Remove and replace passenger restraint system components.

LEARNING TASKS

1. Describe passenger restraint systems
   - Safety
   - Principles of operation
   - Passive
     - Airbags
     - Shoulder belts
     - Whiplash protection
     - Side impact
     - Passenger detection
     - Crash avoidance
   - Active
     - Pyrotechnical seat belts
   - Visual inspection
   - Tampering
   - Passenger system disabling

2. Remove and replace passenger restraint system components
   - Disarm
   - Transferring precautions
   - Connections
   - Clock spring indexing
   - Storing
   - Rearming

Achievement Criteria:
Given a written and/or a practical assessment on passenger restraint systems the learner will be able to demonstrate knowledge of the trade by achieving 70% or better based on a summative total of Instructor assessment. For suggested practical assessments see Appendix A.
Program Content

LINE (GAC): H STEERING SYSTEMS
Competency: H3 Inspect steering columns

Objectives
To be competent in this area, the individual must be able to:
- Identify steering columns and related components.
- Describe the removal, replacement and adjustment of steering columns and related components.
- Diagnose causes of steering column and related component failure.

LEARNING TASKS

1. Describe the components of steering columns
   - Mounting
   - Bearings
   - Coupling assemblies
   - Collapsing function
   - Dust seals
   - Steering wheel security systems
   - Master splines for steering wheel
   - Noise suppression and sealing
   - Airbag precautions and procedures

2. Describe the design and construction of steering columns
   - Tilting and telescoping function
   - Collapsing function
   - Noise transmission
   - Vibration suppression
   - Supplementary Restraint Systems (SRS)
   - Shift linkage

3. Inspect steering columns
   - SRS safety awareness
   - Steering wheel alignment
   - Alignment for noise and vibration
   - Electrical connections
   - Mounting procedures and hardware
   - Shift linkage adjustment
   - Collapsing feature

Achievement Criteria:
Given a written and/or a practical assessment on steering columns the learner will be able to demonstrate knowledge of the trade by achieving 70% or better based on a summative total of Instructor assessment. For suggested practical assessments see Appendix A.
LINE (GAC): H STEERING SYSTEMS
Competency: H4 Service steering linkage

Objectives
To be competent in this area, the individual must be able to:
- Identify steering linkage components.
- Remove, replace and adjust steering linkage components.
- Diagnose steering linkage wear or damage.

LEARNING TASKS

1. Describe the components of steering linkage
   - Tie rod ends and sockets
   - Pitman arm
   - Idler arm
   - Centre (drag) link
     - Steering damper
   - Associated hardware

2. Describe the design and construction of steering linkage
   - Parallelogram linkage
   - Haltenberger
   - Cross steer

3. Inspect and repair steering linkage
   - Steering wheel freeplay
   - Dry park test
   - Linkage
   - Wear
   - Lubrication and boot condition
   - Sleeve clamp alignment
   - Torque of hardware
   - Cotter pins and castellated nuts

Achievement Criteria:
Given a written and/or a practical assessment on steering linkage the learner will be able to demonstrate knowledge of the trade by achieving 70% or better based on a summative total of Instructor assessment. For suggested practical assessments see Appendix A.
LINE (GAC):     H      STEERING SYSTEMS
Competency:     H5      Service power steering systems

Objectives
To be competent in this area, the individual must be able to:
• Identify power steering system components.
• Remove, replace and adjust power steering system components.
• Diagnose causes of power steering system problems.
• Describe the operation of four wheel steering systems.

LEARNING TASKS
1. Describe the components of a power steering system
   • Pump
   • Associated hoses
   • Spool valve
   • Power cylinder
   • Fluid types
   • Electric supply to steering gear

2. Describe the design and construction of a power steering system
   • Pump pressure and flow regulation
   • Spool valve operation
   • Power cylinder operation
   • Speed control and variable assist
   • Electric power steering

3. Diagnose causes of power steering system problems
   • Fluid level and condition
   • Leaks
     o Internal
     o External
   • Pump replacement
   • Pump mounting and belt adjustment
   • Pressure and volume testing
   • Bleeding
   • Road test
   • Turning effort test
   • Select and use diagnostic tools
     o Scan tool
     o Pressure and flow gauge
     o Measuring tools
Achievement Criteria:
Given a written and/or a practical assessment on power steering systems the learner will be able to demonstrate knowledge of the trade by achieving 70% or better based on a summative total of Instructor assessment. For suggested practical assessments see Appendix A.
LINE (GAC): H  STEERING SYSTEMS
Competency: H6  Perform wheel alignment

Objectives
To be competent in this area, the individual must be able to:
• Describe wheel alignment angles.
• Measure and adjust wheel alignment angles.
• Diagnose wheel alignment problems.

LEARNING TASKS

1. Describe steering geometry
   • Caster
   • Camber
   • Toe
   • Steering axis inclination
   • Scrub radius
   • Toe out on turns
   • Thrust angle
   • Two-wheel versus four-wheel alignment
   • Collision damage

2. Describe methods of adjusting steering geometry
   • Pre-checks
   • Factory adjustment methods
   • Aftermarket adjustment methods

3. Adjust wheel alignment
   • Four-wheel alignment procedures
   • Rear wheels
     • Thurst angle
     • Camber
     • Toe
   • Front wheels
     • Caster
     • Camber
     • Toe
   • Check toe-out on turns
   • Check steering axis inclination
   • Check steering wheel centre
   • Use Scanner for wheel center

Achievement Criteria:
Given a written and/or a practical assessment on wheel alignments the learner will be able to demonstrate knowledge of the trade by achieving 70% or better based on a summative total of Instructor assessment. For suggested practical assessments see Appendix A.
Program Content

LINE (GAC): I SUSPENSION SYSTEMS
Competency: I1 Describe frame types

Objectives
To be competent in this area, the individual must be able to:
- Identify frame types.
- Describe the advantages and disadvantages of unibody and conventional frame designs.

LEARNING TASKS

1. Describe unibody frame design
   - Advantages/ Disadvantages
     - Welding construction
     - Rivet construction
     - Adhesive bonding
     - Torque boxes
     - Material selection
     - Strength
     - Accident crush zones

2. Describe conventional frame design
   - Advantages/ Disadvantages
     - Perimeter
     - Ladder
     - Sub-frames
     - Hydroformed
     - Material selection
     - Strength
     - Accident crush zones
LINE (GAC): I SUSPENSION SYSTEMS
Competency: I2 Describe suspension geometry

Objectives
To be competent in this area, the individual must be able to:
- Describe the design and operation of suspension systems.
- Describe the forces acting upon a suspension system.

LEARNING TASKS

1. Describe suspension types
   - Front
     - Rigid
     - Independent
       - McPherson strut
       - Short and long arm
       - Multi-link
       - Twin I-beam
   - Rear
     - Rigid
     - Independent
       - Chapman strut
       - Short and long arm
       - Multi-link
       - Semi-rigid

2. Describe suspension dynamics
   - Forces
     - Lateral
     - Acceleration
     - Braking
   - Body roll
   - Suspension travel
   - Weight shifting
LINE (GAC):  I  SUSPENSION SYSTEMS
Competency:  I3  Describe suspension components

Objectives
To be competent in this area, the individual must be able to:
• Identify components of suspension systems.
• Describe the design and operation of suspension components.

LEARNING TASKS

1. Describe common automotive spring designs
   • Coil
   • Leaf
   • Mono leaf
   • Air
   • Torsion bar
   • Anti-sway bar
   • Modification
     o Ride height
       – Towing
       – Off road
       – Performance

2. Describe the construction and operation of shock absorbers and struts
   • Purpose
   • Components
   • Types
     • Conventional
       o Gas
       o Low pressure
       o High pressure
     • Adjustable
       o Mechanical
       o Electrical
       o Pneumatic
     • Modification
       o Towing
       o Off road
       o Performance

3. Describe suspension components design and construction
   • Ball joints
     o Loaded
     o Follower
   • Rubber bushings
   • Frame and body mounting points
   • Construction materials
LINE (GAC): 1 SUSPENSION SYSTEMS
Competency: I4 Service suspension systems

Objectives
To be competent in this area, the individual must be able to:

- Remove, replace and adjust suspension system types.
- Diagnose suspension system problems.

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Achievement Criteria:
Given a written and/or a practical assessment on suspension systems the learner will be able to demonstrate knowledge of the trade by achieving 70% or better based on a summative total of Instructor assessment. For suggested practical assessments see Appendix A.
**Program Content**

**LINE (GAC):** I  
**SUSPENSION SYSTEMS**

**Competency:** I5  
Describe electronic suspension systems

**Objectives**
To be competent in this area, the individual must be able to:
- Identify electronic suspension system components.
- Describe the removal, replacement and adjustment of electronic suspension system components.

**LEARNING TASKS**

**CONTENT**

1. Describe electronic suspension systems

<table>
<thead>
<tr>
<th>Basic</th>
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<tbody>
<tr>
<td>Electrically controlled shocks</td>
</tr>
<tr>
<td>Load levelling system</td>
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<tr>
<td>Advanced</td>
</tr>
<tr>
<td>Air springs / struts</td>
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<tr>
<td>Electronic / computer controlled dynamic systems</td>
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2. Describe the inspection and repair of electronic suspension systems

<table>
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Section 4

TRAINING PROVIDER STANDARDS
Facility Requirements

Classroom Area

- Comfortable seating and tables suitable for training, teaching, and lecturing
- Compliance with all local and national fire codes and occupational safety requirements
- Lighting controls to allow easy visibility of projection screen while also allowing students to take notes
- Windows must have shades or blinds to adjust sunlight
- Heating / Air Conditioning for comfort all year round
- In-room temperature regulation to ensure comfortable room temperature
- In-room ventilation sufficient to control training room temperature
- Acoustics in the room must allow the instructor to be heard
- Whiteboard with pens and eraser (optional: flipchart in similar size)
- Projection screen or projection area at front of classroom
- Overhead projector and/or multi-media projector

Shop Area

- Ceiling must be a minimum height of 16’ or height approved through the building engineer
- Appropriate lifting devices (hoists) used in industry
- Suitable demonstration area
- Lighting appropriate for good vision in ambient light
- Compliance with all local and national fire codes and occupational safety requirements
- Must meet municipal and provincial bylaws in regards to waste water management and environmental laws
- Adequate hoist to student ratio

Lab Requirements

- Does not apply to this program

Student Facilities

- Does not apply to this program

Instructor’s Office Space

- Does not apply to this program
Tools and Equipment

Shop Equipment

Standard Tools

1. Air drills/tools
2. Air hammer/chisel
3. Air ratchet
4. Antifreeze tester
5. Axle boot clamp tool
6. Battery post service and reshape tool
7. Belt tension release tool
8. Blow gun
9. Bolt extractor set (easy outs)
10. Brake service tools (adjusters, spring removal, installation and caliper tools)
11. Caulking gun
12. Centre punch
13. Chisels, punches
14. Creeper/fender covers
15. Crowfoot wrenches (flare and std, SAE and metric)
16. Dial indicator set (flare and std, SAE and metric)
17. Die grinder
18. Drill and bits
19. Drill gauge
20. Feeler gauges – SAE and metric
21. Files – bastard cut/half round/mill cut/square and thread file
22. Filter wrenches
23. Flare nut wrenches – SAE and metric
24. Flaring tool (SAE, metric and ISO)
25. Flash lights
26. Fuel line disconnect set
27. Hacksaw
28. Hammers – ball peen/dead blow/rubber
29. Mallet/soft face
30. Hex keys – SAE and metric
31. High voltage safety gloves (0 rated 1000v)
32. Impact driver and bits
33. Impact wrench and impact socket set – SAE and metric, swivel, spark plug, extensions and adapters
34. Inspection mirror
35. Jumper lead
36. Magnetic pick up tool
37. Mechanic’s pick set
38. Multi-meter (DVOM)
39. Nut driver set – SAE and metric
40. Pliers – slip joint, needle nose, adjustable, wheel weight, side cutter, snap ring, locking, hog ring and battery types
41. Pry bar
42. Pullers – gear, pulley, battery terminal and steering wheel
43. Ratchet and sockets – ¼, ⅜ and ½ drive – SAE and metric, swivel, spark plug, extensions and adapters
44. Rivet gun
45. Scraper (gasket and carbon)
46. Screwdriver set
47. Seal drivers and extractors
48. Soldering tools
49. Standard test leads and probes
50. Steel rule
51. Stethoscope
52. Straight edge
53. Stud extractor
54. Tamper-proof torx set
55. Tap and die set – SAE and metric
56. Tap extractor
57. Tape and ruler
58. Terminal remover tools
59. Test lamp – electronics safe (powered and non-powered)
60. Thermometer
61. Thread files
62. Thread pitch gauge
63. Tin snips – centre, left and right cut
64. Tire pressure gauge
65. Tool box
66. Torque angle meter/indicator
67. Torque limited sockets (torque sticks)
68. Torque wrenches – various sizes and ranges
69. Torx bits
70. Tread depth gauge (for tires and brakes)
71. Trouble light
72. Tube bending tool
73. Tube cutters
74. Upholstery tools – trim panel tools, hog ring pliers
75. Utility knife
76. Vacuum pump
77. Vacuum/pressure gauge
78. Vernier caliper – SAE and metric
79. Vise grips
80. Wire brush
81. Wire stripper/crimping tool
82. Wrench set – SAE and metric/ various designs

**Shop Tools and Equipment**

1. Acetylene torches
2. Airbag for alignment adjustments
3. Airbag removal tools
4. Airbag simulators
5. Air buffer
6. Air compressor – hoses – inline filter and water separators
7. Alignment lift
8. And equipment- 4 wheel
9. Angle grinder
10. Anti-static devices
11. Arbor press
12. Ball joint press and adapters
13. Battery charger/boosting equipment
14. Battery hydrometer
15. Battery tester/alternator and starter tester (AVR)
16. Bearing remover
17. Belt tension gauge
18. Bench grinders
19. Bench vises
20. Bottle jacks (2)
21. Brake adjustment calipers
22. Brake bleeder wrenches
23. Brake cylinder hone
24. Brake fluid moisture tester
25. Lathe
26. Brake pedal depressor
27. Brake pressure tester
28. Brake rotor gauge/micrometer
29. Brake system bleeder
30. Calibrated vessel
31. Caliper tools for rear-wheel disc
32. Chassis ears
33. Brake washer system (for 2 and 4 post hoists)
34. Computer – PC
35. Drill press
36. Electrical short detector
37. Floor jack
38. Funnels
39. Grease gun and fluid suction pump
40. Heat gun
41. Heli-coil kits
42. Hub service kit
43. Hydraulic press
44. Jack stands and supports
45. Leak detection equipment (refrigerants)
46. Leak detection tank (tires)
47. Oil drain barrels and disposal system
48. Parts washers
49. Pickle-fork tool set
50. Pitman arm pullers
51. Power-steering pressure tester
52. Presses
53. Pressure washer
54. Reamer
55. Vacuum
56. Slide hammer
57. Smoke machine
58. Spreaders (tire)
59. Spring compressors – coil spring and strut
60. Spring
61. Steering wheel holder
62. Steering wheel puller set
63. Steering lock plate removal tool
64. Steering tilt pin removal tool
65. Tie-rod end puller
66. Tie-rod sleeve tools
67. Tire changing machine (run-flat capable)
68. Tire balancer equipment (road-force type recommended)
69. Tire repair equipment
70. TPMS system service tools
71. Transmission fixtures
72. U-joint press
Training Provider Standards

73. Door trim tools
74. Vehicle lifts
75. Vehicle service information system
76. Water hose
77. Welding equipment – GMAW welder and oxy fuelled

Measuring Tools and Equipment

1. ABS pressure tester
2. Ball joint dial indicator set
3. Brake drum gauge (for brake shoe adjusting)
4. Brake drum micrometer
5. Battery tester (electronic)
6. DVOM (Digital Volt Ohm Meter) (CAT III)
7. Headlight aiming equipment
8. Infrared thermometer
9. Lab scope or graphing multi-meter; 8 per class of 16 (channel, digital, cursor function with time capture capability)
10. Lab scope accessories (shielded cables and back probes)
11. Low amp probe
12. Logic probe
13. Micrometer – SAE and metric
14. Power steering pressure tester
15. Pressure gauges
16. Scan tools; 8 per class of 16 (CAN bus capable with appropriate software no older than 5 years of current MY vehicles)
17. Spring scale

Student Equipment & Tools

During attendance and completion of the technical training sessions, apprentices may be responsible for having specific equipment and tools. If equipment and tools are required, a list will be given to each apprentice at the beginning of the technical training session.
Reference Materials

Suggested Texts

<table>
<thead>
<tr>
<th>Order #</th>
<th>Alberta Learning Guides</th>
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<tbody>
<tr>
<td>7850001029</td>
<td>Measuring Tools</td>
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<td>7850001030</td>
<td>Specialty Hand Tools</td>
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<td>7850001031</td>
<td>Fastening Devices</td>
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<td>7850001868</td>
<td>Introduction to Scan Tools</td>
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<td>7850001034</td>
<td>Oxyacetylene Heating and Cutting</td>
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<td>7850001867</td>
<td>Gas Metal Arc Welding</td>
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<td>7850001047</td>
<td>Hydraulic System Components</td>
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<td>Power Brakes</td>
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<td>7850001044</td>
<td>Steering Columns</td>
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<td>7850001042</td>
<td>Steering Angles</td>
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SUGGESTED TEXTS

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<tr>
<td>CDX Automotive</td>
<td>Foundation and Safety</td>
<td>978-0-7637-8510-9</td>
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<tr>
<td>CDX Automotive</td>
<td>Brakes</td>
<td>978-0-7637-8507-9</td>
</tr>
<tr>
<td>CDX Automotive</td>
<td>Suspension and Steering</td>
<td>978-0-7637-8467-6</td>
</tr>
<tr>
<td>CDX Automotive</td>
<td>Electrical and Electronic Systems will be required for AST 3 also.</td>
<td>978-0-7637-8508-6</td>
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Additional texts

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<td>American Lift Institute</td>
<td>Lifting It Right</td>
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<tr>
<td>Halderman</td>
<td>Automotive Chassis Systems</td>
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Instructor Requirements

Occupation Qualification

The instructor must possess:

- An Automotive Service Technician Certificate of Qualification with a Red Seal Endorsement
- A recognized “Advanced Automotive Electrical” certification

Work Experience

- Must have a minimum of five years experience as a journeyperson
- Must have diverse industry experience covering all the competencies in this program

Instructional Experience and Education

It is preferred that the instructor possesses one of the following:

- Instructor Certificate (minimum 30-hour course)
- Instructors must have or be registered in an Instructor Diploma Program, to be completed within a five-year period
- Bachelor’s or Master’s Degree in Education
Appendices
APPENDIX A -
Practical Assessment
## Appendices

### Practical Assessment

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<th>CDX Booklet</th>
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## Appendices

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<tr>
<td>H3-</td>
<td>Inspect steering columns</td>
<td>Suspension and</td>
<td>C173</td>
<td>C170</td>
<td></td>
<td></td>
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<tr>
<td></td>
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<td>Steering</td>
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<td>H4-</td>
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<tr>
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<td>Perform wheel alignment</td>
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<td>C213</td>
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<td>C214</td>
<td>C216</td>
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<td>C793</td>
<td>C193</td>
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<td></td>
<td></td>
<td>C194</td>
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</table>
APPENDIX B - Assessment Guidelines
Program: Automotive Service Technician (AST 1)

Training providers delivering Automotive Service Technician (AST 1) apprenticeship in-school technical training are required to enter the following information in ITA Direct Access for each apprentice:

- An in-school mark in the form of a percentage
  (Minimum 70% is required for a pass)

Training Provider Component: In-School Technical Training

The in-school mark for each level is derived from a combination of theory and practical assessments. This mark is then combined with the ITA Standard Level Examination to determine a final mark for the level.

Calculation tables showing the subject competencies, theory and practical percentage weightings for each competency are shown in the Grading Sheet: “Subject Competency and Weightings” section of this document.

Automotive Service Technician (AST 1):

- The theory competency result is calculated based on 100% of accumulated competencies;
- The practical competency result is calculated based on 100% on accumulated competencies;
- The final in-school result is calculated by applying a weighting of 80% to the final theory result and a weighting of 20% to the practical result and then adding the two results together.

Successful completion of the in-school training for each level is defined as an in-school mark of 70% or greater.

ITA Component: ITA Standardized Level Examinations

There are no standardized level examinations for the current Automotive Service Technician (AST 1) program.

ITA Certificate of Qualification (C of Q) Exam

Apprentices registered in the Automotive Service Technician (AST 1) program are required to write a C of Q exam after completing the in-school technical training. A score of 70% or higher is required for a pass.

ITA Certificate of Qualification exams should be requested by training providers via the usual ITA procedure.

ITA will administer and invigilate ITA Certificate of Qualification exams and score and record exam results in ITA Direct Access.
### Grading Sheet: Subject Competency and Weightings

**PROGRAM:** AUTOMOTIVE SERVICE TECHNICIAN (AST 1)  
**IN-SCHOOL TRAINING:** LEVEL 1  
**ITA DIRECT ACCESS CODE:** 0002AM101

<table>
<thead>
<tr>
<th>LINE</th>
<th>TRAINING TOPICS &amp; SUGGESTED TIME ALLOCATION</th>
<th>THEORY WEIGHTING</th>
<th>PRACTICAL WEIGHTING</th>
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<tr>
<td>1A</td>
<td>Workplace Safety</td>
<td>8%</td>
<td>2%</td>
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<tr>
<td>1B</td>
<td>Employability Skills</td>
<td>2%</td>
<td>0%</td>
</tr>
<tr>
<td>1C</td>
<td>Tools and Equipment</td>
<td>8%</td>
<td>9%</td>
</tr>
<tr>
<td>1D</td>
<td>General Automotive Maintenance</td>
<td>12%</td>
<td>10%</td>
</tr>
<tr>
<td>1E</td>
<td>General Automotive Practices</td>
<td>4%</td>
<td>8%</td>
</tr>
<tr>
<td>1F</td>
<td>Basic Electrical Systems</td>
<td>18%</td>
<td>19%</td>
</tr>
<tr>
<td>1G</td>
<td>Brake Systems</td>
<td>18%</td>
<td>22%</td>
</tr>
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<td>1H</td>
<td>Steering Systems</td>
<td>18%</td>
<td>20%</td>
</tr>
<tr>
<td>1I</td>
<td>Suspension Systems</td>
<td>12%</td>
<td>10%</td>
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</tbody>
</table>

**Total**

100% 100%

*Calculated by the Training Provider*

**AUTOMOTIVE SERVICE TECHNICIAN (AST 1) in-school theory & practical subject competency weighting**

80% 20%

*Training Provider enters final in-school mark into ITA Direct Access*

A score of 70% or higher is required for a pass.

X%

*Uploaded by ITA: C of Q Final Mark*

A score of 70% or higher is required for a pass.  

FINAL%
Previous Contributors

This Program Outline was prepared with the advice and direction of an industry steering committee convened initially by the Automotive Training Standards Organization. Members include:

Matthew Wilkie  Automotive Service Technician
Loi Truong  Automotive Service Technician
Jeff Summers  Automotive Service Technician

Industry Subject Matter Experts retained to assist in the development of the Program Outline content:

Russ Hunter  Instructor, BCIT
Matthew Wilkie  Automotive Service Technician
Loi Truong  Automotive Service Technician
Jeff Summers  Automotive Service Technician
PROGRAM OUTLINE

Automotive Service Technician 2
AUTOMOTIVE SERVICE TECHNICIAN 2

PROGRAM OUTLINE

MARCH 2015

BASED ON
NOA 2011

Developed by
Industry Training Authority
Province of British Columbia
# TABLE OF CONTENTS

## Section 1 INTRODUCTION

<table>
<thead>
<tr>
<th>Topic</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foreword</td>
<td>AST 2 - 5</td>
</tr>
<tr>
<td>Acknowledgements</td>
<td>AST 2 - 5</td>
</tr>
<tr>
<td>Acknowledgements</td>
<td>AST 2 - 6</td>
</tr>
<tr>
<td>How to Use this Document</td>
<td>AST 2 - 7</td>
</tr>
</tbody>
</table>

## Section 2 PROGRAM OVERVIEW

<table>
<thead>
<tr>
<th>Topic</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Program Credentialing Model</td>
<td>AST 2 - 9</td>
</tr>
<tr>
<td>Occupational Analysis Chart</td>
<td>AST 2 - 10</td>
</tr>
<tr>
<td>Training Topics and Suggested Time Allocation</td>
<td>AST 2 - 12</td>
</tr>
</tbody>
</table>

## Section 3 PROGRAM CONTENT

<table>
<thead>
<tr>
<th>Topic</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Automotive Service Technician 2</td>
<td>AST 2 - 14</td>
</tr>
</tbody>
</table>

## Section 4 TRAINING PROVIDER STANDARDS

<table>
<thead>
<tr>
<th>Topic</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Facility Requirements</td>
<td>AST 2 - 46</td>
</tr>
<tr>
<td>Tools and Equipment</td>
<td>AST 2 - 47</td>
</tr>
<tr>
<td>Reference Materials</td>
<td>AST 2 - 51</td>
</tr>
<tr>
<td>Suggested Texts</td>
<td>AST 2 - 51</td>
</tr>
<tr>
<td>Instructor Requirements</td>
<td>AST 2 - 53</td>
</tr>
</tbody>
</table>

## Appendices

<table>
<thead>
<tr>
<th>Topic</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>APPENDIX A - Practical Assessment</td>
<td>AST 2 - 55</td>
</tr>
<tr>
<td>APPENDIX B - Assessment Guidelines</td>
<td>AST 2 - 58</td>
</tr>
</tbody>
</table>
Section 1

INTRODUCTION

Automotive Service Technician 2
Introduction

Foreword

This Program Outline was developed by the Automotive Training Standards Organization (ATSO) in accordance with the General Regulations made pursuant to the "Industry Training and Apprenticeship Act" of British Columbia. It reflects updated standards based on the 2009 Automotive Service Technician National Occupational Analysis. This Program Outline was prepared with the advice and assistance of an industry centered advisory committee in cooperation with the Automotive Training Standards Organization (ATSO). The Program Outline is intended as a guide for providers, instructors, apprentices and their sponsors. This Program Outline is separated into four main sections which include:

The Introduction This section contains this Foreword; Acknowledgements that list all of the participants who were involved in the creation of this document; as well as, a section called “How to Use this Document” which provides an oversight on how this document can be used.

The Program Overview This section contains a Credentialing Model that shows the path and time requirements for the apprentice; an Occupational Analysis Chart that has the General Areas of Competency (GAC) and the individual competencies, and Training Topics and Suggested Time Allocation which provides a suggested percentage of time for the theory and practical components for each GAC in this program.

The Program Content This section of the document represents individual General Areas of Competencies, which are further separated into competencies defined by Learning Objectives, Learning Tasks and Content.

The Training Provider Standards This section is a guide on Automotive Service Technician teaching facilities which outline the requirements needed to provide training for this program. The Facility Requirements section provides minimal requirements for facilities seeking designation and upgrade. The Tools and Equipment section lists the tools required to cover the competencies of this program. The Reference Material section is a collection of materials used for learning guides by the apprentice and instructors for the theory and at times the practical portion of the program. Finally, the Instructor Requirements section provides the level of knowledge and experience that each instructor must have to competently provide instruction in this program.

Practical instruction through demonstration and through student participation should be integrated within classroom sessions. Safe working practices, even though not always specified in each operation or topic, are an implied part of the program and should be stressed throughout the apprenticeship. It is the responsibility of employers to ensure safety training for the apprentices working on their work sites.

For more information please refer to the Program Profile document on the ITA website for the individual program.

SAFETY ADVISORY

Be advised that references to the WorkSafeBC safety regulations contained within these materials do not/may not reflect the most recent Occupational Health and Safety Regulation (the current Standards and Regulation in BC can be obtained on the following website: http://www.worksafebc.com). Please note that it is always the responsibility of any person using these materials to inform him/herself about the Occupational Health and Safety Regulation pertaining to his/her work.
Acknowledgements

This Program Outline was prepared with the advice and direction of an industry steering committee convened initially by the Automotive Training Standards Organization. Members include:

- Matthew Wilkie    Automotive Service Technician
- Loi Truong       Automotive Service Technician
- Jeff Summers      Automotive Service Technician

Industry Subject Matter Experts retained to assist in the development of the Program Outline content:

- Russ Hunter       Instructor BCIT
- Matthew Wilkie    Automotive Service Technician
- Loi Truong       Automotive Service Technician
- Jeff Summers      Automotive Service Technician

Industry Subject Matter Experts retained to review and update Program Outline content (February 2015):

- Corey Bransfield  Instructor, Okanagan College
- Dean Cadieux      Instructor, Vancouver Island University
- Russ Hunter       Instructor, British Columbia Institute of Technology
- Jeff Hoff         Manager, Napa Autopro, Prince George
- Brian Yanda       Service Manager, Harris Mazda and Instructor, Malaspina College

Consultant / Facilitator for the February 2015 review and update was Dan McFaull from North Pacific Training & Performance Inc.

The Industry Training Authority would like to acknowledge the dedication and hard work of all the industry representatives appointed to identify the training requirements of the Automotive Service Technician occupation.
## How to Use this Document

This Program Outline has been developed for the use of individuals from several different audiences. The table below describes how each section can be used by each intended audience.

<table>
<thead>
<tr>
<th>Section</th>
<th>Training Providers</th>
<th>Employers/ Sponsors</th>
<th>Apprentices</th>
<th>Challengers</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Program Credentialing Model</strong></td>
<td>Communicate program length and structure, and all pathways to completion</td>
<td>Understand the length and structure of the program</td>
<td>Understand the length and structure of the program, and pathway to completion</td>
<td>Understand challenger pathway to Certificate of Qualification</td>
</tr>
<tr>
<td><strong>OAC</strong></td>
<td>Communicate the competencies that industry has defined as representing the scope of the occupation</td>
<td>Understand the competencies that an apprentice is expected to demonstrate in order to achieve certification</td>
<td>View the competencies they will achieve as a result of program completion</td>
<td>Understand the competencies they must demonstrate in order to challenge the program</td>
</tr>
<tr>
<td><strong>Training Topics and Suggested Time Allocation</strong></td>
<td>Shows proportionate representation of various GACs at each program level; should map to proportions of time spent on training, practical experience, and assessment</td>
<td>Understand the relative scope of various areas of the occupation, and areas in which the apprentice would require on-the-job experience</td>
<td>Understand the relative scope of various areas of the occupation, and areas in which on-the-job experience would be provided</td>
<td>Understand the relative weightings of various areas of the occupation on which assessment is based</td>
</tr>
<tr>
<td><strong>Program Content</strong></td>
<td>Defines the objectives, learning tasks, high level content that must be covered for each competency, as well as defining observable, measurable achievement criteria for objectives with a practical component</td>
<td>Identifies detailed program content and performance expectations for competencies with a practical component; may be used as a checklist prior to signing a recommendation for certification (RFC) for an apprentice</td>
<td>Provides detailed information on program content and performance expectations for demonstrating competency</td>
<td>Allows individual to check program content areas against their own knowledge and performance expectations against their own skill levels</td>
</tr>
<tr>
<td><strong>Training Provider Standards</strong></td>
<td>Defines the facility requirements, tools and equipment, reference materials (if any) and instructor requirements for the program</td>
<td>Identifies the tools and equipment an apprentice is expected to have access to; which are supplied by the training provider and which the student is expected to own</td>
<td>Provides information on the training facility, tools and equipment provided by the school and the student, reference materials they may be expected to acquire, and minimum qualification levels of program instructors</td>
<td>Identifies the tools and equipment a tradesperson is expected to be competent in using or operating; which may be used or provided in a practical assessment</td>
</tr>
</tbody>
</table>
Section 2

PROGRAM OVERVIEW

Automotive Service Technician 2
Automotive Service Technician (AST 4)
Technical Training: 180 hours (6 weeks*)
WBT: 6,000 hours
ITA Standardized Written Exam
Interprovincial Red Seal Exam

Automotive Service Technician 3
Technical Training: 210 hours (7 weeks*)
Accumulate work-based training hours
ITA Certificate of Qualification Exam

Automotive Service Technician 2
Technical Training: 180 hours (6 weeks*)
Accumulate work-based training hours
ITA Certificate of Qualification Exam

Automotive Service Technician 1
Technical Training: 210 hours (7 weeks*)
Accumulate work-based training hours
ITA Certificate of Qualification Exam

C of C Automotive Service Technician
Technical Training: AST 1
WBT: 450 hours

Automotive Service Technician Foundation Program
Technical Training: 30 weeks*

C of Q Automotive Service Technician
Technical Training: None
Work-Based Training:

C of Q Heavy Duty Equipment Technician
Technical Training: None
Work-Based Training: 1,500 hours*

C of Q = Certificate of Qualification
C of A = Certificate of Apprenticeship
C of C = Certificate of Completion
WBT = Work-Based Training

*Individuals who are holders of both certificates will only be awarded credit for 1,500 WBT hours total

*Suggested duration based on 30-hour week

CROSS-PROGRAM CREDITS
Occupational Analysis Chart

**AUTOMOTIVE SERVICE TECHNICIAN 2**

**Occupation Description:** “Automotive Service Technician 2” means a person who repairs, adjusts and replaces mechanical, electrical and electronic parts of automobiles and light trucks in a retail automotive business. “Retail automotive business” means a business whose primary mechanical repair work is repairing and adjusting vehicles whose gross vehicle weight is less than 5,500 kg.

<table>
<thead>
<tr>
<th>ADVANCED ELECTRICAL SYSTEMS</th>
<th>Perform advanced electrical testing</th>
<th>Service starting systems</th>
<th>Service charging systems</th>
<th>Diagnose passenger restraint systems</th>
<th>Service electrical accessories</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>A1</td>
<td>A2</td>
<td>A3</td>
<td>A4</td>
<td>A5</td>
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<table>
<thead>
<tr>
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<th>Service heating and ventilation systems</th>
<th>Service air conditioning systems</th>
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<tr>
<td>B</td>
<td>B1</td>
<td>B2</td>
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<table>
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<tr>
<th>ENGINES</th>
<th>Describe principles of gasoline internal combustion engines</th>
<th>Describe principles of diesel internal combustion engines</th>
<th>Evaluate engine mechanical condition</th>
<th>Describe engine removal and installation procedures</th>
<th>Disassemble and assess engines</th>
<th>Service gaskets and seals</th>
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<tbody>
<tr>
<td>C</td>
<td>C1</td>
<td>C2</td>
<td>C3</td>
<td>C4</td>
<td>C5</td>
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<th>ENGINE SUPPORT SYSTEMS</th>
<th>Service lubrication systems</th>
<th>Service cooling systems</th>
<th>Describe air induction and exhaust systems</th>
</tr>
</thead>
<tbody>
<tr>
<td>D</td>
<td>D1</td>
<td>D2</td>
<td>D3</td>
</tr>
<tr>
<td>HYBRID AND ELECTRIC VEHICLE SAFETY</td>
<td>Describe hybrid and electric vehicle safety</td>
<td></td>
<td></td>
</tr>
<tr>
<td>------------------------------------</td>
<td>-------------------------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>E1</td>
<td></td>
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</table>
## Training Topics and Suggested Time Allocation

### AUTOMOTIVE SERVICE TECHNICIAN 2

<table>
<thead>
<tr>
<th>Line</th>
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<th>% of Time</th>
<th>Theory</th>
<th>Practical</th>
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<td>Perform advanced electrical testing</td>
<td>√</td>
<td></td>
<td>√</td>
<td></td>
</tr>
<tr>
<td>A2</td>
<td>Service starting systems</td>
<td>√</td>
<td></td>
<td>√</td>
<td></td>
</tr>
<tr>
<td>A3</td>
<td>Service charging systems</td>
<td>√</td>
<td></td>
<td>√</td>
<td></td>
</tr>
<tr>
<td>A4</td>
<td>Diagnose passenger restraint systems</td>
<td>√</td>
<td></td>
<td>√</td>
<td></td>
</tr>
<tr>
<td>A5</td>
<td>Service electrical accessories</td>
<td>√</td>
<td></td>
<td>√</td>
<td></td>
</tr>
<tr>
<td>Line B</td>
<td>HEATING, VENTILATION AND AIR CONDITIONING SYSTEMS</td>
<td>19%</td>
<td>40%</td>
<td>60%</td>
<td>100%</td>
</tr>
<tr>
<td>B1</td>
<td>Service heating and ventilation systems</td>
<td>√</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B2</td>
<td>Service air conditioning systems</td>
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<td>70%</td>
<td>100%</td>
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<tr>
<td>C1</td>
<td>Describe principles of gasoline internal combustion engines</td>
<td>√</td>
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</tr>
<tr>
<td>C2</td>
<td>Describe principles of diesel internal combustion engines</td>
<td>√</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C3</td>
<td>Evaluate engine mechanical condition</td>
<td>√</td>
<td></td>
<td>√</td>
<td></td>
</tr>
<tr>
<td>C4</td>
<td>Describe engine removal and installation procedures</td>
<td>√</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C5</td>
<td>Disassemble and assess engines</td>
<td>√</td>
<td></td>
<td>√</td>
<td></td>
</tr>
<tr>
<td>C6</td>
<td>Service gaskets and seals</td>
<td>√</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Line D</td>
<td>ENGINE SUPPORT SYSTEMS</td>
<td>12%</td>
<td>30%</td>
<td>70%</td>
<td>100%</td>
</tr>
<tr>
<td>D1</td>
<td>Service lubrication systems</td>
<td>√</td>
<td></td>
<td>√</td>
<td></td>
</tr>
<tr>
<td>D2</td>
<td>Service cooling systems</td>
<td>√</td>
<td></td>
<td>√</td>
<td></td>
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<tr>
<td>D3</td>
<td>Describe air induction and exhaust systems</td>
<td>√</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Line E</td>
<td>HYBRID AND ELECTRIC VEHICLE SAFETY</td>
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<td>100%</td>
<td>0%</td>
<td>100%</td>
</tr>
<tr>
<td>E1</td>
<td>Describe hybrid and electrical vehicle safety</td>
<td>√</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The theory and practical weighting distribution for AST 2 is 46% theory and 54% practical.
Section 3

PROGRAM CONTENT

Automotive Service Technician 2
Automotive Service Technician 2
LINE (GAC): A ADVANCED ELECTRICAL SYSTEMS

Competency: A1 Perform advanced electrical testing

Objectives
To be competent in this area, the individual must be able to:
- Describe advanced electrical terms.
- Use electrical diagnostic tools to measure advanced electrical signals.
- Describe advanced diagnostic procedures used for troubleshooting.
- Describe advanced electronic principles.

LEARNING TASKS

1. Define electrical terminology applied to electronic components
   - Volts
   - Amps
   - Resistance
   - Voltage drop
   - Frequency
   - Duty cycle
   - Pulse width modulation
   - Solid state components
     - Transistors
     - NPN & PNP junctions

2. Describe application of magnetism
   - Permanent magnet motors
   - Electromagnet motors
   - Relays
   - Inductive sensors
   - Hall effect sensors
   - Transformers
   - Mutual / self induction

3. Use electrical measuring tools
   - Multi-meter
   - Voltage
   - Amperage
   - Resistance
   - Frequency
   - Duty cycle

Achievement Criteria:
Given a written and/or a practical assessment on advanced electrical testing equipment the learner will be able to demonstrate knowledge of the trade by achieving 70% or better based on a summative total of Instructor assessment. For suggested practical assessments see Matrix in Appendix A.
### Objectives

To be competent in this area, the individual must be able to:
- Identify starting system components.
- Describe the design and operation of starting systems.
- Inspect and service starting systems.

### LEARNING TASKS

<table>
<thead>
<tr>
<th>Task Description</th>
<th>CONTENT</th>
</tr>
</thead>
</table>
| 1. Identify starting systems components                                        | - Battery  
|                                                                                 | - Starter motor assembly  
|                                                                                 | - Solenoids and relays  
|                                                                                 | - Ring gear  
|                                                                                 | - Ignition switch  
|                                                                                 | - Neutral safety switch / clutch pedal switch  
|                                                                                 | - Cables and terminals  
|                                                                                 | - Anti-theft devices  |
| 2. Describe the design and operation of starting systems                        | - Starter motor assembly  
|                                                                                 |   - Motor  
|                                                                                 |   - Solenoid and relays  
|                                                                                 |   - Starter drive  
|                                                                                 | - Ring gear  
|                                                                                 | - Ignition switch  
|                                                                                 | - Neutral safety switch / clutch pedal switch  
|                                                                                 | - Cables and terminals  
|                                                                                 | - Anti-theft devices  
|                                                                                 | - PCM controlled starting systems  |
| 3. Service starting systems                                                      | - On-vehicle inspection  
|                                                                                 |   - Visual  
|                                                                                 |   - Audible  
|                                                                                 | - On-vehicle testing  
|                                                                                 |   - Electrical  
|                                                                                 |   - Mechanical  
|                                                                                 | - Routine maintenance  
|                                                                                 | - Component removal and replacement  
|                                                                                 | - Adjustments  |
Achievement Criteria:
Given a written and/or a practical assessment on starting systems the learner will be able to demonstrate knowledge of the trade by achieving 70% or better based on a summative total of Instructor assessment. For suggested practical assessments see Matrix in Appendix A.
Program Content

LINE (GAC): A ADVANCED ELECTRICAL SYSTEMS
Competency: A3 Service charging systems

Objectives
To be competent in this area, the individual must be able to:
- Identify charging system components.
- Describe the design and operation of charging systems.
- Inspect and service charging systems.

LEARNING TASKS

1. Identify components of charging systems
   • Belts and drives
     - Over-running pulleys
   • Alternators
   • Regulators
   • Wires and connectors
   • Battery
   • Gauges and indicators
   • Electrical protection devices

2. Describe the design and operation of charging systems
   • Belts and drives
     - Over-running pulleys
   • Alternators
   • Regulators
     - Internal
     - PCM controlled
   • Wires and connectors
   • Battery
   • Gauges and indicators
   • Electrical protection devices

3. Service charging systems
   • On-vehicle inspection
     - Visual
     - Audible
   • On-vehicle testing
     - Electrical
     - Mechanical
   • Routine maintenance
   • Component removal and replacement
   • Adjustments
Achievement Criteria:
Given a written and/or a practical assessment on charging systems the learner will be able to
demonstrate knowledge of the trade by achieving 70% or better based on a summative total of Instructor
assessment. For suggested practical assessments see Matrix in Appendix A.
LINE (GAC): A

ADVANCED ELECTRICAL SYSTEMS

Competency: A4 Diagnose passenger restraint systems

Objectives
To be competent in this area, the individual must be able to:
• Diagnose problems with passenger restraint system components.
• Describe the design and operation of passenger restraint systems.
• Inspect, diagnose and repair passenger restraint systems.

LEARNING TASKS
1. Describe the design and operation of passenger restraint systems

CONTENT
• Safing sensors
• Impact sensors
• Computer
• Wiring
• Clock spring
• Passive
  • Airbags
  • Side impact protection
  • Whiplash protection
  • Automatic seatbelts
  • Body structure
  • Pyrotechnical seatbelts
  • Passenger detection
  • Clock spring
• Active
  • Mechanical seatbelts
  • Seatbelt warning system
• Criteria for deployment
  • Frontal impact
  • Side impact
• Progressive deployment
• Construction of components
• Chemical reaction of airbag deployment
• Passenger detection sensors
LEARNING TASKS

2. Diagnose and service passenger restraint systems

CONTENT

- Airbag system disarming procedures
- Airbag rearming procedures
  - Precautions when handling deployed airbags
- Vehicle inspection after airbag deployment
- Inspect vehicle for hidden damage
- Fault code retrieval
- Clearing fault codes
- Diagnose following manufacturer procedures
- Safe deployment of airbag unit prior to disposal

Achievement Criteria:
Given a written and/or a practical assessment on passenger restraint system the learner will be able to demonstrate knowledge of the trade by achieving 70% or better based on a summative total of Instructor assessment. For suggested practical assessments see Matrix in Appendix A.
LINE (GAC):  A  ADVANCED ELECTRICAL SYSTEMS
Competency:  A5  Service electrical accessories

Objectives
To be competent in this area, the individual must be able to:
- Identify electrical accessories and related components.
- Describe the design and operation of electrical accessories.
- Inspect, diagnose and repair electrical accessories

LEARNING TASKS CONTENT

1. Identify electrical accessories

- Power accessories
  - Windows
  - Door locks
  - Wipers
  - Power seats
- Instruments
  - Speedometer
  - Tachometer
  - Gauges
- Displays
  - Temperature
  - Engine monitoring
- Remote alarm systems
- Radio / infotainment
  - Displays
  - Speakers
  - Power antennae
- Lighting
  - HID
  - LED
  - Conventional
LEARNING TASKS

2. Describe the design and operation of electrical accessories

CONTENT

- Power accessories
  - Windows
  - Door locks
  - Wipers
  - Power seats
- Instruments
  - Speedometer
  - Tachometer
  - Gauges
- Displays
  - Temperature
  - Engine monitoring
- Remote alarm systems
- Radio / infotainment
  - Displays
  - Speakers
  - Power antennae
- Lighting
  - HID
  - LED
  - Conventional

3. Service electrical accessories

CONTENT

- Power accessories
  - Continuity tests
  - Voltage drop
  - Identify circuit operation
  - Current flow
- Diagnostic fault codes

Achievement Criteria:
Given a written and/or a practical assessment on electrical accessories the learner will be able to demonstrate knowledge of the trade by achieving 70% or better based on a summative total of Instructor assessment. For suggested practical assessments see Matrix in Appendix A.
LINE (GAC): B  HEATING, VENTILATION AND AIR CONDITIONING SYSTEMS

Competency: B1  Service heating and ventilation systems

Objectives
To be competent in this area, the individual must be able to:
• Identify heating and ventilation system components.
• Service heating and ventilation system components.
• Diagnose heating and ventilation systems.

LEARNING TASKS
1. Describe the principles of heating and ventilation systems.
2. Identify components of heating and ventilation systems

CONTENT
• Principles of heat transfer
• Recirculation Pumps
• Heater cores
• Fans
• Hoses and piping
• Heater control valves
• Blend doors
• Levers
• Plenum
  o Damper
• Mode controls
  o Vacuum
  o Electrical
  o Mechanical
• Cabin filters
• Air quality control systems
• Sensors
• Seals and gaskets
# Program Content

## Content

<table>
<thead>
<tr>
<th>LEARNING TASKS</th>
<th>CONTENT</th>
</tr>
</thead>
</table>
| 3. Describe the design and operation of heating and ventilation systems | - Recirculation Pumps  
- Heater cores  
- Fans  
- Hoses and piping  
- Heater control valves  
- Blend doors  
- Levers  
- Plenum  
  - Damper  
- Mode controls  
  - Vacuum  
  - Electrical  
  - Mechanical  
- Cabin filters  
- Air quality control systems  
- Sensors  
- Automatic climate control |
| 4. Inspect and repair heating and ventilation systems | - Inspection  
  - Visual  
  - Audible  
  - Smell  
- Testing  
  - Vacuum  
  - Electrical  
  - Diagnostic codes  
  - Mechanical  
- Removing and replacing components  
- Bleeding  
- Environmental considerations  
- Automatic climate control  
  - Calibration |

**Achievement Criteria:**

Given a written and/or a practical assessment on heating and ventilation systems the learner will be able to demonstrate knowledge of the trade by achieving 70% or better based on a summative total of Instructor assessment. For suggested practical assessments see Matrix in Appendix A.


LINE (GAC): B

HEATING, VENTILATION AND AIR CONDITIONING SYSTEMS

Competency: B2 Service air conditioning systems

NOTE: Apprentice must independently obtain Refrigerant Handling Certificate before servicing air conditioning systems.

Objectives

To be competent in this area, the individual must be able to:

- Identify air conditioning system components.
- Service air conditioning system components.
- Diagnose air conditioning systems.

LEARNING TASKS

<table>
<thead>
<tr>
<th>LEARNING TASKS</th>
<th>CONTENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Describe the principles of air conditioning systems</td>
<td>• Describe the laws of thermodynamics</td>
</tr>
</tbody>
</table>
| 2. Identify components of air conditioning systems | • Compressor  
  ○ Drive systems  
  • Evaporator  
  • Condenser  
  • Receiver drier / accumulator  
  • Orifice tubes / expansion valves  
  • Refrigerant  
  • Lubricants  
  • Controls  
  • Sensors  
  • Hoses, piping and connectors  
  • Seals and gaskets |
| 3. Describe the design and operation of air conditioning systems | • Refrigeration cycle  
  ○ Compressor  
  ○ Evaporator  
  ○ Condenser  
  ○ Receiver drier / accumulator  
  ○ Orifice tubes / expansion valves  
  ○ Refrigerant  
  ○ Lubricants  
  ○ Controls  
  ○ Sensors |
### LEARNING TASKS

4. Inspect and repair air conditioning systems

### CONTENT

- Inspection
  - Visual
  - Audible
  - Smell
- Testing
  - Vacuum
  - Electrical
  - Mechanical
- Pressures
- Leak detection methods
- Evacuation and recharging
- Recycling
- Deodorization
- Refrigerant identifiers
- Conversion of system to other gasses
- Environmental considerations
- Removing and replacing components
- Paper work / logging service information

**Achievement Criteria:**

Given a written and/or a practical assessment on air conditioning systems the learner will be able to demonstrate knowledge of the trade by achieving 70% or better based on a summative total of Instructor assessment. For suggested practical assessments see Matrix in Appendix A.
LINE (GAC): C ENGINES

Competency: C1 Describe principles of gasoline internal combustion engines

Objectives
To be competent in this area, the individual must be able to:
- Identify gasoline internal combustion engine components.
- Describe the design and operation of gasoline internal combustion engines.

LEARNING TASKS

1. Describe gasoline internal combustion engine components
   - Short block assembly
   - Cylinder head assembly
   - Associated parts and fasteners

2. Describe the design and operation of gasoline internal combustion engines
   - Fuel type
   - Two and four stroke cycle
   - Construction design and materials
   - Engine configurations
     - Inline
     - V
     - Rotary
     - Opposed
   - Cooling method(s)
   - Lubrication
   - Design variations
     - Diesel
     - Miller
     - Wankel rotary
     - Variable valve timing
   - Engine Measurements
     - Horse power
     - Torque
     - Volumetric efficiency
     - Thermal efficiency
     - Compression ratio
     - Area
     - Volume
LINE (GAC): C ENGINES
Competency: C2 Describe principles of diesel internal combustion engines

Objectives
To be competent in this area, the individual must be able to describe the operation of a compression ignition engine.

LEARNING TASKS
1. Describe the operating principles of a diesel engine

CONTENT
- Four stroke cycle
- Compression ignition
- Compression ratio
- Fuel properties
- Intake manifold design
- Forced induction
- Compare component construction to gasoline internal combustion engines
- Engine Measurements
  - Horse power
  - Torque
  - Volumetric efficiency
  - Thermal efficiency
LINE (GAC): C ENGINES
Competency: C3 Evaluate engine mechanical condition

Objectives
To be competent in this area, the individual must be able to test and diagnose engine mechanical condition.

LEARNING TASKS

1. Describe engine mechanical problems
   - Short block assembly
   - Cylinder head assembly
   - Associated parts and fasteners

2. Perform engine mechanical condition tests
   - Oil pressure
   - Cooling system
   - Cylinder pressure testing
     - Spark ignition
     - Compression ignition
   - Cylinder leak down
   - Power balance
   - Emissions
   - Audible
   - Visual
   - Oil analysis

3. Evaluate engine mechanical condition test results
   - Probable cause
   - Tolerances
   - Cost of repair
   - Potential damage
   - Recommendations
   - Repair options

Achievement Criteria:
Given a written and/or a practical assessment on engine mechanical condition the learner will be able to demonstrate knowledge of the trade by achieving 70% or better based on a summative total of Instructor assessment.
LINE (GAC): C ENGINES
Competency: C4 Describe engine removal and installation procedures

Objectives
To be competent in this area, the individual must be able to:
- Describe engine removal and installation procedures.
- Describe initial start-up and break-in procedures.

LEARNING TASKS
1. Describe engine mounting methods
   - Front wheel drive
   - Rear wheel drive

2. Describe engine removal
   - Safety
     - Jacking and hoisting
     - Weight distribution
     - Rigging
   - Systems removal
   - Identification for reinstallation
     - Electrical
     - Vacuum
     - Air conditioning
     - Cooling
     - Oil
     - Drive train
     - Air intake
     - Exhaust
   - Body component removal
   - Engine mount removal
   - Care and inspection of lifting and blocking equipment
   - Engine hoisting
     - Engine crane
   - Mounting on engine stand
<table>
<thead>
<tr>
<th>LEARNING TASKS</th>
<th>CONTENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>3. Describe engine installation procedures</td>
<td>• Safety</td>
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<tr>
<td></td>
<td>○ Jacking and hoisting</td>
</tr>
<tr>
<td></td>
<td>○ Weight distribution</td>
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<td></td>
<td>○ Rigging</td>
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<td></td>
<td>• Engine mount removal</td>
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<tr>
<td></td>
<td>• Engine hoisting</td>
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<td></td>
<td>• Systems installation</td>
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<tr>
<td></td>
<td>○ Electrical</td>
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<tr>
<td></td>
<td>○ Vacuum</td>
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<tr>
<td></td>
<td>○ Air conditioning</td>
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<td>○ Cooling</td>
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<td></td>
<td>○ Oil</td>
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<tr>
<td></td>
<td>○ Drive train</td>
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<td></td>
<td>○ Air intake</td>
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<td></td>
<td>○ Exhaust</td>
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<td></td>
<td>• Body component installation</td>
</tr>
<tr>
<td>4. Describe engine initial start-up and break-in procedures</td>
<td>• Lubrication</td>
</tr>
<tr>
<td></td>
<td>• Install and adjust ignition timing</td>
</tr>
<tr>
<td></td>
<td>• Camshaft break-in</td>
</tr>
<tr>
<td></td>
<td>• Ring seating</td>
</tr>
</tbody>
</table>
**LINE (GAC):** C ENGINES

**Competency:** C5 Disassemble, inspect and assemble engines

### Objectives
To be competent in this area, the individual must be able to:
- Disassemble an engine following manufacturer’s procedures.
- Measure and evaluate the condition of engine components.
- Determine work required to restore engine components.
- Assemble an engine following manufacturer’s procedures.

### LEARNING TASKS

<table>
<thead>
<tr>
<th>LEARNING TASKS</th>
<th>CONTENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Describe engine disassembly procedures</td>
<td>• Disassembly procedures</td>
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<tr>
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<td>• Cleaning</td>
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<tr>
<td></td>
<td>o Solvent</td>
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<td>o Chemical</td>
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<tr>
<td></td>
<td>o Pressure washer</td>
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<td>o Abrasive</td>
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<td>o Steam</td>
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<td></td>
<td>• Measuring and evaluating</td>
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<tr>
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<td>• Short block assembly</td>
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<td>o Boring and honing</td>
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<tr>
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<td>o Machining</td>
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<tr>
<td></td>
<td>– Bearing surfaces</td>
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<td></td>
<td>– Mating surfaces</td>
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<td></td>
<td>o Thread repair</td>
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<tr>
<td></td>
<td>o Crack detection and repair</td>
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<tr>
<td></td>
<td>o Piston fitting</td>
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<tr>
<td></td>
<td>o Bearing installation</td>
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<tr>
<td></td>
<td>• Cylinder head assembly</td>
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<td>o Machining</td>
</tr>
<tr>
<td></td>
<td>o Thread repair</td>
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<tr>
<td></td>
<td>o Crack detection and repair</td>
</tr>
<tr>
<td></td>
<td>o Valve train assembly</td>
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<tr>
<td></td>
<td>• Associated parts and fasteners</td>
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<td></td>
<td>o Oil pump</td>
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<td></td>
<td>o Pans, covers and breathers</td>
</tr>
<tr>
<td></td>
<td>o Thread repair</td>
</tr>
</tbody>
</table>
LEARNING TASKS

2. Describe design and operation of engine components
   - Engine block
   - Crankshaft
   - Connecting rods
   - Pistons
   - Bearings
   - Cylinder head
   - Camshaft
   - Valvetrain
   - Valves

3. Perform engine disassembly and inspection procedures
   - Disassembly and removal
     - Cylinder head
     - Pistons
     - Crankshaft
     - Camshaft
     - Bearings
   - Cleaning
   - Measuring and evaluating
     - Thread repair
     - Crack detection
     - Piston fitting
     - Bearing installation
     - Mating surfaces
     - Block
     - Crankshaft
     - Camshaft
     - Valves

4. Perform engine assembly procedures
   - Preassembly cleaning
   - Assemble short block
     - Fitting parts
     - Measuring and torquing
     - Lubrication
   - Install cylinder head
   - Assemble valvetrain
     - Sprockets
     - Belt
     - Chain
     - Tensioners
     - Balance shafts
   - Assemble associated parts and fasteners
   - Gasket installation
<table>
<thead>
<tr>
<th>LEARNING TASKS</th>
<th>CONTENT</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Seal installation</td>
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<td>Liquid sealants</td>
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</tbody>
</table>

**Achievement Criteria:**
Given a written and/or a practical assessment on engine repairs the learner will be able to demonstrate knowledge of the trade by achieving 70% or better based on a summative total of Instructor assessment. For suggested practical assessments see Matrix in Appendix A.
Objective
To be competent in this area, the individual must be able to:
- Identify causes of engine gasket and seal failure.
- Select engine gaskets and seals.
- Remove and replace engine gaskets and seals.
- Locate engine leaks and determine solutions.

**Learning Tasks**

<table>
<thead>
<tr>
<th>#</th>
<th>Task Description</th>
<th>Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Describe gasket and seal construction</td>
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<tr>
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<td>- Cylinder head</td>
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<td>- Other gaskets</td>
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<td>2.</td>
<td>Diagnose cause of failure</td>
<td>Incorrect assembly</td>
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<td>Over pressurization</td>
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<td>Lack of lubrication</td>
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<td>Seal deterioration</td>
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<td>Mating surface damage</td>
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<td>3.</td>
<td>Describe leak detection methods</td>
<td>Visual</td>
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<td>Audible</td>
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<td>Fluid analysis</td>
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<td>Pressurization / vacuum</td>
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<td>Smoke generator</td>
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</tbody>
</table>
## LEARNING TASKS

4. Assess leak relevance

5. Service gaskets and seals

## CONTENT

- Cost of repair
- Potential damage
- Removal techniques
- Surface preparation
- Installation techniques
- Torque sequence

## Achievement Criteria:

Given a written and/or a practical assessment on gaskets and seals the learner will be able to demonstrate knowledge of the trade by achieving 70% or better based on a summative total of Instructor assessment.
LINE (GAC): D  ENGINE SUPPORT SYSTEMS
Competency: D1  Service lubrication systems

Objectives
To be competent in this area, the individual must be able to:
- Identify lubrication system components.
- Service lubrication system components.
- Diagnose lubrication systems.

LEARNING TASKS

1. Describe components of lubrication systems
   - Oil
     - Grades
     - Types
   - Pumps
     - Gerotor
     - Vane
     - Gear
   - Filters
   - Sensors
   - Oil galleries
   - Piston cooling
   - Crank case ventilation systems
   - Sumps and strainers
   - Coolers
   - Associated plumbing and hardware
   - Gauges

2. Describe the design and operation of lubrication systems
   - Oil
   - Pumps
   - Filters
   - Sensors
   - Oil galleries
   - Valvetrain
     - Variable valve timing
     - Cylinder deactivation
   - Piston cooling
   - Crank case ventilation systems
   - Sumps and strainers
   - Coolers
   - Associated plumbing and hardware
   - Gauges
LEARNING TASKS

3. Inspect and repair lubrication systems

CONTENT

- Inspection
  - Visual
  - Audible
- Pressure testing
- Crank case ventilation systems
- Filter service
- Oil change intervals
- Disposal / recycling
- Components testing and replacement
- Leak detection
- Seals and gaskets
- Priming

Achievement Criteria:
Given a written and/or a practical assessment on lubrication systems the learner will be able to demonstrate knowledge of the trade by achieving 70% or better based on a summative total of Instructor assessment. For suggested practical assessments see Matrix in Appendix A.
LINE (GAC):  D  ENGINE SUPPORT SYSTEMS
Competency:  D2  Service cooling systems

Objectives
To be competent in this area, the individual must be able to:
• Identify cooling system components.
• Service cooling system components.
• Diagnose cooling systems.

LEARNING TASKS
1. Describe cooling system components
   • Water pump
   • Radiator and pressure cap
   • Thermostat
   • Coolant temperature sensor
   • Warning system
   • Heater core
   • Valves
   • Fans and shrouds
     o Mechanical
     o Electric
     o Hydraulic
   • Coolant recovery systems
   • Hoses
   • Coolant
   • Secondary or auxiliary cooling systems

2. Describe the design and operation of cooling systems
   • Principles of heat transfer
   • Liquid cooled
     o Conduction and convection
   • Conventional and reverse flow coolant paths
   • Component purpose and operation
   • Coolant and additive properties
   • Pressurization
   • Secondary or auxiliary cooling systems
LEARNING TASKS
3. Inspect and repair cooling systems

CONTENT
- Inspection
  - Audible
  - Visible
- Depressurization
- Testing
  - Pressure / vacuum
  - Air flow
  - Temperature
  - Coolant
    - Temperature
    - Additives
    - Contamination
    - Flow
    - Electrical testing
    - Recycling
    - Flushing
    - Bleeding
- Removal techniques
- Surface preparation
- Installation techniques
- Torque sequence

Achievement Criteria:
Given a written and/or a practical assessment on cooling systems the learner will be able to demonstrate knowledge of the trade by achieving 70% or better based on a summative total of Instructor assessment. For suggested practical assessments see Matrix in Appendix A.
LINE (GAC): D  ENGINE SUPPORT SYSTEMS
Competency: D3  Describe air induction and exhaust systems

Objectives
To be competent in this area, the individual must be able to:
• Identify air induction and exhaust system components.
• Describe the design and operation of air induction and exhaust systems.

LEARNING TASKS
1. Describe components of air induction and exhaust systems
   • Air Induction
     o Air filtration
     o Throttle body
     o Electrical
     o Mechanical
     o Intake manifold
     o Intake tuning (variable length runners)
     o Intercoolers
     o Plumbing, seals and gaskets
   • Exhaust Systems
     o Manifold and headers
     o Catalytic converter
     o Muffler and resonator
     o Associated pipes and hardware
     o Turbocharger

2. Describe the design and operation of air induction and exhaust systems
   • Air intake
     o Purpose of intake manifold
     o Construction materials
     o Variable length runners
     o Natural aspiration / forced induction
   • Exhaust system
     o Construction materials
     o Manifold and headers
     o Muffler and resonator
     o Associated pipes and hardware
     o Turbocharger
       o Boost control
         ▪ Waste gate
         ▪ Blow off valve
         ▪ Variable geometry
**LINE (GAC):** E  HYBRID AND ELECTRICAL VEHICLE SAFETY

**Competency:** E1  Describe hybrid and electrical vehicle safety

### Objectives
To be competent in this area, the individual must be able to:
- Identify high voltage components.
- Describe hybrid and electric vehicle safety.

### Learning Tasks

<table>
<thead>
<tr>
<th><strong>Content</strong></th>
<th><strong>Learning Tasks</strong></th>
</tr>
</thead>
</table>
| **1. Identify high voltage components** | • High voltage battery  
  • Auxiliary battery  
  • Inverter  
  • Motor / generator |
| **2. Describe hybrid and electric vehicle safety** | • Safety  
  o Shop set up  
    o Cones  
    o Insulated work bench  
    o Caution signs  
  o Personal equipment  
    o Gloves  
    o CAT III DVOM  
    o One Hand Rule  
  • Voltage  
    o Low  
    o Intermediate  
    o High  
  • High voltage battery  
    o Power  
    o Safety  
  • Hybrid vehicle types  
    o Full electric only  
    o Combined power  
    o Reverse (electric only)  
    o Auto stop  
  • High voltage disconnect procedures  
    o High voltage breaker  
    o Removable high voltage service  
    o Shut-down service plug |
Achievement Criteria:
Given a written and/or a practical assessment on hybrid vehicle safety the Learner will be able to demonstrate knowledge of the trade by achieving 70% or better based on a summative total of Instructor assessment.
Section 4

TRAINING PROVIDER STANDARDS
Facility Requirements

Classroom Area

- Comfortable seating and tables suitable for training, teaching, and lecturing
- Compliance with all local and national fire code and occupational safety requirements
- Lighting controls to allow easy visibility of projection screen while also allowing students to take notes
- Windows must have shades or blinds to adjust sunlight
- Heating / Air Conditioning for comfort all year round
- In-room temperature regulation to ensure comfortable room temperature
- In-room ventilation sufficient to control training room temperature
- Acoustics in the room must allow audibility of the instructor
- White marking board with pens and eraser (optional: flipchart in similar size)
- Projection screen or projection area at front of classroom
- Overhead projector and/or multi-media projector

Shop Area (Fixed Properties)

- Ceiling shall be a minimum height of 16’ or as varied by good engineering practices and code
- Appropriate lifting devices (hoists) used in industry
- Suitable demonstration area
- Lighting appropriate for good vision in ambient light
- Compliance with all local and national fire code and occupational safety requirements
- Must meet Municipal and Provincial bylaws in regards to waste water management and environmental laws
- Adequate hoist to student ratio

Lab Requirements

- Does not apply to this program

Student Facilities

- Does not apply to this program

Instructor’s Office Space

- Does not apply to this program
Tools and Equipment

Standard Tools

1. Air drills/tools
2. Air hammer/chisel
3. Air ratchet
4. Antifreeze tester
5. Axle boot clamp tool
6. Battery post service and reshape tool
7. Belt tension release tool
8. Blow gun
9. Bolt extractor set (easy outs)
10. Brake service tools (adjusters, spring removal, installation and caliper tools)
11. Caulking gun
12. Centre punch
13. Chisels, punches
14. Creeper/fender covers
15. Crowfoot wrenches (flare and std, SAE and metric)
16. Dial indicator set (flare and std, SAE and metric)
17. Die grinder
18. Drill and bits
19. Drill gauge
20. Feeler gauges – SAE and metric
21. Files – bastard cut/half round/mill cut/square and thread file
22. Filter wrenches
23. Flare nut wrenches – SAE and metric
24. Flaring tool (SAE, metric and ISO)
25. Flash lights
26. Fuel line disconnect set
27. Hacksaw
28. Hammers – ball peen/dead blow/rubber
29. Mallet/soft face
30. Hex keys – SAE and metric
31. High voltage safety gloves (0 rating 1000v)
32. Impact driver and bits
33. Impact wrench and impact socket set – SAE and metric
34. Inspection mirror
35. Jumper lead
36. Magnetic pick up tool
37. Mechanic's pick set
38. Multimeter (DVOM)
39. Nut driver set – SAE and metric
40. Pliers – slip joint, needle nose, adjustable, wheel weight, side cutter, snap ring, locking, hog ring and battery types
41. Pry bar
42. Pullers – gear, pulley, battery terminal and steering wheel
43. Ratchet and sockets – ¼, 3/8 and ½ drive – SAE and metric, swivel, spark plug, extensions and adapters
44. Rivet gun
45. Scraper (gasket and carbon)
46. Screwdriver set
47. Seal drivers and extractors
48. Soldering tools  
49. Standard test leads and probes  
50. Steel rule  
51. Stethoscope  
52. Straight edge  
53. Stud extractor  
54. Tamper-proof torx set  
55. Tap and die set – SAE and metric  
56. Tap extractor  
57. Tape and ruler  
58. Terminal remover tools  
59. Test lamp – electronics safe (powered and non-powered)  
60. Thermometer  
61. Thread files  
62. Thread pitch gauge  
63. Tin snips – centre, left and right cut  
64. Tire pressure gauge  
65. Tool box  
66. Torque angle meter/indicator  
67. Torque limited sockets (torque sticks)  
68. Torque wrenches – various sizes and ranges  
69. Torx bits  
70. Tread depth gauge (for tires and brakes)  
71. Trouble light  
72. Tube bending tool  
73. Tube cutters  
74. Upholstery tools – trim panel tools, hog ring pliers  
75. Utility knife  
76. Vacuum pump  
77. Vacuum/pressure gauge  
78. Vernier caliper – SAE and metric  
79. Vise grips  
80. Wire brush  
81. Wire stripper/crimping tool  
82. Wrench set – SAE and metric/various designs  

**Shop Tools and Equipment**

1. Acetylene torches  
2. Airbag for alignment adjustments  
3. Removal tools  
4. Simulators  
5. Air buffer  
6. Air compressor – hoses – inline filter and water separators  
7. Alignment lift  
8. And equipment- 4 wheel  
9. Angle grinder  
10. Anti-static devices  
11. Arbor press  
12. Ball joint press and adapters  
13. Battery charger/boosting equipment  
14. Battery hydrometer  
15. Battery tester/alternator and starter tester (AVR)  
16. Bearing remover  
17. Belt tension gauge
18. Bench grinders
19. Bench vises
20. Bottle jacks (2)
21. Brake adjustment calipers
22. Brake bleeder wrenches
23. Brake cylinder hone
24. Brake fluid moisture tester
25. Lathe
26. Brake pedal depressor
27. Brake pressure tester
28. Brake rotor gauge/micrometer
29. Brake system bleeder
30. Calibrated vessel
31. Caliper tools for rear-wheel disc
32. Chassis ears
33. Brake washer system (for 2 and 4 post hoists)
34. Computer – PC
35. Drill press
36. Electrical short detector
37. Floor jack
38. Funnels
39. Grease gun and fluid suction pump
40. Heat gun
41. Heli-coil kits
42. Hub service kit
43. Hydraulic press
44. Jack stands and supports
45. Leak detection equipment (refrigerants)
46. Leak detection tank (tires)
47. Oil drain barrels and disposal system
48. Parts washers
49. Pickle-fork tool set
50. Pitman arm pullers
51. Power steering pressure tester
52. Presses
53. Pressure washer
54. Reamer
55. Vacuum
56. Slide hammer
57. Smoke machine
58. Spreaders (tire)
59. Spring compressors – coil spring and strut
60. Spring
61. Steering wheel holder
62. Steering wheel puller set
63. Steering lock plate removal tool
64. Steering tilt pin removal tool
65. Tie-rod end puller
66. Tie-rod sleeve tools
67. Tire changing machine (run-flat capable)
68. Tire balancer equipment (road force type recommended)
69. Tire repair equipment
70. TPMS system service tools
71. Transmission fixtures
72. U-joint press
73. Door trim tools
74. Vehicle lifts
75. Vehicle service information system
76. Water hose
77. Welding equipment – GMAW welder and oxy fuelled

Measuring Tools and Equipment

1. ABS pressure tester
2. Ball joint dial indicator set
3. Brake drum gauge (for brake shoe adjusting)
4. Brake drum micrometer
5. Battery tester (electronic)
6. DVOM (Digital Volt Ohm Meter) (CATIII)
7. Headlight aiming equipment
8. Infrared thermometer
9. Lab scope or graphing multimeter; 8 per class of 16 (channel, digital, cursor function with time capture capability)
10. Lab scope accessories (shielded cables and back probes)
11. Low amp probe
12. Logic probe
13. Micrometer – SAE and metric
14. Power steering pressure tester
15. Pressure gauges
16. Scan tools; 8 per class of 16 [CAN (Controller Area Network) bus capable with appropriate software no older than 5 years of current vehicles]
17. Spring scale

Student Equipment & Tools

During attendance and completion of the technical training sessions, apprentices may be responsible for having specific equipment and tools. If equipment and tools are required, a list will be given to each apprentice at the beginning of the technical training session.
Reference Materials

Suggested Texts

- Alberta Learning Guides for AST 2: 7850001169

  Fundamentals of Magnetism 7850001055
  Engine Fundamentals 7850001058
  Blocks & Related Components (Theory) 7850001059
  Blocks & Related Components (Service) 7850001060
  Crankshafts, Friction. Bearings & Related. Components (Theory) 7850001061
  Crankshafts, Friction. Bearings & Related. Components (Service) 7850001062
  Piston Rings & Control Rods (Theory) 7850001063
  Piston Rings & Control Rods (Service) 7850001064
  Camshaft & Valve Trains (Theory) 7850001065
  Camshaft & Valve Trains (Service) 7850001066
  Cylinder Head Assemblies (Theory) 7850001067
  Cylinder Head Assemblies (Service) 7850001068
  Engine Disassembly Procedures 7850001069
  Engine Assembly Procedures 7850001070
  Exhaust Systems 7850001072
  Starting Aids 7850001074
  Lubrication Systems 7850001075
  Cooling Systems 7850001076
  Engine Diagnosis 7850001077
  Electrical Fundamentals II 7850001082
  Electrical Circuits 7850001083
  Electrical System Diagnosis II 7850001084
  Electrical Fundamentals 3 7850001085
  Charging Systems and Control Circuits 7850001091
  Charging System Testing and Diagnosis 7850001092
  Generator Service Procedures 7850001093
  DC Motor Fundamentals 7850001094
  Starter Motors and Control Circuits 7850001095
## Program Content
### Section 4

<table>
<thead>
<tr>
<th>Course Title</th>
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<tbody>
<tr>
<td>Starting System Testing and Diagnosis</td>
<td>7850001096</td>
</tr>
<tr>
<td>Starter Motor Service</td>
<td>7850001097</td>
</tr>
<tr>
<td>Diesel Fuel Injection Systems (Mechanical) - Part A</td>
<td>7850001110</td>
</tr>
<tr>
<td>Diesel Fuel Injection Systems (Electronic)</td>
<td>7850001111</td>
</tr>
<tr>
<td>Gauges and Warning Systems</td>
<td>7850001118</td>
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<tr>
<td>Lighting Systems</td>
<td>7850001119</td>
</tr>
<tr>
<td>Wiper and Washer Systems</td>
<td>7850001120</td>
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<tr>
<td>Power Accessory Systems</td>
<td>7850001121</td>
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<td>Heated Glass Systems</td>
<td>7850001122</td>
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<tr>
<td>Speed Control Systems</td>
<td>7850001123</td>
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<tr>
<td>Safety and Security Systems</td>
<td>7850001125</td>
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<tr>
<td>Air Conditioning - Part A</td>
<td>7850001144</td>
</tr>
<tr>
<td>Air Conditioning Controls</td>
<td>7850001145</td>
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<tr>
<td>Air Conditioning Service</td>
<td>7850001146</td>
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<tr>
<td>Active Restraint Systems</td>
<td>7850001147</td>
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<tr>
<td>Passive Restraint Systems</td>
<td>7850001148</td>
</tr>
</tbody>
</table>

### SUGGESTED TEXT

- **Automotive Engine Repair and Rebuilding (Halderman Equivalent)**
  By James D. Halderman, Prentice Hall, publishers
  Latest Edition

- **Automotive Electrical and Electronic Systems (Halderman Equivalent)**
  By James D. Halderman, Prentice Hall, publishers
  Latest Edition

- **Automotive Electricity and Electronics**
  By James D. Halderman, Prentice Hall, publishers
  Latest Edition

- **Automotive Technology (Latest Edition)**
  By Jack Erjavec
  Delmar Cengage Learning, publishers

- **Automotive Diesel Technology (Latest Edition)**
Instructor Requirements

Occupation Qualification

The instructor must possess:

- Automotive Service Technician with an Interprovincial “Red Seal” endorsement
- A recognized “Advanced Automotive Electrical” certification.

Work Experience

- Must have a minimum of five years experience as a journeyperson
- Must have diverse industry experience covering all the competencies in this program

Instructional Experience and Education

It is preferred that the instructor possesses one of the following:

- Instructors Certificate (minimum 30-hour course)
- Instructors must have or be registered in an Instructor’s Diploma Program, to be completed within a five year period
- Hold a Bachelors or Masters Degree in Education
### Appendix A
#### Practical Assessment

<table>
<thead>
<tr>
<th>Competency</th>
<th>CDX Booklet</th>
<th>Reference Number Essential</th>
<th>Reference Number Secondary</th>
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<tbody>
<tr>
<td>A1- Perform advanced electrical testing</td>
<td>Electrical and Electronic Systems</td>
<td>C 641</td>
<td></td>
</tr>
<tr>
<td>A2- Service starting systems</td>
<td>Electrical and Electronic Systems</td>
<td>C309, C310, C313, C311</td>
<td>C312, C314</td>
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<tr>
<td>A3- Service charging systems</td>
<td>Electrical and Electronic Systems</td>
<td>C317, C315, C319, C318, C316</td>
<td></td>
</tr>
<tr>
<td>A4- Diagnose passenger restraint systems</td>
<td>Electrical and Electronic Systems</td>
<td>C335, C335</td>
<td></td>
</tr>
<tr>
<td>A5- Service electrical accessories</td>
<td>Electrical and Electronic Systems</td>
<td>C336, C310</td>
<td></td>
</tr>
<tr>
<td>B2- Service heating and ventilation systems</td>
<td>HVAC</td>
<td>C362, C833, C366, C834, C367</td>
<td>C364, C834</td>
</tr>
<tr>
<td>B3- Service air conditioning systems</td>
<td>HVAC</td>
<td>C350, C654, C863, C356, C830</td>
<td>C653, C826, C355, C829, C873, C831, C832</td>
</tr>
<tr>
<td>C3- Evaluate engine mechanical condition</td>
<td>ENGINE REPAIR</td>
<td>C004, C007, C715, C716, C005, C670</td>
<td></td>
</tr>
<tr>
<td>C5- Perform engine repairs</td>
<td>ENGINE REPAIR</td>
<td>C676, C673, C674, C677, C723, C021, C722, C719, C720, C679, C029, C030, C736, C678, C727, C728, C036, C729, C733, C597, C731</td>
<td>C886, C671, C012, C025, C721, C724, C027, C718, C730, C039, C596</td>
</tr>
<tr>
<td>C6- Service gaskets and seals</td>
<td>ENGINE REPAIR</td>
<td>C541, C675</td>
<td></td>
</tr>
<tr>
<td>-------------------------------</td>
<td>---------------</td>
<td>------------</td>
<td></td>
</tr>
<tr>
<td>D1- Service lubrication systems</td>
<td>ENGINE REPAIR</td>
<td>C737, C732, C736</td>
<td></td>
</tr>
<tr>
<td>D2- Service cooling systems</td>
<td>ENGINE REPAIR</td>
<td>C578, C734, C048, C735, C050, C053, C598, C680, C052, C871</td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX B -
Assessment Guidelines
Appendix B
Assessment Guidelines

Program: Automotive Service Technician (AST 2)

Training providers delivering Automotive Service Technician (AST 2) apprenticeship in-school technical training are required to enter the following information in ITA Direct Access for each apprentice:

- An in-school mark in the form of a percentage
  (Minimum 70% is required for a pass)

Training Provider Component: In-School Technical Training

The in-school mark for each level is derived from a combination of theory and practical assessments. This mark is then combined with the ITA Standard Level Examination to determine a final mark for the level.

Calculation tables showing the subject competencies, theory and practical percentage weightings for each competency are shown in the Grading Sheet: “Subject Competencies and Weightings” section of this document.

Automotive Service Technician (AST 2):

- The theory competency result is calculated based on 100% on accumulated competencies;
- The practical competency result is calculated based on 100% on accumulated competencies;
- The final in-school result is calculated by applying a weighting of 80% to the final theory result and a weighting of 20% to the practical result and then adding the two results together.

Successful completion of the in-school training for each level is defined as an in-school mark of 70% or greater.

ITA Component: ITA Standardized Level Examinations

There are no standardized level examinations for the current Automotive Service Technician (AST 2) program.

ITA Certificate of Qualification (C of Q) Exam

Apprentices registered in the Automotive Service Technician (AST 2) program are required to write a C of Q exam after completing the in-school technical training. A score of 70% or higher is required for a pass.

ITA Certificate of Qualification exams should be requested by training providers via the usual ITA procedure.

ITA will administer and invigilate ITA Certificate of Qualification exams and score and record exam results in ITA Direct Access.
# Grading Sheet: Subject Competency and Weightings

<table>
<thead>
<tr>
<th>LINE</th>
<th>TRAINING TOPICS &amp; SUGGESTED TIME ALLOCATION</th>
<th>THEORY WEIGHTING</th>
<th>PRACTICAL WEIGHTING</th>
</tr>
</thead>
<tbody>
<tr>
<td>2A</td>
<td>Advanced Electrical Systems</td>
<td>20%</td>
<td>31%</td>
</tr>
<tr>
<td>2B</td>
<td>Heating, Ventilation and Air Conditioning Systems</td>
<td>22%</td>
<td>17%</td>
</tr>
<tr>
<td>2C</td>
<td>Engines</td>
<td>38%</td>
<td>39%</td>
</tr>
<tr>
<td>2D</td>
<td>Engine Support Systems</td>
<td>18%</td>
<td>13%</td>
</tr>
<tr>
<td>2E</td>
<td>Hybrid Vehicle Safety</td>
<td>2%</td>
<td>0%</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>100%</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

Calculated by the Training Provider
AUTOMOTIVE SERVICE TECHNICIAN (AST 2) in-school theory & practical subject competency weighting

80%  20%

Training Provider enters final in-school mark into ITA Direct Access
A score of 70% or higher is required for a pass.

Uploaded by ITA:
C of Q Final Mark
A score of 70% or higher is required for a pass.

FINAL%
PROGRAM OUTLINE
Automotive Service Technician 3
Automotive Service Technician 3

PROGRAM OUTLINE

MAY 2012

BASED ON
NOA 2009

Developed by
Industry Training Authority
Province of British Columbia
# TABLE OF CONTENTS

## Section 1 INTRODUCTION
- Foreword
- Acknowledgements
- How to Use this Document

## Section 2 PROGRAM OVERVIEW
- Program Credentialing Model
- Occupational Analysis Chart
- Training Topics and Suggested Time Allocation

## Section 3 PROGRAM CONTENT
- Automotive Service Technician

## Section 4 TRAINING PROVIDER STANDARDS
- Facility Requirements
- Tools and Equipment
- Reference Materials
- Instructor Requirements

## APPENDIX A – PRACTICAL ASSESSMENT
## APPENDIX B – ASSESSMENT GUIDELINES
Section 1
INTRODUCTION

Automotive Service Technician 3
Introduction

Foreword

This Program Outline is developed by the Automotive Training Standards Organization (ATSO) in accordance with the General Regulations made pursuant to the “Industry Training and Apprenticeship Act” of British Columbia. It reflects updated standards based on the 2009 Automotive Service Technician National Occupational Analysis (NOA). This Program Outline was prepared with the advice and assistance of an industry-centered advisory committee in cooperation with the Automotive Training Standards Organization. The Program Outline is intended as a guide for providers, instructors, apprentices and their sponsors. This Program Outline is separated into four main sections which include:

The Introduction - Contains a Foreword and an Acknowledgements section that lists all of the participants who were involved in the creation of this document, as well as a section called “How to Use this Document” which provides an oversight on how this document can be used.

The Program Overview - Contains a Credentialing Model that shows the path and time requirements for the apprentice, an Occupational Analysis Chart that has the General Areas of Competency (GAC) and the individual competencies, and a Training Topics and Suggested Time Allocation which provides a suggested percentage of time for the theory and practical components for each GAC in this program.

The Program Content - Represents individual General Areas of Competency which are further separated into competencies defined by Objectives, Learning Tasks and Content.

The Training Provider Standards - A guide on Automotive Service Technician teaching facilities which outlines the requirements needed to provide training for this program. The Facility Requirements section provides minimal requirements for facilities seeking designation and upgrade. The Tools and Equipment section lists the tools required to cover the competencies of this program. The Reference Material section is a collection of materials used for learning guides by the apprentice and instructors for the theory and the practical portion of the program. Finally, the Instructor Requirements section provides the level of knowledge and experience that each instructor must have to competently provide instruction in this program.

Practical instruction through demonstration and through student participation should be integrated within classroom sessions. Safe working practices, even though not always specified in each operation or topic, are an implied part of the program and should be stressed throughout the apprenticeship. It is the responsibility of employers to ensure safety training for the apprentices working on their work sites.

For more information please refer to the Program Profile document on the ITA website for the individual program.

SAFETY ADVISORY

Be advised that references to the WorkSafe BC safety regulations contained within these materials do not/may not reflect the most recent Occupational Health and Safety Regulation (the current Standards and Regulation in BC can be obtained on the following website: [http://www.worksafebc.com](http://www.worksafebc.com)). Please note that it is always the responsibility of any person using these materials to inform him/herself about the Occupational Health and Safety Regulation pertaining to his/her work.
Acknowledgements

The Program Outline was prepared with the advice and direction of an industry steering committee convened initially by the Automotive Training Standards Organization (ATSO). Members include:

- Matthew Wilkie  Automotive Service Technician
- Loi Truong  Automotive Service Technician
- Jeff Summers  Automotive Service Technician

Industry Subject Matter Experts retained to assist in the development of Program Outline content:

- Russ Hunter  Instructor BCIT
- Matthew Wilkie  Automotive Service Technician
- Loi Truong  Automotive Service Technician
- Jeff Summers  Automotive Service Technician

Industry Subject Matter Experts retained as outline reviewers:

- Matthew Wilkie  Automotive Service Technician
- Loi Truong  Automotive Service Technician
- Jeff Summers  Automotive Service Technician

Facilitators:

- Lloyd Stamm  ATSO CEO
- Kevin Cudmore  ATSO Program Development Coordinator
- Lee Bouchard  ATSO Assessment Coordinator
- Taryn Wilson  ATSO Administrative Coordinator

The Industry Training Authority would like to acknowledge the dedication and hard work of all the industry representatives appointed to identify the training requirements of the Automotive Service Technician occupation.
# Introduction

## How to Use this Document

This Program Outline has been developed for the use of individuals from several different audiences. The table below describes how each section can be used by each intended audience.

<table>
<thead>
<tr>
<th>Section</th>
<th>Training Providers</th>
<th>Employers/ Sponsors</th>
<th>Apprentices</th>
<th>Challengers</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Industry Training Model</strong></td>
<td>Communicate program length and structure, and all pathways to completion</td>
<td>Understand the length and structure of the program</td>
<td>Understand the length and structure of the program, and pathway to completion</td>
<td>Understand challenger pathway to Certificate of Qualification</td>
</tr>
<tr>
<td><strong>OAC</strong></td>
<td>Communicate the competencies that industry has defined as representing the scope of the occupation</td>
<td>Understand the competencies that an apprentice is expected to demonstrate in order to achieve certification</td>
<td>View the competencies they will achieve as a result of program completion</td>
<td>Understand the competencies they must demonstrate in order to challenge the program</td>
</tr>
<tr>
<td><strong>Training Topics and Suggested Time Allocation</strong></td>
<td>Shows proportionate representation of various GACs at each program level; should map to proportions of time spent on training, practical experience, and assessment</td>
<td>Understand the relative scope of various areas of the occupation, and areas in which the apprentice would require on-the-job experience</td>
<td>Understand the relative scope of various areas of the occupation, and areas in which on-the-job experience would be provided</td>
<td></td>
</tr>
<tr>
<td><strong>Program Outline</strong></td>
<td>Defines the objectives, learning tasks, high level content that must be covered for each competency, as well as defining observable, measurable achievement criteria for objectives with a practical component</td>
<td>Identifies detailed program content and performance expectations for competencies with a practical component; may be used as a checklist prior to signing a recommendation for certification (RFC) for an apprentice</td>
<td>Provides detailed information on program content and performance expectations for demonstrating competency</td>
<td>Allows individual to check program content areas against their own knowledge and performance expectations against their own skill levels</td>
</tr>
<tr>
<td><strong>Training Provider Standards</strong></td>
<td>Defines the facility requirements, tools and equipment, reference materials (if any) and instructor requirements for the program</td>
<td>Identifies the tools and equipment an apprentice is expected to have access to; which are supplied by the training provider and which the student is expected to own</td>
<td>Provides information on the training facility, tools and equipment provided by the school and the student, reference materials they may be expected to acquire, and minimum qualification levels of program instructors</td>
<td>Identifies the tools and equipment a tradesperson is expected to be competent in using or operating; which may be used or provided in a practical assessment</td>
</tr>
</tbody>
</table>
Section 2

PROGRAM OVERVIEW

Automotive Service Technician 3
Program Overview

Program Credentialing Model

Automotive Service Technician (AST 4)
Technical Training: 180 hours (6 weeks*)
WBT: 6,000 hours
ITA Standardized Written Exam
Interprovincial Red Seal Exam

Automotive Service Technician 3
Technical Training: 210 hours (7 weeks*)
Accumulate work-based training hours
ITA Certificate of Qualification Exam

Automotive Service Technician 2
Technical Training: 180 hours (6 weeks*)
Accumulate work-based training hours
ITA Certificate of Qualification Exam

Automotive Service Technician 1
Technical Training: 210 hours (7 weeks*)
Accumulate work-based training hours
ITA Certificate of Qualification Exam

Automotive Service Technician Foundation Program
Technical Training: 30 weeks*

APPRENTICESHIP - DIRECT ENTRY

C of Q = Certificate of Qualification
C of A = Certificate of Apprenticeship
C of C = Certificate of Completion
WBT = Work-Based Training

*Individuals who are holders of both certificates will only be awarded credit for 1,500 WBT hours total

CROSS-PROGRAM CREDITS

C of Q, Truck and Transport Mechanic
Technical Training: None
Work-Based Training: 1,500 hours*

C of Q, Heavy Duty Equipment Technician
Technical Training: None
Work-Based Training: 1,500 hours*

*Suggested duration based on 30-hour week

*Individuals who are holders of both certificates will only be awarded credit for 1,500 WBT hours total
Program Overview

Occupational Analysis Chart

**AUTOMOTIVE SERVICE TECHNICIAN 3**

**Occupation Description:** "Automotive Service Technician 3" means a person who repairs, adjusts and replaces mechanical, electrical and electronic parts of automobiles and light trucks in a retail automotive business. "Retail automotive business" means a business whose primary mechanical repair work is repairing and adjusting vehicles whose gross vehicle weight is less than 5,500 kg.

<table>
<thead>
<tr>
<th>Category</th>
<th>Task Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ELECTRICAL AND ELECTRONIC SYSTEMS</strong></td>
<td>A1 Describe advanced electrical and electronic principles, A2 Interpret advanced wiring diagrams, A3 Describe advanced diagnostic procedures, A4 Use advanced electrical test equipment, A5 Describe computer control systems, A6 Describe multiplex and network systems</td>
</tr>
<tr>
<td><strong>FUEL DELIVERY SYSTEMS</strong></td>
<td>B1 Describe fuel types, B2 Service fuel delivery components, B3 Service gasoline fuel injection components, B4 Describe electronic diesel fuel injection systems</td>
</tr>
<tr>
<td><strong>ELECTRONIC IGNITION SYSTEMS</strong></td>
<td>C1 Describe electronic ignition principles, C2 Service electronic distributor ignition systems, C3 Service electronic ignition systems</td>
</tr>
<tr>
<td><strong>ENGINE MANAGEMENT SYSTEMS</strong></td>
<td>D1 Describe engine management systems, D2 Test engine management input sensors, D3 Test engine management output actuators, D4 Analyze on-board diagnostic system data, D5 Describe gasoline direct injection</td>
</tr>
</tbody>
</table>
### EMISSION CONTROL SYSTEMS

| E1 | Describe vehicle emissions |
| E2 | Describe emission legislation |
| E3 | Service pre-combustion emission systems |
| E4 | Service post-combustion emission systems |
| E5 | Describe diesel emissions systems |
| E6 | Test OBD II evaporative emission systems |
| E7 | Perform exhaust gas analysis |

---

**Program Overview**
## Training Topics and Suggested Time Allocation

### AUTOMOTIVE SERVICE TECHNICIAN 3

<table>
<thead>
<tr>
<th>Line A</th>
<th>ELECTRICAL AND ELECTRONIC SYSTEMS</th>
<th>% of Time</th>
<th>Theory</th>
<th>Practical</th>
<th>Total</th>
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<tbody>
<tr>
<td>A1</td>
<td>Describe advanced electrical and electronic principles</td>
<td>17%</td>
<td>50%</td>
<td>50%</td>
<td>100%</td>
</tr>
<tr>
<td>A2</td>
<td>Interpret advanced wiring diagrams</td>
<td>√</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A3</td>
<td>Describe advanced diagnostic procedures</td>
<td>√</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A4</td>
<td>Use advanced electrical test equipment</td>
<td>√</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A5</td>
<td>Describe computer control systems</td>
<td></td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A6</td>
<td>Describe multiplex and network systems</td>
<td></td>
<td>√</td>
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<table>
<thead>
<tr>
<th>Line B</th>
<th>FUEL DELIVERY SYSTEMS</th>
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<th>Practical</th>
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<tr>
<td>B1</td>
<td>Describe fuel types</td>
<td>23%</td>
<td>40%</td>
<td>60%</td>
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<tr>
<td>B2</td>
<td>Service fuel delivery components</td>
<td></td>
<td>√</td>
<td></td>
<td></td>
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<tr>
<td>B3</td>
<td>Service gasoline fuel injection components</td>
<td>√</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B4</td>
<td>Describe electronic diesel fuel injection systems</td>
<td></td>
<td>√</td>
<td></td>
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</table>

<table>
<thead>
<tr>
<th>Line C</th>
<th>ELECTRONIC IGNITION SYSTEMS</th>
<th>% of Time</th>
<th>Theory</th>
<th>Practical</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1</td>
<td>Describe electronic ignition principles</td>
<td>17%</td>
<td>30%</td>
<td>70%</td>
<td>100%</td>
</tr>
<tr>
<td>C2</td>
<td>Service electronic distributor ignition systems</td>
<td></td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C3</td>
<td>Service electronic ignition systems</td>
<td></td>
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</table>

<table>
<thead>
<tr>
<th>Line D</th>
<th>ENGINE MANAGEMENT SYSTEMS</th>
<th>% of Time</th>
<th>Theory</th>
<th>Practical</th>
<th>Total</th>
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<tr>
<td>D1</td>
<td>Describe engine management systems</td>
<td>29%</td>
<td>80%</td>
<td>20%</td>
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<td>D2</td>
<td>Test engine management input sensors</td>
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<td>√</td>
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</tr>
<tr>
<td>D3</td>
<td>Test engine management output actuators</td>
<td>√</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>D4</td>
<td>Analyze on-board diagnostic system data</td>
<td></td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D5</td>
<td>Describe gasoline direct injection</td>
<td></td>
<td>√</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Line E</th>
<th>EMISSION CONTROL SYSTEMS</th>
<th>% of Time</th>
<th>Theory</th>
<th>Practical</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>E1</td>
<td>Describe vehicle emissions</td>
<td>14%</td>
<td>30%</td>
<td>70%</td>
<td>100%</td>
</tr>
<tr>
<td>E2</td>
<td>Describe emission legislation</td>
<td></td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>E3</td>
<td>Service pre-combustion emission systems</td>
<td>√</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E4</td>
<td>Service post-combustion emission systems</td>
<td></td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>E5</td>
<td>Describe diesel emissions systems</td>
<td></td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>E6</td>
<td>Test OBD II evaporative emission systems</td>
<td>√</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E7</td>
<td>Perform exhaust gas analysis</td>
<td>√</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Total Percentage for Automotive Service Technician 3**: 100%

The theory and practical weighting distribution for AST 3 is **46%** theory and **54%** practical.
Section 3

PROGRAM CONTENT

Automotive Service Technician 3
Automotive Service Technician 3
Program Content

LINE (GAC): A ELECTRICAL AND ELECTRONIC SYSTEMS
Competency: A1 Describe advanced electrical and electronic principles

Objectives
To be competent in this area, the individual must be able to:
- Identify components of advanced electronic systems.
- Describe the design and operation of advanced electronic components.
- Describe electrical signal types.

LEARNING TASKS

1. Identify electronic components
   - Diodes
     - Clamping
     - Zener
   - Transistors
   - Analog to digital converter
   - Digital to analog converter
   - Logic gates
   - Capacitors
   - Photonic semiconductors
     - Diodes
     - Resistors
     - Transistors

2. Describe the design and operation of advanced electronic components
   - Semiconductor theory
     - Doping
     - PN junction
     - PNP and NPN junction
   - Capacitance
     - Noise suppression devices
   - Diodes
     - Zener
     - Clamping

3. Describe electrical signal types
   - Analog
     - Alternating Current / sine wave
   - Digital
     - Direct Current / square wave
   - Frequency modulation
   - Amplitude modulation
   - Pulse width modulation
   - Duty cycle
   - Serial data
Program Content

LINE (GAC): A ELECTRICAL AND ELECTRONIC SYSTEMS
Competency: A2 Interpret advanced wiring diagrams

Objectives
To be competent in this area, the individual must be able to:
• Describe components found on advanced wiring diagrams.
• Interpret advanced wiring diagrams and relate them to vehicle wiring.

LEARNING TASKS

1. Identify symbols and components located on advanced wiring diagrams
   • Harness locations
   • Connectors
     o Location
     o Pin terminal numbers
     o Terminal signal
   • Branching points
   • Ground locations
   • Power source
   • Computer controls
     o Ground control circuits
     o Power control circuits
     o Regulated voltage circuits
   • Shielding
     o Twisted pairs
     o Fiber optics
     o Routing

2. Describe the design and layout of advanced wiring diagrams
   • North American wiring diagrams
   • European wiring diagrams
     o Track style
     o D.I.N.
   • Asian wiring diagrams
   • Aftermarket wiring diagrams

Achievement Criteria:
Given a written and/or a practical assessment of advanced wiring diagrams, the learner will be able to demonstrate knowledge of the trade by achieving 70% or better based on a summative total of Instructor assessment.
Program Content

LINE (GAC): A ELECTRICAL AND ELECTRONIC SYSTEMS
Competency: A3 Describe advanced diagnostic procedures

Objectives
To be competent in this area, the individual must be able to:
- Describe advanced diagnostic procedures used for troubleshooting.
- Locate information sources to assist with troubleshooting procedures.

LEARNING TASKS

1. Review the importance of following a diagnostic process

   - Cost of improper diagnosis
   - Unhappy customers
   - Lost business
   - Time management
   - Efficiency
   - Damage to components

2. Describe diagnostic procedures

   - Seven-step process
     - Gather information from customer
     - Verify complaint
     - Brainstorm possible causes
     - Fault trace most likely cause
     - Locate root cause of problem
     - Repair root cause
     - Verify repair
     - Baseline test

3. Describe troubleshooting resources for technicians

   - Factory service manuals
     - Diagnostic flow charts
       - By code
       - By symptom
   - Technical Service Bulletins
   - Aftermarket resources
   - Internet forums
   - Peer groups
     - Shop foreman
     - Other technicians
Program Content

LINE (GAC): A ELECTRICAL AND ELECTRONIC SYSTEMS
Competency: A4 Use advanced electrical test equipment

Objectives

To be competent in this area, the individual must be able to:
- Select appropriate electrical testing equipment for the testing advanced electrical signals.
- Demonstrate the use of advanced diagnostic electrical testing equipment.

LEARNING TASKS

1. Describe the types of electrical testing equipment
   - Multi meter
   - Lab scope
   - Digital storage oscilloscope
   - Digital test equipment
     - Sample rate
     - Refresh rate
     - Baud rate
   - Scan tools
     - Factory
     - Aftermarket
   - Break out box

2. Use electrical testing equipment
   - Multi meter
     - Duty cycle
     - Frequency
     - Voltage drop
   - Lab scope
     - Alternating Current (A/C)
     - Direct Current (D/C)
     - Trigger
       - Rising slope
       - Falling slope
     - Pulse width
     - Time base scale
   - Scan tools
   - Code retrieval
   - Freeze frames
   - Movie capture
   - Live data stream
   - Clearing codes
   - Two way communication
     - Activation of actuators
   - Break out box
   - Airbag precautions
LEARNING TASKS

Achievement Criteria:
Given a written and/or a practical assessment on advanced electrical test systems, the learner will be able to demonstrate knowledge of the trade by achieving 70% or better based on a summative total of Instructor assessment.
Program Content

LINE (GAC): A ELECTRICAL AND ELECTRONIC SYSTEMS
Competency: A5 Describe computer control systems

Objectives
To be competent in this area, the individual must be able to:
- Describe the components of computer control systems.
- Describe the function of computer control systems.

LEARNING TASKS

1. Identify the components of computer control systems
   - Microprocessor
   - Software
   - Inputs
   - Outputs
   - Wiring and connectors
   - Diagnostic connections
     - Data Link Connector (DLC)

2. Describe the operation of computer control systems
   - Microprocessor
     - Memory
       - Random Access (RAM)
       - Keep Alive (KAM)
       - Programmable Read Only (PROM)
       - Electronic Erasable Programmable (EEPROM)
     - Analog digital converters
     - Processor speed
     - Sample rate
     - Baud rate
   - Software
     - Version
     - Upgrading
     - Re-flashing modules
   - Diagnostic connection
     - Communication
     - Diagnostic bus
Program Content

Line (GAC): A Electrical and Electronic Systems

Competency: A6 Describe multiplex and network systems

Objectives

To be competent in this area, the individual must be able to:

• Describe the components of multiplex and network computer control systems.
• Describe the function of multiplex and network computer control systems.

LEARNING TASKS

1. Identify the components of multiplex and network computer control systems
   - Microprocessor
   - Software
   - Inputs
   - Outputs
   - Wiring and connectors
     - Shielded wires
     - Twisted pair
     - Fiber optic
   - Diagnostic connections
     - Data Link Connector (DLC)
   - Modules
   - Slaves
   - Gateways
   - Network configurations
     - Ring
     - Parallel
     - Bus

2. Describe the operation of multiplex and network computer control systems
   - Advantages over traditional computer control systems
     - Less wiring
     - Software flexibility
     - Application of accessories
     - Detailed fault finding
     - Two way communication with entire vehicle
   - Microprocessor
     - Processing speed
   - Protocol Classifications
     - Society of Automotive Engineers (SAE)
       - A
       - B
       - C
LEARNING TASKS

CONTENT

- Control Area Network (CAN)
  - Lo speed
  - Medium speed
  - Hi speed
- Types and locations of modules
- End of line resistors
- Modules in parallel or series
- Local Interconnect Network (LIN)
  - Slave module
  - One way communication
  - Diagnostic

3. Describe operations of Multiplexed Electronic System

- Inputs
- Outputs
- Relay control
- Testing
  - Headlight
  - Wiper
  - Window control
  - Anti-theft

Achievement Criteria:
Given a written and/or a practical assessment on multiplex and network systems, the learner will be able to demonstrate knowledge of the trade by achieving 70% or better based on a summative total of Instructor assessment.
LINE (GAC):  B  FUEL DELIVERY SYSTEMS
Competency:  B1  Describe fuel types

Objectives
To be competent in this area, the individual must be able to:
• Identify different fuel types.
• Describe the characteristics and composition of different fuel types.
• Describe the benefits and drawbacks of each fuel type.

LEARNING TASKS
1. Identify fuel types
   • Diesel
   o Bio diesel
   • Gasoline
   • Ethanol / methanol blends
   • Liquid petroleum gas
   • Compressed natural gas

2. Describe fuel characteristics and composition
   • Safety
   • Refining
   • Ratings
   o Octane
   o Cetane
   o Blend ratio
   • Properties
   o Molecular composition
   o Heat value
   o Flash point
   o Gel point
   • Additives
   • Market share
   • Benefits and drawbacks
   • Storage
LINE (GAC): B  FUEL DELIVERY SYSTEMS
Competency: B2  Service fuel delivery components

Objectives
To be competent in this area, the individual must be able to:
- Identify fuel delivery system components.
- Describe the design and operation of fuel delivery systems.
- Inspect, diagnose and repair fuel delivery systems.

LEARNING TASKS
1. Identify components of fuel delivery systems
   - Fuel tank
   - Filler neck and cap
   - Roll over valves
   - Fuel pumps
   - Control relays
   - Fuel pressure regulator
   - Filters and strainers
   - Fuel heaters
   - Water separators
   - Level sensor and gauge
   - Gaskets and seals
   - Associated lines and fittings

2. Describe the design and operation of fuel delivery systems
   - Fuel tank
   - Filler neck and cap
   - Roll over valves
   - Fuel pumps
   - Fuel pump control module
   - Emergency fuel shut off
   - Control relays
   - Fuel pressure regulator
   - Returnless fuel system
   - Fuel temperature sensor
   - Fuel pressure sensor
   - Filters and strainers
   - Fuel heaters
   - Water separators
   - Level sensor and gauge
   - Gaskets and seals
   - Associated lines and fittings
   - Construction materials
Program Content

<table>
<thead>
<tr>
<th>LEARNING TASKS</th>
<th>CONTENT</th>
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<tbody>
<tr>
<td>3. Inspect and service fuel delivery systems</td>
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</tr>
<tr>
<td></td>
<td>• Safety</td>
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<td></td>
<td>• Inspection</td>
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<tr>
<td></td>
<td>• Routine maintenance</td>
</tr>
<tr>
<td></td>
<td>• Parts removal and replacement</td>
</tr>
<tr>
<td></td>
<td>• Depressurize and recover fuel</td>
</tr>
</tbody>
</table>

**Achievement Criteria:**
Given a written and/or a practical assessment on fuel delivery components, the learner will be able to demonstrate knowledge of the trade by achieving 70% or better based on a summative total of Instructor assessment.
Program Content

LINE (GAC): B FUEL DELIVERY SYSTEMS
Competency: B3 Service gasoline fuel injection components

Objectives
To be competent in this area, the individual must be able to:
• Identify gasoline fuel injection system components.
• Describe the design and operation of gasoline fuel injection systems.
• Inspect, diagnose and repair gasoline fuel injection system components.

LEARNING TASKS
1. Identify components of gasoline fuel injection systems
   - Fuel injectors
     - Throttle body
     - Multi port
   - Injector rail
   - Throttle body
   - Lines and fittings

2. Describe the design and operation of gasoline fuel injection system components
   - Fuel injectors
     - Throttle body
     - Multi port
     - Top feed
     - Side feed
   - Injector firing sequences
     - Group fired
     - Simultaneous
     - Sequential
   - Injector driver types
     - Pulse width modulation
     - Saturation
     - Peak and hold
   - Injector rail
   - Throttle body
   - Lines and fittings
   - Construction materials
Program Content

LEARNING TASKS

3. Inspect and service fuel injection systems

CONTENT

- Safety
- Inspection
  - Visual
  - Audible
  - Smell
- Testing
  - Pressure
  - Vacuum
  - Volume
  - Electrical
  - Mechanical
- Routine maintenance
- Parts removal and replacement
- Cleaning precautions
- Emissions

Achievement Criteria:
Given a written and/or a practical assessment on gasoline and fuel injection components, the learner will be able to demonstrate knowledge of the trade by achieving 70% or better based on a summative total of Instructor assessment.
Program Content

LINE (GAC): B  FUEL DELIVERY SYSTEMS
Competency: B4  Describe electronic diesel fuel injection systems

Objectives
To be competent in this area, the individual must be able to:
• Identify diesel electronic fuel injection system components.
• Describe the design and operation of diesel electronic fuel injection systems.

LEARNING TASKS

1. Identify components of diesel electronic fuel injection systems
   • Fuel pumps
     o Low pressure
     o High pressure
   • Filters
   • Heaters
   • Water separators
   • Gaskets and seals
   • Associated lines and fittings
   • Fuel rails
   • Fuel injectors
     o Piezo
     o HEUI
     o Unit injectors
   • Control modules
   • Sensors
   • Glow plugs

2. Describe the design and operation of alternate fuel systems
   • Fuel pumps
     o Low pressure
     o High pressure
   • Pump timing
   • Sensors
   • Fuel injectors
     o Piezo
     o HEUI
     o Unit injectors
   • Fuel injection timing
     o Pre-combustion
     o Main charge
     o Post combustion
   • Glow plugs
Program Content

LINE (GAC): C ELECTRONIC IGNITION SYSTEMS

Competency: C1 Describe electronic ignition principles

Objectives
To be competent in this area, the individual must be able to describe the design and operation of electronic ignition systems.

LEARNING TASKS

1. Describe the design and operation of electronic ignition systems

CONTENT
- Purpose of ignition system
- Timing
  - Before top dead centre (BTDC)
  - After top dead centre (ATDC)
  - Advance
  - Retard
  - Mechanical
  - Electrical
- Coils
  - Primary circuit
  - Secondary circuit
  - Induced voltage
  - Coil saturation
- Dwell
  - Fixed
  - Variable
- Triggering devices
  - Engine position
  - Engine speed
- Sensors
  - Knock
  - Temperature
  - Load
- Distributor systems
- Electronic systems
  - Coil on plug
  - Waste spark
- Spark plugs
  - Temperature
  - Reach
  - Thread diameter
  - Resistance
  - Electrode design
Achievement Criteria:
Given a written and/or a practical assessment of electronic ignition principles, the learner will be able to demonstrate knowledge of the trade by achieving 70% or better based on a summative total of Instructor assessment.
Program Content

LINE (GAC): C  ELECTRONIC IGNITION SYSTEMS
Competency: C2  Service electronic distributor ignition systems

Objectives
To be competent in this area, the individual must be able to:
- Describe the components of electronic distributor ignition systems.
- Diagnose and repair electronic distributor ignition systems.

LEARNING TASKS
1. Describe the components of electronic distributor ignition systems
   - Coil
     - Primary circuit
     - Secondary circuit
   - Triggering devices
     - Engine position
     - Engine speed
   - Sensors
     - Knock
     - Temperature
     - Load
   - Modules
   - Distributor
     - Cap
     - Rotor
     - Housing
   - High tension wires
   - Spark plugs
     - Temperature
     - Reach
     - Thread diameter
     - Resistance
     - Electrode design
<table>
<thead>
<tr>
<th>LEARNING TASKS</th>
<th>CONTENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Inspect and repair electronic distributor</td>
<td>• Inspection</td>
</tr>
<tr>
<td>ignition systems</td>
<td>o Visual</td>
</tr>
<tr>
<td></td>
<td>o Audible</td>
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<td>• Testing</td>
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<td>o Electrical</td>
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<td></td>
<td>- Primary</td>
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<td>- Secondary wave pattern</td>
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<td>- Diagnostic codes</td>
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<td>- Data stream</td>
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<td></td>
<td>o Mechanical</td>
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<tr>
<td></td>
<td>• Component removal and replacement</td>
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<td></td>
<td>• Adjustments</td>
</tr>
<tr>
<td></td>
<td>o Timing</td>
</tr>
</tbody>
</table>

**Achievement Criteria:**
Given a written and/or a practical assessment on electronic distributor ignition systems, the learner will be able to demonstrate knowledge of the trade by achieving 70% or better based on a summative total of Instructor assessment.
Program Content

LINE (GAC): C ELECTRONIC IGNITION SYSTEMS
Competency: C3 Service electronic ignition systems

Objectives
To be competent in this area, the individual must be able to:
- Describe the components of electronic ignition systems.
- Diagnose and repair electronic ignition systems.

LEARNING TASKS
1. Describe the components of electronic ignition systems
   - Coil
     - Waste spark
     - Coil on plug
     - Primary circuit
     - Secondary circuit
   - Triggering devices
     - Engine position
     - Engine speed
   - Sensors
     - Knock
     - Temperature
     - Load
   - High tension wires
   - Spark plugs
     - Temperature
     - Reach
     - Thread diameter
     - Resistance
     - Electrode design

2. Inspect and repair electronic ignition systems
   - Inspection
     - Visual
   - Testing
     - Electrical
       - Ignition patterns
       - Primary
       - Secondary
       - Diagnostic codes
       - Data stream
     - Mechanical
   - Component removal and replacement
Achievement Criteria:
Given a written and/or a practical assessment on electronic ignition systems, the learner will be able to demonstrate knowledge of the trade by achieving 70% or better based on a summative total of Instructor assessment.
LINE (GAC): D ENGINE MANAGEMENT SYSTEMS
Competency: D1 Describe engine management systems

Objectives
To be competent in this area, the individual must be able to:
- Identify components of engine management systems.
- Describe the functions of engine management systems.

LEARNING TASKS

1. Identify components of engine management systems
- Microprocessors
- Software
- Inputs
- Outputs
- Wiring and connectors
- Diagnostic connections

2. Describe the design and operation of engine management systems
- Monitoring and controlling
  - Emissions
  - Fuel economy
  - Drive-ability
  - Warranty data collection
  - Trouble shooting
- Modes of operation
  - Open loop
  - Closed loop
  - Limp home
- Communication with other systems
  - Ignition
  - Transmission
  - Brakes
    - Traction control
    - Dynamic stability
  - Air conditioning / climate control
Program Content

LINE (GAC): D ENGINE MANAGEMENT SYSTEMS
Competency: D2 Test engine management input sensors

Objectives
To be competent in this area, the individual must be able to:
- Identify engine management input sensors.
- Describe the function and operation of engine management input sensors.
- Inspect, test and repair engine management input sensors.

LEARNING TASKS
1. Identify engine management input sensors
   - Air volume
   - Air
     - Temperature
     - Pressure
   - Engine
     - Temperature
     - Speed
     - Position
     - Load
     - Knock
     - Oil pressure
   - Throttle position
   - Oxygen content of exhaust
   - Vehicle speed
   - Inputs from other computer systems
     - Transmission
     - Air conditioning
     - Brake system

2. Describe the design and operation of engine management input sensors
   - Air volume
   - Air
     - Temperature
     - Pressure
   - Engine
     - Temperature
     - Speed
     - Position
     - Load
     - Knock
     - Oil pressure
   - Throttle position
   - Oxygen content of exhaust
Program Content

LEARNING TASKS

3. Inspect, test and repair engine management input sensors

CONTENT

- Vehicle speed
- Inputs from other computer systems
  - Transmission
  - Ignition (non-integral)
  - Air conditioning
  - Brake system
- Safety
- Inspection
  - Visual
- Testing
  - Vacuum
  - Electrical
  - Mechanical
- Routine maintenance
- Parts removal and replacement
- Cleaning precautions
- Adjustment
- Emissions

Achievement Criteria:
Given a written and/or a practical assessment on engine management input sensors, the learner will be able to demonstrate knowledge of the trade by achieving 70% or better based on a summative total of Instructor assessment.
Program Content

LINE (GAC): D  ENGINE MANAGEMENT SYSTEMS
Competency: D3  Test engine management output actuators

Objectives
To be competent in this area, the individual must be able to:
- Identify engine management output actuators.
- Describe the function and operation of engine management output actuators.
- Inspect, test and repair engine management output actuators.

LEARNING TASKS

1. Identify engine management output actuators
   - Fuel injectors
   - Idle speed control
     - Electronic throttle body
     - Idle speed motor
   - Control circuits
     - Fuel pump
     - Cooling fan
     - Air conditioning compressor
     - Vacuum solenoids
     - Oxygen sensor heater
   - Communication with other computer systems
     - Transmission
     - Air conditioning
     - Ignition (non-integral)
     - Brake system

2. Describe the design and operation of engine management output sensors
   - Fuel injectors
   - Idle speed control
     - Electronic throttle body
     - Idle speed motor
   - Control circuits
     - Fuel pump
     - Cooling fan
     - Air conditioning compressor
     - Vacuum solenoids
     - Oxygen sensor heater
   - Communication with other computer systems
     - Transmission
     - Air conditioning
     - Ignition (non-integral)
     - Brake system
### LEARNING TASKS

3. Inspect, test and repair engine management output sensors

### CONTENT

- Safety
- Inspection
  - Visual
- Testing
  - Electrical
  - Mechanical
- Routine maintenance
- Parts removal and replacement
- Cleaning precautions
- Adjustment
- Emissions

**Achievement Criteria:**

Given a written and/or a practical assessment on engine management output actuators, the learner will be able to demonstrate knowledge of the trade by achieving 70% or better based on a summative total of Instructor assessment.
Program Content

LINE (GAC): D
COMPETENCY: D4 Analyze on-board diagnostic system data

Objectives
To be competent in this area, the individual must be able to:
- Describe the types of on-board diagnostic systems.
- Describe the types of on-board diagnostic system data.
- Access, and interpret on-board diagnostic system data.

LEARNING TASKS

1. Describe on-board diagnostic systems
   - History
   - Agencies
     - Environmental Protection Agency (EPA)
     - California Air Resources Board (CARB)
     - International Organization of Standardization (ISO)
   - OBD I
     - Pre 1996
   - Fault codes
     - Fuel system
     - Ignition system
   - OBD II
     - Post 1996 systems
   - Fault codes
     - Fuel system
     - Ignition system
     - Emissions exceeding 1.5 times federal standard

2. Describe the design and operation of engine on-board diagnostic systems
   - OBD I
   - Self diagnostics
     - Passive
   - Fault codes
     - Fuel system
     - Ignition system
   - Manufacturer specific
     - Code retrieval
     - Tooling
     - Two-way communication
     - Data stream information
   - OBD II
LEARNING TASKS

CONTENT

- Self diagnostics
  - Passive
  - Active
  - Rational
- Fault codes
  - Identification
  - Types 0,1,2,3
  - Systems P,B,C,U
- Standardized Data Link Connector (DLC)
- Diagnostics
- Mandatory information
- MIL control
- Emission system monitors

3. Access, and interpret on-board diagnostic system information

- Fault codes
  - Hard
  - Pending
  - Clearing codes
  - Use resources to look up codes
- Freeze frame information
- Live data stream information
- Parameters
- Two-way communication
  - Activating output actuators
- Upgrading software
- Readiness status
- Reset adaptations
- Drive cycles
- Scan tool interfacing
  - OEM interface
  - Global OBD II interface
  - Diagnostic modes 1-9

Achievement Criteria:
Given a written and/or a practical assessment on onboard diagnostic systems data, the learner will be able to demonstrate knowledge of the trade by achieving 70% or better based on a summative total of Instructor assessment.
Program Content

LINE (GAC): D  ENGINE MANAGEMENT SYSTEMS
Competency: D5  Describe gasoline direct injection

Objectives
To be competent in this area, the individual must be able to:
- Describe components of gasoline direct injection.
- Describe the design and operation of gasoline direct injection.

<table>
<thead>
<tr>
<th>LEARNING TASKS</th>
<th>CONTENT</th>
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</thead>
<tbody>
<tr>
<td>1. Describe components of gasoline direct injection</td>
<td>• Cylinder deactivation systems</td>
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<td></td>
<td>• High pressure fuel pump</td>
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<td>o Mechanical</td>
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<td>o Electrical</td>
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<td>• Lean burn</td>
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<td>• Throttle body less systems</td>
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<tr>
<td>2. Describe the design and operation of gasoline</td>
<td>• Cylinder deactivation systems</td>
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<td>direct injection</td>
<td>• High pressure fuel pump</td>
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<td>o Mechanical</td>
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<td>• Lean burn</td>
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<td>• Throttle-less systems</td>
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<td>• Modes</td>
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<td>o Homogeneous</td>
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<td>o Stratified</td>
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<td></td>
<td>• Injector timing</td>
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<td>• Spray pattern</td>
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<td>• Compression ratio</td>
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</tbody>
</table>
Program Content

LINE (GAC): E  EMISSION CONTROL SYSTEMS
Competency: E1  Describe vehicle emissions

Objectives
To be competent in this area, the individual must be able to:
- Describe the principles of combustion.
- Describe the by-products from combustion.
- Describe the effects by-products have on the environment from combustion.

LEARNING TASKS
1. Describe the combustion process
   - Products of complete combustion
   - Products of incomplete combustion

2. Describe causes of harmful vehicle emissions
   - Oxides of nitrogen
   - Hydrocarbons
   - Carbon monoxide
   - Carbon dioxide
   - Oxides of sulfur
   - Particulates
   - Ground level ozone

3. Describe the effects by-products have on the environment from combustion
   - Oxides of nitrogen
     - Smog
   - Hydrocarbons
     - Smog
     - Haze
     - Respiratory health
   - Carbon monoxide
     - Poisonous gas
   - Carbon dioxide
     - Global warming
     - Greenhouse effect
   - Oxides of sulfur
     - Acid rain
   - Particulates
     - Smog
     - Haze
     - Respiratory health
   - Ground level ozone
Program Content

LINE (GAC): E  EMISSION CONTROL SYSTEMS
Competency: E2 Describe emission legislation

Objectives
To be competent in this area, the individual must be able to identify and describe legislation pertaining to vehicle emission regulations.

LEARNING TASKS
1. Describe legislation pertaining to vehicle emissions

CONTENT
- Federal
  - Canadian Environmental Assessment Agency
- Provincial
  - AirCare program
- American
  - Environmental Protection Agency (EPA)
  - California Air Resource Board (CARB)
- Federal Test Procedure (FTP)
- Inspection / Maintenance (I/M) test
- Acceleration Simulation Mode (ASM) test
- On-board Diagnostic (OBD) test
Program Content

LINE (GAC): E EMISSION CONTROL SYSTEMS
Competency: E3 Service pre-combustion emission systems

Objectives
To be competent in this area, the individual must be able to:
• Identify components of pre-combustion emission systems.
• Describe the design and operation of pre-combustion emission systems.
• Inspect, diagnose and repair pre-combustion emission systems.

LEARNING TASKS
1. Identify components of pre-combustion emission systems

CONTENT
• Engine design
  o Forced induction
  o Cooling system
  o Compression ratio
  o Combustion chamber shape
  o Valve geometry
• Camshaft
  o Profile
  o Variable camshaft timing
• Exhaust gas recirculation
  o Vacuum controls
  o Electric controls
• Fuel control
  o Closed loop
  o Stoichiometric operation
• Positive crank case ventilation
  o Breather box
  o Valves
  o Fixed orifice
  o Filters
  o Heaters
LEARNING TASKS

2. Describe the design and operation of pre-combustion emission systems

- Engine design
  - Miller cycle
  - Forced induction
  - Cooling system
    - Quick warm-up
    - Regulating temperature
  - Compression ratio
  - Combustion chamber shape
- Camshaft
  - Profile
  - Variable camshaft timing
    - Cold start
    - Power enrichment
    - Cruising
- Exhaust gas recirculation
  - Vacuum controls
  - Electric controls
- Fuel control
  - Closed loop
  - Stoichiometric operation
- Positive crank case ventilation
  - Operating cycle
  - Open systems
  - Closed systems

3. Service pre-combustion emission systems

- Inspection
  - Visual
  - Audible
- Testing
  - Electrical
  - Mechanical
- Routine maintenance
- Component cleaning, removal and replacement

Achievement Criteria:

Given a written and/or a practical assessment on pre-combustion emission systems, the learner will be able to demonstrate knowledge of the trade by achieving 70% or better based on a summative total of Instructor assessment.
**Program Content**

**LINE (GAC):** E EMISSION CONTROL SYSTEMS  
**Competency:** E4 Service post-combustion emission systems

**Objectives**

To be competent in this area, the individual must be able to:

- Identify components of post-combustion emission systems.
- Describe the design and operation of post-combustion emission systems.
- Inspect, diagnose and repair post-combustion emission systems.

**LEARNING TASKS**

<table>
<thead>
<tr>
<th>LEARNING TASKS</th>
<th>CONTENT</th>
</tr>
</thead>
</table>
| 1. Identify components of post-combustion emission systems | - Catalyst  
  - 2 way  
  - 3 way  
  - Reduction  
  - Secondary air injection  
  - Air pump  
  - Electric  
  - Mechanical  
  - Pulse air systems  
  - Piping and passages  
  - Sensors  
  - Valves |
| 2. Describe the design and operation of post-combustion emission systems | - Catalyst  
  - 2 way  
  - 3 way  
  - Reduction  
  - Secondary air injection  
  - Air pump  
  - Electric  
  - Mechanical  
  - Pulse air systems  
  - Piping and passages  
  - Sensors  
  - Valves  
  - Modes of operation  
  - Open loop  
  - Closed loop  
  - Cold start  
  - Warm up  
  - Operating temperature  
  - Load  
  - Deceleration  
  - Cruising |
### LEARNING TASKS

3. Service post-combustion emission systems

### CONTENT

- Inspection
  - Visual
  - Audible
- Testing
  - Electrical
  - Mechanical
- Routine maintenance
- Component cleaning, removal and replacement

**Achievement Criteria:**
Given a written and/or a practical assessment on post-combustion emission systems, the learner will be able to demonstrate knowledge of the trade by achieving 70% or better based on a summative total of Instructor assessment.
**Competency:** E5 Describe diesel emissions systems

**Objectives**
To be competent in this area, the individual must be able to:
- Describe diesel pre/post-combustion emission systems.
- Describe diesel exhaust emissions.

<table>
<thead>
<tr>
<th>LEARNING TASKS</th>
<th>CONTENT</th>
</tr>
</thead>
</table>
| 1. Describe diesel pre-combustion emission systems | • Intake air heaters  
• Glow plug systems  
• Block heaters  
• Oil pan heaters  
• Charge air coolers  
• Exhaust gas recirculation systems  
• Crankcase ventilation  
• Evaporative systems |
| 2. Describe post-combustion emissions systems | • Oxidation catalyst  
• Selective catalyst reduction  
• Particulate traps |
| 3. Describe diesel exhaust emissions | • Oxides of Nitrogen  
• Particulate soot  
• Carbon monoxide  
• Hydrocarbons  
• Smoke analysis  
  o White  
  o Black |
**Program Content**

LINE (GAC): E  EMISSION CONTROL SYSTEMS  
Competency: E6  Test OBD II evaporative emission systems

**Objectives**

To be competent in this area, the individual must be able to:
- Identify components of OBD II evaporative emission systems.
- Describe the design and operation of OBD II evaporative emission systems.
- Inspect, diagnose and repair OBD II evaporative emission systems.

**LEARNING TASKS**

<table>
<thead>
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<th>CONTENT</th>
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<tbody>
<tr>
<td><strong>1. Describe the components of OBD II evaporative emission systems</strong></td>
</tr>
<tr>
<td>- Fuel tank</td>
</tr>
<tr>
<td>- Vent lines</td>
</tr>
</tbody>
</table>
| - Valves  
  - Roll over |
| - Purge |
| - Vent |
| - Computer |
| - Sensors  
  - Tank pressure |
| - Fuel temperature |
| - Charcoal canister |
| - Vacuum system |
| - Leakage detection system  
  - Sensors |
| - Leakage detection pump |

<table>
<thead>
<tr>
<th>CONTENT</th>
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</thead>
<tbody>
<tr>
<td><strong>2. Describe the design and operation of OBD II evaporative emission systems</strong></td>
</tr>
<tr>
<td>- Fuel tank</td>
</tr>
</tbody>
</table>
| - Valves  
  - Roll over |
| - Purge |
| - Vent |
| - Computer |
| - Sensors  
  - Tank pressure |
| - Fuel temperature |
| - Charcoal canister |
| - Vacuum system |
| - Leakage detection system  
  - Modes of self-diagnostics |
| - Criteria for leakage detection  
  - Sensors |
| - Leakage detection pump  
  - Fuel cap |
Program Content

LEARNING TASKS

3. Service OBD II evaporative emission systems

CONTENT

- Inspection
  - Visual
  - Audible
- Testing
  - Electrical
    - Scan tool
  - Mechanical
    - Smoke machine
    - Manufacture specific techniques
    - Service port
- Routine maintenance
- Component cleaning, removal and replacement

Achievement Criteria:
Given a written and/or a practical assessment on OBD II evaporative emission systems, the learner will be able to demonstrate knowledge of the trade by achieving 70% or better based on a summative total of Instructor assessment.
Program Content

LINE (GAC):  E  EMISSION CONTROL SYSTEMS
Competency:  E7  Perform exhaust gas analysis

Objectives
To be competent in this area, the individual must be able to:
• Identify gas analysis methods.
• Use gas analyzers to assess exhaust gas content and determine corrective measures.

LEARNING TASKS

1. Identify gas analysis methods
   • Analyzer designs
     o 4 gas
     o 5 gas
   • Opacity
   • Dynamometer

2. Use gas analyzers
   • Calibration and routine maintenance
   • Sample location
     o Pre-cat
     o Post-cat
   • Engine operating modes
     o Open loop
     o Closed loop

3. Assess gas analysis results
   • Cost
   • Causes
   • Corrective measures
   • Potential damage to components
   • Legislative requirements

Achievement Criteria:
Given a written and/or a practical assessment on exhaust gas analysis, the learner will be able to demonstrate knowledge of the trade by achieving 70% or better based on a summative total of Instructor assessment.
Section 4

TRAINING PROVIDER STANDARDS
Facility Requirements

Classroom Area
- Comfortable seating and tables suitable for training, teaching, lecturing.
- Compliance with all local and national fire code and occupational safety requirements.
- Lighting controls to allow easy visibility of projection screen allowing students to take notes.
- Windows must have shades or blinds to adjust sunlight.
- Heating / air conditioning for comfort all year round.
- In-room temperature regulation and ventilation to ensure comfortable room temperature.
- Acoustics in the room must allow the instructor to be heard.
- White marking board with pens and eraser (optional: flipchart in similar size).
- Projection screen or projection area at front of classroom.
- Overhead projector and/or multi-media projector.

Shop Area
- Ceiling shall be a minimum height of 16’ or as varied by good engineering practices and code.
- Appropriate lifting devices (hoists) used in industry.
- Suitable demonstration area.
- Lighting appropriate for good vision in ambient light.
- Compliance with all local and national fire code and occupational safety requirements.
- Must meet Municipal and Provincial bylaws in regards to waste water management and environmental laws.
- Adequate hoist to student ratio.

Lab Requirements
- Does not apply to this program.

Student Facilities
- Does not apply to this program.

Instructor's Office Space
- Does not apply to this program.
Tools and Equipment

Shop Equipment

Standard Tools

1. Air drills/tools
2. Air hammer/chisel
3. Air ratchet
4. Antifreeze tester
5. Axle boot clamp tool
6. Battery post service and reshape tool
7. Belt tension release tool
8. Blow gun
9. Bolt extractor set (easy outs)
10. Brake service tools (adjusters, spring removal, installation and caliper tools)
11. Caulking gun
12. Centre punch
13. Chisels, punches
14. Creeper/fender covers
15. Crowfoot wrenches (flare and std, SAE and Metric)
16. Dial indicator set (flare and std, SAE and Metric)
17. Die grinder
18. Drill and bits
19. Drill gauge
20. Feeler gauges – SAE and metric
21. Files – bastard cut/half round/mill cut/square and thread file
22. Filter wrenches
23. Flare nut wrenches – SAE and metric
24. Flaring tool (SAE, metric and ISO)
25. Flash lights
26. Fuel line disconnect set
27. Hacksaw
28. Hammers – ball peen/dead blow/rubber
29. Mallet/softface
30. Hex keys – SAE and metric
31. High voltage safety gloves (0 rated 1000v)
32. Impact driver and bits
33. Impact wrench and impact socket set – SAE and metric
34. Inspection mirror
35. Jumper lead
36. Magnetic pick up tool
37. Mechanic’s pick set
38. Multimeter (DVOM)
39. Nut driver set – SAE and metric
40. Pliers – slip joint, needle nose, adjustable, wheel weight, side cutter, snap ring, locking, hog ring and battery types
41. Pry bar
42. Pullers – gear, pulley, battery terminal and steering wheel
43. Ratchet and sockets – ¼, ⅜ and ½ drive – SAE and metric, swivel, spark plug, extensions and adapters
44. Rivet gun
45. Scraper (gasket and carbon)
46. Screwdriver set
47. Seal drivers and extractors
48. Soldering tools
49. Standard test leads and probes
50. Steel rule
51. Stethoscope
52. Straight edge
53. Stud extractor
54. Tamper-proof torx set
55. Tap and die set – SAE and metric
56. Tap extractor
57. Tape and ruler
58. Terminal remover tools
59. Test lamp – electronics safe (powered and non-powered)
60. Thermometer
61. Thread files
62. Thread pitch gauge
63. Tin snips – centre, left and right cut
64. Tire pressure gauge
65. Tool box
66. Torque angle meter/indicator
67. Torque limited sockets (torque sticks)
68. Torque wrenches – various sizes and ranges
69. Torx bits
70. Tread depth gauge (for tires and brakes)
71. Trouble light
72. Tube bending tool
73. Tube cutters
74. Upholstery tools – trim panel tools, hog ring pliers
75. Utility knife
76. Vacuum pump
77. Vacuum/pressure gauge
78. Vernier caliper – SAE and metric
79. Vise grips
80. Wire brush
81. Wire stripper/crimping tool
82. Wrench set – SAE and metric/ various designs

Shop Tools and Equipment

1. Acetylene torches
2. Air bag for alignment adjustments
3. Airbag removal tools
4. Airbag simulators
5. Air buffer
6. Air compressor – hoses – inline filter and water separators
7. Alignment lift
8. And equipment- 4 wheel
9. Angle grinder
10. Anti-static devices
11. Arbor press
12. Ball joint press and adapters
13. Battery charger/boosting equipment
14. Battery hydrometer
15. Battery tester/alternator and starter tester (AVR)
16. Bearing remover
17. Belt tension gauge
18. Bench grinders
19. Bench vises
20. Bottle jacks (2)
21. Brake adjustment calipers
22. Brake bleeder wrenches
23. Brake cylinder hone
24. Brake fluid moisture tester
25. Lathe
26. Brake pedal depressor
27. Brake pressure tester
28. Brake rotor gauge/micrometer
29. Brake system bleeder
30. Calibrated vessel
31. Caliper tools for rear-wheel disc
32. Chassis ears
33. Brake washer system (for 2 and 4 post hoists)
34. Computer – PC
35. Drill press
36. Electrical short detector
37. Floor jack
38. Funnel
39. Grease gun and fluid suction pump
40. Heat gun
41. Heli-coil kits
42. Hub service kit
43. Hydraulic press
44. Jack stands and supports
45. Leak detection equipment (refrigerants)
46. Leak detection tank (tires)
47. Oil drain barrels and disposal system
48. Parts washers
49. Pickle-fork tool set
50. Pitman arm pullers
51. Power steering pressure tester
52. Presses
53. Pressure washer
54. Reamer
55. Vacuum
56. Slide hammer
57. Smoke machine
58. Spreaders (tire)
59. Spring compressors – coil spring and strut
60. Spring
61. Steering wheel holder
62. Steering wheel puller set
63. Steering lock plate removal tool
64. Steering tilt pin removal tool
65. Tie-rod end puller
66. Tie-rod sleeve tools
67. Tire changing machine (run-flat capable)
68. Tire balancer equipment (road force type recommended)
69. Tire repair equipment
70. TPMS system service tools
71. Transmission fixtures
Program Content  
Section 4

72. U-joint press  
73. Door trim tools  
74. Vehicle lifts  
75. Vehicle service information system  
76. Water hose  
77. Welding equipment – GMAW welder and oxy fuelled

Measuring Tools and Equipment

1. ABS pressure tester  
2. Ball joint dial indicator set  
3. Brake drum gauge (for brake shoe adjusting)  
4. Brake drum micrometer  
5. Battery tester (electronic)  
6. DVOM (Digital Volt Ohm Meter) (CAT III)  
7. Headlight aiming equipment  
8. Infrared thermometer  
9. Lab scope or graphing multi-meter; 8 per class of 16 (channel, digital, cursor function with time capture capability)  
10. Lab scope accessories (shielded cables and back probes)  
11. Low amp probe  
12. Logic probe  
13. Micrometer – SAE and metric  
14. Power steering pressure tester  
15. Pressure gauges  
16. Scan tools; 8 per class of 16 [CAN (Controller Area Network) bus capable with appropriate software no older than 5 years of current vehicles]  
17. Spring scale
Reference Materials

SUGGESTED TEXTS for Level 3

- Alberta Learning Guides: Product Number- 7850000151
  
  Air Induction 7850001071
  Emission Control Systems 7850001073
  Electronic Drives 7850001086
  Computer Inputs, Switches and Sensors 7850001087
  On-board Computers 7850001088
  Fuel Properties 7850001098
  Combustion and Exhaust Emissions 7850001099
  Exhaust Gas Analysis 7850001100
  Ignition System Fundamentals 7850001101
  Distributor Ignition Systems 7850001102
  Electronic Ignition Systems 7850001103
  Ignition System Diagnosis and Service 7850001104
  Fuel Tanks and Supply Systems 7850001105
  Gasoline Fuel Injection System Fundamentals 7850001107
  Gasoline Fuel Injection Systems 7850001108
  Gasoline Fuel Injection System Diagnosis and Service 7850001109
  Liquefied Petroleum Gas/Compressed Natural Gas Fuel Systems 7850001112
  Heated Air Intake Systems 7850001113
  Exhaust Gas Recirculation Systems 7850001114
  Air Injection Systems 7850001115
  Catalytic Converter Systems 7850001116
  Evaporative Emission Control 7850001117
  Computer Outputs and Output Devices 7850001089
  Electronic Testing Equipment 7850001090
  Multiplexing and Networking 7850001876
  Electrical Fundamentals III 785000185
- **Automotive Heating, Ventilation and Air Conditioning Systems**  
  By Check-Chart, H.M. Gousha Company  
  Harper and Row, publishers

- **Automotive Electrical and Electronic Systems**  
  By Check-Chart, H.M. Gousha Company  
  Harper and Row, publishers

- **Fuel Systems and Emission Controls**  
  By Check-Chart, H.M. Gousha Company  
  Harper and Row, publishers

- **Halderman's Advanced Engine Performance**  
  By James D. Halderman  
  Publisher: Prentice Hall; Pap/Cdr edition (November 1997)

- **Automotive Fuel and Emission control systems**  
  James D Halderman  

- **Automotive Electricity and Electronics**  
  James D Halderman  

- **Automotive Technology (4th Edition)**  
  By Jack Erjavec  
  Delmar Cengage Learning, publishers  
  ISBN: 1401848311

**SUGGESTED TEXT**

**Practical Assessment Tasksheet Booklets**

- CDX Automotive Engine Performance 978-0-7637-8509-3
- CDX Automotive Electrical and Electronic Systems 978-0-7637-8508-6

**ADDITIONAL REFERENCES**

- **Automotive Fundamentals**  
  By Martin W. Stockel/Martin T. Stockel  
  Goodheart-Wilcox, publishers
Instructor Requirements

Occupation Qualification
The instructor must possess:

- An Automotive Service Technician Certificate of Qualification with a Red Seal Endorsement
- A recognized “Advanced Automotive Electrical” certification

Work Experience

- Must have a minimum of five years experience as a journeyperson
- Must have diverse industry experience including that which would cover all the competencies in this program

Instructional Experience and Education
It is preferred that the instructor possesses one of the following:

- Instructor’s Certificate (minimum 30-hour course)
- Instructors must have or be registered in an Instructor’s Diploma Program, to be completed within a five year period
- Hold a Bachelors or Masters Degree in Education
APPENDIX A –
Practical Assessment
### Appendix A
#### Practical Assessment

**Competency** | **CDX Booklet** | **Reference Number Essential** | **Reference Number Secondary**
--- | --- | --- | ---
A2- Interpret advanced wiring diagrams | Outline Instructions | Page 10 |  
A4- Use advanced electrical test equipment | Engine Performance | C661, C659, C867, C840 |  
A6- Describe multiplex and network systems | Engine Performance | C839 |  
B2- Service fuel delivery components | Engine Performance | C868, C420 |  
B3- Service gasoline fuel injection components | Engine Performance | C842, C422, C424, C665, C713 |  
C1- Describe electronic ignition principles | Outline Instructions | Page 23 |  
C2- Service electronic distributor ignition systems | Engine Performance | C662, C841, C664, C712 |  
C3- Service electronic ignition systems | Engine Performance | C663 |  
D2- Test engine management input sensors | Engine Performance | C661, C659, C840 |  
D3- Test engine management output actuators | Engine Performance | C867 |  
D4- Analyze on-board diagnostic system data | Engine Performance | C839, C840 |  
E3- Service pre-combustion emission systems | Engine Performance | C432, C666, C434, C435, C667 |  
E4- Service post-combustion emission systems | Engine Performance | C437, C438, C428 | C843, C429  
E6- Test OBD II evaporative emission systems | Engine Performance | C870, C844 |  
E7- Perform exhaust gas analysis | Engine Performance | C714 |  

Program: Automotive Service Technician (AST 3)

Training providers delivering Automotive Service Technician (AST 3) apprenticeship in-school technical training are required to enter the following information in ITA Direct Access for each apprentice:

- An in-school mark in the form of a percentage
  (Minimum 70% is required for a pass)

Training Provider Component: In-School Technical Training

The in-school mark for each level is derived from a combination of theory and practical assessments. This mark is then combined with the ITA Standard Level Examination to determine a final mark for the level.

Calculation tables showing the subject competencies, theory and practical percentage weightings for each competency are shown in the Grading Sheet: “Subject Competencies and Weightings” section of this document.

Automotive Service Technician (AST 3):

- The theory competency result is calculated based on 100% on accumulated competencies;
- The practical competency result is calculated based on 100% on accumulated competencies;
- The final in-school result is calculated by applying a weighting of 80% to the final theory result and a weighting of 20% to the practical result and then adding the two results together.

Successful completion of the in-school training for each level is defined as an in-school mark of 70% or greater.

ITA Component: ITA Standardized Level Examinations

There are no standardized level examinations for the current Automotive Service Technician (AST 3) program.

ITA Certificate of Qualification (C of Q) Exam

Apprentices registered in the Automotive Service Technician (AST 3) program are required to write a C of Q exam after completing the in-school technical training. A score of 70% or higher is required for a pass.

ITA Certificate of Qualification exams should be requested by training providers via the usual ITA procedure.

ITA will administer and invigilate ITA Certificate of Qualification exams and score and record exam results in ITA Direct Access.
## Grading Sheet: Subject Competency and Weightings

**Program:**
**In-School Training:**
**ITA Direct Access Code:**

<table>
<thead>
<tr>
<th>LINE</th>
<th>TRAINING TOPICS &amp; SUGGESTED TIME ALLOCATION</th>
<th>THEORY WEIGHTING</th>
<th>PRACTICAL WEIGHTING</th>
</tr>
</thead>
<tbody>
<tr>
<td>3A</td>
<td>Electrical and Electronic Systems</td>
<td>18%</td>
<td>14%</td>
</tr>
<tr>
<td>3B</td>
<td>Fuel Delivery Systems</td>
<td>24%</td>
<td>18%</td>
</tr>
<tr>
<td>3C</td>
<td>Electronic Ignition Systems</td>
<td>18%</td>
<td>22%</td>
</tr>
<tr>
<td>3D</td>
<td>Engine Management Systems</td>
<td>28%</td>
<td>26%</td>
</tr>
<tr>
<td>3E</td>
<td>Emission Control Systems</td>
<td>12%</td>
<td>20%</td>
</tr>
</tbody>
</table>

**Total**

Calculated by the Training Provider

**Automotive Service Technician (AST 3) in-school theory & practical subject competency weighting**

<table>
<thead>
<tr>
<th></th>
<th>THEORY</th>
<th>PRACTICAL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>80%</td>
<td>20%</td>
</tr>
</tbody>
</table>

**Training Provider enters final in-school mark into ITA Direct Access**

A score of 70% or higher is required for a pass.

**Uploaded by ITA:**

**C of Q Final Mark**

A score of 70% or higher is required for a pass.

**FINAL%**
Program: Automotive Service Technician (AST 3)

Training providers delivering Automotive Service Technician (AST 3) apprenticeship in-school technical training are required to enter the following information in ITA Direct Access for each apprentice:

- An in-school mark in the form of a percentage
  (Minimum 70% is required for a pass)

Training Provider Component: In-School Technical Training

The in-school mark for each level is derived from a combination of theory and practical assessments. This mark is then combined with the ITA Standard Level Examination to determine a final mark for the level.

Calculation tables showing the subject competencies, theory and practical percentage weightings for each competency are shown in the Grading Sheet: “Subject Competencies and Weightings” section of this document.

Automotive Service Technician (AST 3):

- The theory competency result is calculated based on 100% on accumulated competencies;
- The practical competency result is calculated based on 100% on accumulated competencies;
- The final in-school result is calculated by applying a weighting of 80% to the final theory result and a weighting of 20% to the practical result and then adding the two results together.

Successful completion of the in-school training for each level is defined as an in-school mark of 70% or greater.

ITA Component: ITA Standardized Level Examinations

There are no standardized level examinations for the current Automotive Service Technician (AST 3) program.

ITA Certificate of Qualification (C of Q) Exam

Apprentices registered in the Automotive Service Technician (AST 3) program are required to write a C of Q exam after completing the in-school technical training. A score of 70% or higher is required for a pass.

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## Grading Sheet: Subject Competency and Weightings

<table>
<thead>
<tr>
<th>LINE</th>
<th>TRAINING TOPICS &amp; SUGGESTED TIME ALLOCATION</th>
<th>THEORY WEIGHTING</th>
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<td>3C</td>
<td>Electronic Ignition Systems</td>
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<td>22%</td>
</tr>
<tr>
<td>3D</td>
<td>Engine Management Systems</td>
<td>28%</td>
<td>26%</td>
</tr>
<tr>
<td>3E</td>
<td>Emission Control Systems</td>
<td>12%</td>
<td>20%</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>100%</td>
<td>100%</td>
</tr>
</tbody>
</table>

Calculated by the Training Provider

**AUTOMOTIVE SERVICE TECHNICIAN (AST 3) in-school theory & practical subject competency weighting**

| Training Provider enters final in-school mark into ITA Direct Access | 80% | 20% |

A score of 70% or higher is required for a pass.

Uploaded by ITA: C of Q Final Mark

A score of 70% or higher is required for a pass.

| FINAL% |
PROGRAM OUTLINE

Automotive Service Technician
(Automotive Service Technician 4)
# TABLE OF CONTENTS

Section 1 INTRODUCTION .................................................................................................. AST 4 - 2
  Foreword ..............................................................................................................AST 4 - 3
  Acknowledgements ..............................................................................................AST 4 - 4
  How to Use this Document ...................................................................................AST 4 - 5

Section 2 PROGRAM OVERVIEW ...................................................................................... AST 4 - 6
  Program Credentialing Model ..............................................................................AST 4 - 7
  Occupational Analysis Chart ................................................................................AST 4 - 8
  Training Topics and Suggested Time Allocation ............................................... AST 4 - 10

Section 3 PROGRAM CONTENT ...................................................................................... AST 4 - 11
  Automotive Service Technician 4 ...................................................................... AST 4 - 12

Section 4 TRAINING PROVIDER STANDARDS .............................................................. AST 4 - 37
  Facility Requirements ........................................................................................ AST 4 - 38
  Tools and Equipment .......................................................................................... AST 4 - 39
  Reference Materials .......................................................................................... AST 4 - 43
  Instructor Requirements .................................................................................... AST 4 - 45

APPENDIX A – PRACTICAL ASSESSMENT ................................................................. AST 4 - 46

APPENDIX B – ASSESSMENT GUIDELINES ................................................................. AST 4 - 49
Section 1
INTRODUCTION

Automotive Service Technician 4
Introduction

Foreword

This Program Outline is developed by the Automotive Training Standards Organization (ATSO) in accordance with the General Regulations made pursuant to the “Industry Training and Apprenticeship Act” of British Columbia. It reflects updated standards based on the 2009 Automotive Service Technician National Occupational Analysis (NOA). This Program Outline was prepared with the advice and assistance of an industry-centered advisory committee in cooperation with the Automotive Training Standards Organization. The Program Outline is intended as a guide for providers, instructors, apprentices and their sponsors. This Program Outline is separated into four main sections which include:

The Introduction - Contains a Foreword and an Acknowledgements section that lists all of the participants who were involved in the creation of this document, as well as a section called “How to Use this Document” which provides an oversight on how this document can be used.

The Program Overview - Contains a Credentialing Model that shows the path and time requirements for the apprentice, an Occupational Analysis Chart that has the General Areas of Competency (GAC) and the individual competencies, and a Training Topics and Suggested Time Allocation which provides a suggested percentage of time for the theory and practical components for each GAC in this program.

The Program Content - Represents individual General Areas of Competency which are further separated into competencies defined by Objectives, Learning Tasks and Content.

The Training Provider Standards - A guide on Automotive Service Technician teaching facilities which outline the requirements needed to provide training for this program. The Facility Requirements section provides minimal requirements for facilities seeking designation and upgrade. The Tools and Equipment section lists the tools required to cover the competencies of this program. The Reference Material section is a collection of materials used for learning guides by the apprentice and instructors for the theory and the practical portion of the program. Finally, the Instructor Requirements section provides the level of knowledge and experience that each instructor must have to competently provide instruction in this program.

Practical instruction through demonstration and through student participation should be integrated within classroom sessions. Safe working practices, even though not always specified in each operation or topic, are an implied part of the program and should be stressed throughout the apprenticeship. It is the responsibility of employers to ensure safety training for the apprentices working on their work sites.

For more information please refer to the program profile document on the ITA website for the individual program.

SAFETY ADVISORY

Be advised that references to the WorkSafe BC safety regulations contained within these materials do not/may not reflect the most recent Occupational Health and Safety Regulation (the current Standards and Regulation in BC can be obtained on the following website: http://www.worksafebc.com). Please note that it is always the responsibility of any person using these materials to inform him/herself about the Occupational Health and Safety Regulation pertaining to his/her work.
Acknowledgements

The Program Outline was prepared with the advice and direction of an industry steering committee convened initially by the Automotive Training Standards Organization (ATSO). Members include:

- Matthew Wilkie Automotive Service Technician
- Loi Truong Automotive Service Technician
- Jeff Summers Automotive Service Technician

**Industry Subject Matter Experts retained to assist in the development of the Program Outline content:**

- Russ Hunter Instructor BCIT
- Matthew Wilkie Automotive Service Technician
- Loi Truong Automotive Service Technician
- Jeff Summers Automotive Service Technician

**Industry Subject Matter Experts retained as outline reviewers:**

- Matthew Wilkie Automotive Service Technician
- Loi Truong Automotive Service Technician
- Jeff Summers Automotive Service Technician

**Facilitators:**

- Lloyd Stamm ATSO CEO
- Kevin Cudmore ATSO Program Development Coordinator
- Lee Bouchard ATSO Assessment Coordinator
- Taryn Wilson ATSO Administrative Coordinator

The Industry Training Authority would like to acknowledge the dedication and hard work of all the industry representatives appointed to identify the training requirements of the Automotive Service Technician occupation.
# How to Use this Document

This Program Outline has been developed for the use of individuals from several different audiences. The table below describes how each section can be used by each intended audience.

<table>
<thead>
<tr>
<th>Section</th>
<th>Training Providers</th>
<th>Employers/Sponsors</th>
<th>Apprentices</th>
<th>Challengers</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Industry Training Model</strong></td>
<td>Communicate program length and structure, and all pathways to completion</td>
<td>Understand the length and structure of the program</td>
<td>Understand the length and structure of the program, and pathway to completion</td>
<td>Understand challenger pathway to Certificate of Qualification</td>
</tr>
<tr>
<td>OAC</td>
<td>Communicate the competencies that industry has defined as representing the scope of the occupation</td>
<td>Understand the competencies that an apprentice is expected to demonstrate in order to achieve certification</td>
<td>View the competencies they will achieve as a result of program completion</td>
<td>Understand the competencies they must demonstrate in order to challenge the program</td>
</tr>
<tr>
<td>Training Topics Suggested Time Allocation</td>
<td>Shows proportionate representation of various GACs at each program level; should map to proportions of time spent on training, practical experience, and assessment</td>
<td>Understand the relative scope of various areas of the occupation, and areas in which the apprentice would require on-the-job experience</td>
<td>Understand the relative scope of various areas of the occupation, and areas in which on-the-job experience would be provided</td>
<td></td>
</tr>
<tr>
<td>Program Outline</td>
<td>Defines the objectives, learning tasks, high level content that must be covered for each competency, as well as defining observable, measurable achievement criteria for objectives with a practical component</td>
<td>Identifies detailed program content and performance expectations for competencies with a practical component; may be used as a checklist prior to signing a recommendation for certification (RFC) for an apprentice</td>
<td>Provides detailed information on program content and performance expectations for demonstrating competency</td>
<td>Allows individual to check program content areas against their own knowledge and performance expectations against their own skill levels</td>
</tr>
<tr>
<td>Training Provider Standards</td>
<td>Defines the facility requirements, tools and equipment, reference materials (if any) and instructor requirements for the program</td>
<td>Identifies the tools and equipment an apprentice is expected to have access to; which are supplied by the training provider and which the student is expected to own</td>
<td>Provides information on the training facility, tools and equipment provided by the school and the student, reference materials they may be expected to acquire, and minimum qualification levels of program instructors</td>
<td>Identifies the tools and equipment a tradesperson is expected to be competent in using or operating; which may be used or provided in a practical assessment</td>
</tr>
</tbody>
</table>
Section 2

PROGRAM OVERVIEW

Automotive Service Technician 4
Program Overview

Program Credentialing Model

Automotive Service Technician (AST 4)
Technical Training: 180 hours (6 weeks*)
WBT: 6,000 hours
ITA Standardized Written Exam
Interprovincial Red Seal Exam

Automotive Service Technician 3
Technical Training: 210 hours (7 weeks*)
Accumulate work-based training hours
ITA Certificate of Qualification Exam

Automotive Service Technician 2
Technical Training: 180 hours (6 weeks*)
Accumulate work-based training hours
ITA Certificate of Qualification Exam

Automotive Service Technician 1
Technical Training: 210 hours (7 weeks*)
Accumulate work-based training hours
ITA Certificate of Qualification Exam

Automotive Service Technician Foundation Program
Technical Training: 30 weeks*

C of Q = Certificate of Qualification
C of A = Certificate of Apprenticeship
C of C = Certificate of Completion
WBT = Work-Based Training

C of Q = Certificate of Qualification
C of A = Certificate of Apprenticeship
C of C = Certificate of Completion
WBT = Work-Based Training

*Individuals who are holders of both certificates will only be awarded credit for 1,500 WBT hours total

*Recommended duration based on 30-hour week

CROSS-PROGRAM CREDITS

C of Q Truck and Transport Mechanic
Technical Training: None
Work-Based Training: 1,500 hours*

C of Q Heavy Duty Equipment Technician
Technical Training: None
Work-Based Training: 1,500 hours*
Occupational Analysis Chart
AUTOMOTIVE SERVICE TECHNICIAN 4

Occupation Description: “Automotive Service Technician 4” means a person who repairs, adjusts and replaces mechanical, electrical and electronic parts of automobiles and light trucks in a retail automotive business. “Retail automotive business” means a business whose primary mechanical repair work is repairing and adjusting vehicles whose gross vehicle weight is less than 5,500 kg.

CLUTCH SYSTEMS

A1. Service clutch systems
A2. Describe transmission removal and installation procedures

MANUAL TRANSMISSIONS

B1. Calculate gear ratios
B2. Service transmission shifting linkages
B3. Overhaul manual transmissions

AUTOMATIC TRANSMISSIONS

C1. Describe torque converters
C2. Describe planetary gear trains
C3. Overhaul automatic transmissions
C4. Service hydraulic and electrical control systems

DRIVE LINES

D1. Service drive lines
D2. Service final drives, differentials and axles

ALL-WHEEL AND FOUR-WHEEL DRIVE SYSTEMS

E1. Inspect all-wheel drive systems
E2. Service mechanical and electronic four-wheel drive systems
### Program Overview

**HYBRID DRIVE LINE TECHNOLOGY**

<table>
<thead>
<tr>
<th></th>
<th>Describe hybrid vehicle systems</th>
<th>Describe hybrid drive systems</th>
</tr>
</thead>
<tbody>
<tr>
<td>F</td>
<td>F1</td>
<td>F2</td>
</tr>
</tbody>
</table>
### Training Topics and Suggested Time Allocation

#### AUTOMOTIVE SERVICE TECHNICIAN 4

<table>
<thead>
<tr>
<th>Line</th>
<th>Area</th>
<th>% of Time</th>
<th>Theory</th>
<th>Practical</th>
<th>Total</th>
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<tbody>
<tr>
<td>A</td>
<td>CLUTCH SYSTEMS</td>
<td>6%</td>
<td>30%</td>
<td>70%</td>
<td>100%</td>
</tr>
<tr>
<td>A1</td>
<td>Service clutch systems</td>
<td></td>
<td>✔️</td>
<td>✔️</td>
<td></td>
</tr>
<tr>
<td>A2</td>
<td>Describe transmission removal and installation procedures</td>
<td></td>
<td>✔️</td>
<td>✔️</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>MANUAL TRANSMISSIONS</td>
<td>13%</td>
<td>20%</td>
<td>80%</td>
<td>100%</td>
</tr>
<tr>
<td>B1</td>
<td>Calculate gear ratios</td>
<td></td>
<td>✔️</td>
<td>✔️</td>
<td></td>
</tr>
<tr>
<td>B2</td>
<td>Service transmission shifting linkages</td>
<td></td>
<td>✔️</td>
<td>✔️</td>
<td></td>
</tr>
<tr>
<td>B3</td>
<td>Overhaul manual transmissions</td>
<td></td>
<td>✔️</td>
<td>✔️</td>
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<tr>
<td>C</td>
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<td>40%</td>
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<td>100%</td>
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<tr>
<td>C1</td>
<td>Describe torque converters</td>
<td></td>
<td>✔️</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C2</td>
<td>Describe planetary gear trains</td>
<td></td>
<td>✔️</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C3</td>
<td>Overhaul automatic transmissions</td>
<td></td>
<td>✔️</td>
<td>✔️</td>
<td></td>
</tr>
<tr>
<td>C4</td>
<td>Service hydraulic and electrical control systems</td>
<td></td>
<td>✔️</td>
<td>✔️</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>DRIVE LINES</td>
<td>12%</td>
<td>20%</td>
<td>80%</td>
<td>100%</td>
</tr>
<tr>
<td>D1</td>
<td>Service drive lines</td>
<td></td>
<td>✔️</td>
<td>✔️</td>
<td></td>
</tr>
<tr>
<td>D2</td>
<td>Service final drives, differentials and axles</td>
<td></td>
<td>✔️</td>
<td>✔️</td>
<td></td>
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**Total Percentage for Automotive Service Technician 4:** 100%

The theory and practical weighting distribution for AST 4 is **38%** theory and **62%** practical.
Section 3

PROGRAM CONTENT

Automotive Service Technician 4
Automotive Service Technician 4
LINE (GAC): A CLUTCH SYSTEMS
Competency: A1 Service clutch systems

Objectives
To be competent in this area, the individual must be able to:
- Identify clutch system components.
- Describe the design and operation of clutches.
- Inspect, diagnose and repair clutches.

LEARNING TASKS

1. Describe clutch components
   - Flywheel
     - Conventional
     - Dual mass
   - Pressure plate
   - Clutch disc
   - Bearings and bushings
   - Safety switch
   - Operating hardware
     - Mechanical
     - Hydraulic
   - Clutch housing
   - Fasteners
   - Construction materials

2. Describe the design and operation of clutches
   - Flywheel
     - Conventional
     - Dual mass
     - Machine surface
   - Pressure plate
   - Clutch disc
   - Safety switch circuit
   - Bearings and bushings
   - Operating hardware
     - Mechanical
     - Hydraulic
   - Clutch housing
   - Fasteners
   - Construction materials
LEARNING TASKS

3. Service clutch components
   • Component service
   • Removal
   • Replacement
   • Cleaning
   • Adjustments

4. Inspect and repair clutches
   • Inspection
     o Road test
     o Visual
     o Audible
     o Smell
   • Diagnostic flow chart
   • Noise Vibration and Harshness (NVH)
   • Routine maintenance and adjustment

Achievement Criteria:
Given a written and/or a practical assessment on clutch systems, the learner will be able to demonstrate knowledge of the trade by achieving 70% or better based on a summative total of Instructor assessment. For suggested practical assessments see Matrix in Appendix A.
Program Content

LINE (GAC): A CLUTCH SYSTEMS
Competency: A2 Describe transmission removal and installation procedures

Objectives
To be competent in this area, the individual must be able to:

- Describe transmission, transaxle and transfer case removal and installation procedures.
- Describe initial start-up and break-in procedures.

LEARNING TASKS

1. Describe transaxle and transfer case mounting systems

   • Drive systems
     o Front wheel
     o Rear wheel
     o All-wheel
   • Cross member supports
   • Mounts
     o Rubber
     o Electric
     o Hydraulic

2. Describe the preparation for transmission, transaxle and transfer case removal

   • Safety
     o Jacking and hoisting
     o Weight distribution
   • Body component removal
   • Systems removal
     o Identification for reinstallation
     o Mounts
     o Electrical
     o Vacuum
     o Cooling
     o Oil
     o Driveline
     o Exhaust
LEARNING TASKS

3. Describe transmission, transaxle and transfer case removal and installation procedures

CONTENT

- Safety
  o Jacking and hoisting
  o Weight distribution
- Body component removal
- Systems removal
  o Identification for reinstallation
  o Mounts
  o Electrical
  o Vacuum
  o Cooling
  o Oil
  o Driveline
  o Exhaust
- Body component installation
- Start-up and break-in
  o Procedures
  o Lubrication
  o Computer adaptations

Achievement Criteria:
Given a written and/or a practical assessment on clutch systems, the learner will be able to demonstrate knowledge of the trade by achieving 70% or better based on a summative total of Instructor assessment.
Program Content

LINE (GAC): B MANUAL TRANSMISSIONS
Competency: B1 Calculate gear ratios

Objectives
To be competent in this area, the individual must be able to:

- Describe gear ratio principles.
- Calculate gear ratios.

LEARNING TASKS

1. Describe principles of gear ratios
   - Torque
     - Multiplication
     - Reduction
   - Speed
     - Multiplication
     - Reduction
   - Gear diameters
   - Simple gear sets
   - Compound gear sets
   - Variable pulley systems

2. Calculate gear ratios
   - Simple gear sets
   - Compound gear sets
   - Variable pulley systems

Achievement Criteria:
Given a written and/or a practical assessment on calculating gear system ratios, the learner will be able to demonstrate knowledge of the trade by achieving 70% or better based on a summative total of Instructor assessment. For suggested practical assessments see Matrix in Appendix A.
Program Content

LINE (GAC): B MANUAL TRANSMISSIONS
Competency: B2 Service transmission shifting linkages

Objectives
To be competent in this area, the individual must be able to:
- Describe the components of transmission shifting linkage.
- Describe the design and operation of transmission shifting linkage.
- Inspect, diagnose and repair transmission shifting linkage.

LEARNING TASKS

1. Describe components of transmission shifting linkage
   - Gear shift lever
   - Gear shift housing boot
   - Pivot ball
   - Linkage systems
     - Shafts and couplings
     - Cables
   - Reverse lock-out devices
   - Reverse light switch

2. Describe the design and operation of transmission shifting linkage
   - Gear shift lever
   - Gear shift housing boot
   - Pivot ball
   - Linkage systems
     - Shafts and couplings
     - Cables
   - Reverse lock-out devices
   - Reverse light switch

3. Service transmission shifting linkage
   - Inspection
     - Road test
     - Visual
   - Adjustments
   - Lubrication

Achievement Criteria:
Given a written and/or a practical assessment on transmission shifting linkages, the learner will be able to demonstrate knowledge of the trade by achieving 70% or better based on a summative total of Instructor assessment. For suggested practical assessments see Matrix in Appendix A.
LINE (GAC): B MANUAL TRANSMISSIONS
Competency: B3 Overhaul manual transmissions

Objectives
To be competent in this area, the individual must be able to:
• Identify manual transmission and transaxle components.
• Describe the design and operation of manual transmissions and transaxles.
• Inspect, diagnose and repair manual transmissions and transaxles.

LEARNING TASKS

1. Describe manual transmission and transaxle components
   • Housings and mounts
   • Gears
   • Synchronizers
   • Shafts
   • Bearings and bushings
   • Interlock system
   • Detent system
   • Control mechanisms
     o External
     o Internal
   • Differentials
   • Switches, solenoids and sensors
   • Lubricants and additives
   • Gaskets and seals
   • Fasteners
   • Construction materials

2. Describe the design and operation manual transmissions and transaxles
   • Housings and mounts
   • Gears
     o Power flow
   • Synchronizers
   • Shafts
   • Bearings and bushings
   • Interlock system
   • Detent system
   • Differentials
   • Switches, solenoids and sensors
   • Lubricants and additives
   • Gaskets and seals
   • Fasteners
   • Construction materials
### LEARNING TASKS

3. Overhaul manual transmissions and transaxles

### CONTENT

- Inspection
  - Road test
  - Visual
  - Audible
- Measurement
- Test shifter mechanism
- Diagnostic flow chart
- Routine maintenance and adjustment
- Component removal, replacement and service
- Component and assembly cleaning

### Achievement Criteria:

Given a written and/or a practical assessment on manual transmissions, the learner will be able to demonstrate knowledge of the trade by achieving 70% or better based on a summative total of Instructor assessment. For suggested practical assessments see Matrix in Appendix A.
Program Content

LINE (GAC): C AUTOMATIC TRANSMISSIONS
Competency: C1 Describe torque converters

Objectives
To be competent in this area, the individual must be able to:
- Identify the components of a torque converter.
- Describe the design and operation of a torque converter.

LEARNING TASKS

1. Describe torque converter components
   - Housing
   - Flex plate connections
   - Mounting fasteners
   - Turbine
   - Stator
   - Impeller
   - Pump drive spline
   - Lock up clutch

2. Describe the design and operation of manual torque converters
   - Housing
   - Flex plate connections
   - Mounting fasteners
   - Turbine
   - Stator
   - Impeller
   - Pump drive spline
   - Rotary flow
   - Vortex flow
   - Stall speed
   - Coupling phase
   - Torque multiplication
   - Lock-up function
Program Content

LINE (GAC): C AUTOMATIC TRANSMISSIONS
Competency: C2 Describe planetary gear trains

Objectives

To be competent in this area, the individual must be able to:

- Identify the components of a planetary gear train.
- Describe the design and operation of a planetary gear train.

### LEARNING TASKS

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Program Content

LINE (GAC): C AUTOMATIC TRANSMISSIONS
Competency: C3 Overhaul automatic transmissions

Objectives
To be competent in this area, the individual must be able to:
- Identify automatic transmission and transaxle components.
- Describe the design and operation of automatic transmissions and transaxles.
- Service automatic transmissions and transaxles.

LEARNING TASKS

1. Describe automatic transmission and transaxle components
   - Housings and mounts
   - Pumps and hydraulics
   - Gears
   - Chains and sprockets
   - Clutches and bands
   - Shafts
   - Bearings and bushings
   - Shifting linkages
   - Parking pawl
   - Differentials
   - Lubricants and additives
   - Fluid coolers
   - Gaskets and seals
   - Fasteners
   - Construction materials

2. Describe the design and operation of automatic transmissions and transaxles
   - Housings and mounts
   - Pumps and hydraulics
   - Gears and gear systems
   - Compound planetary gear trains
     - Simpson
     - Ravigneaux
     - Lepelletier
   - Chains and sprockets
   - Clutches and bands
   - Shafts
   - Bearings and bushings
   - Shifting linkages
   - Parking pawl
   - Differentials
   - Lubricants and additives
   - Gaskets and seals
   - Fasteners
**LEARNING TASKS**

3. Overhaul automatic transmissions and transaxles

**CONTENT**

- Construction materials
- Inspection
  - Road test
  - Visual
  - Audible
  - Smell
- Testing
- Routine maintenance and adjustment
- Component removal, replacement and service
- Component and assembly cleaning
- Diagnostic flow chart

**Achievement Criteria:**
Given a written and/or a practical assessment on automatic transmissions, the learner will be able to demonstrate knowledge of the trade by achieving 70% or better based on a summative total of Instructor assessment. For suggested practical assessments see Matrix in Appendix A.
Program Content

LINE (GAC): C AUTOMATIC TRANSMISSIONS
Competency: C4 Service hydraulic and electrical control systems

Objectives
To be competent in this area, the individual must be able to:
- Identify automatic transmission and transaxle hydraulic and electrical control system components.
- Describe the design and operation of automatic transmissions and transaxles hydraulic and electrical control systems.
- Service automatic transmissions and transaxles hydraulic and electrical control systems.

LEARNING TASKS

1. Describe automatic transmission and transaxle hydraulic and electrical control system components
   - Valve body
   - Hydraulic passages
   - Shift valves
   - Governor
   - Throttle valve pressure
   - Solenoids
   - Switches
   - Temperature sensors
   - Computers
   - Software
   - Inputs
   - Outputs
   - Diagnostic connections

2. Describe the design and operation of automatic transmission and transaxle hydraulic and electrical control systems
   - Valve body
   - Hydraulic passages
   - Shift valves
   - Governor
   - Throttle valve pressure
   - Solenoids
   - Switches
   - Temperature sensors
   - Modes of operation
     - Forward gears
     - Reverse gear
     - Acceleration
     - Coast
     - Deceleration
     - Manual shift positions
     - Electronic index shifting
LEARNING TASKS

3. Service automatic transmission and transaxle hydraulic and electrical control systems

CONTENT

- Inspection
  - Visual
  - Testing
  - Electrical
- Electrical Testing
  - Scan tools
  - Diagnostic codes
  - Break out box
  - Data stream
  - Activating solenoids
- Routine maintenance and adjustment
- Component removal, replacement and service
- Component and assembly cleaning
- Hydraulic flow chart

Achievement Criteria:
Given a written and/or a practical assessment on hydraulic and electrical control systems, the learner will be able to demonstrate knowledge of the trade by achieving 70% or better based on a summative total of Instructor assessment. For suggested practical assessments see Matrix in Appendix A.
Program Content

LINE (GAC): D DRIVE LINES
Competency: D1 Service drive lines

Objectives

To be competent in this area, the individual must be able to:
- Identify drive shaft components.
- Describe the design and operation of drive shafts.
- Service drive shafts.

LEARNING TASKS

1. Describe drive shaft components
   - Mounts and supports
   - Shafts
     - Constant velocity
     - Floating
     - Semi floating
     - Solid
   - Bearings, bushings and joints
   - Lubricants
   - Seals and boots
   - Fasteners
   - Construction materials

2. Describe the design and operation drive shafts
   - Joint design and geometry
     - Plunging
     - Pivoting
   - Balancing
   - Phasing
   - Drive axles
     - Front wheel drive
     - Rear wheel drive
     - All-wheel drive
   - Mounts and supports
   - Shafts
   - Bearings, bushings and joints
   - Lubricants
   - Seals and boots
   - Fasteners
   - Construction materials
LEARNING TASKS
3. Service drive shafts

CONTENT
- Safety
- Inspection
  - Road test
  - Visual
  - Audible
  - Mechanical
- Testing
- Run out
- Balancing
- Phasing
- Working angle
- Routine maintenance
- Component removal, replacement and service
- Component and assembly cleaning
- Diagnostic flow chart
- Noise Vibration and Harshness (NVH)

Achievement Criteria:
Given a written and/or a practical assessment on drive shafts, the learner will be able to demonstrate knowledge of the trade by achieving 70% or better based on a summative total of Instructor assessment. For suggested practical assessments see Matrix in Appendix A.
Program Content

LINE (GAC): D DRIVE LINES
Competency: D2 Service final drives, differentials and axles

Objectives

To be competent in this area, the individual must be able to:

- Identify final drive, differential and axle components.
- Describe the design and operation of final drive, differentials and axles.
- Service final drive, differentials and axles.

LEARNING TASKS

1. Describe final drive, differential and axle components
   - Housings and mounts
     - Integral
     - Removable
   - Gears
   - Shafts
   - Bearings and bushings
   - Spindles and hubs
   - Differentials
   - Locking devices
   - Clutches
   - Switches and sensors
   - Lubricants and additives
   - Gaskets and seals
   - Fasteners
   - Construction materials

2. Describe the design and operation final drive, differentials and axles
   - Gears
     - Hypoid
     - Bevel
     - Spiral bevel
   - Power flow
   - Shafts
     - Full floating
     - Semi floating
   - Bearings and bushings
   - Spindles and hubs
   - Differentials
   - Locking devices
     - Clutch type
     - Cone type
     - Centrifugal
     - Torsen
Program Content

LEARNING TASKS

CONTENT

- Switches and sensors
- Lubricants and additives
- Gaskets and seals
- Fasteners
- Construction materials

3. Service final drive, differentials and axles

- Safety precautions
- Inspection
  - Road test
  - Visual
  - Audible
  - Smell
  - Mechanical
- Testing
  - Gear tooth contact patterns
  - Pinion depth
  - Backlash
- Routine maintenance and adjustments
- Component removal, replacement and service
- Component and assembly cleaning
- Diagnostic flow chart

Achievement Criteria:
Given a written and/or a practical assessment on final drives, differentials and axels, the learner will be able to demonstrate knowledge of the trade by achieving 70% or better based on a summative total of Instructor assessment. For suggested practical assessments see Matrix in Appendix A.
Program Content

LINE (GAC): E  ALL-WHEEL AND FOUR-WHEEL DRIVE SYSTEMS

Competency: E1  Inspect all-wheel drive systems

Objectives

To be competent in this area, the individual must be able to:

- Identify all-wheel drive system components.
- Describe the design and operation of all-wheel drive systems.
- Inspect, all-wheel drive systems.

LEARNING TASKS

1. Describe all-wheel drive system components

   - Housings and mounts
   - Transfer case
   - Torque splitting device
     - Bevel gear
     - Planetary gear
     - Torsen
     - Chain drive
     - Gear drive
   - Couplings
     - Viscous
     - Electronic
   - Valves
   - Electronic controls
   - Sensors
   - Solenoids
   - Transfer case
   - Torque splitting device
     - Bevel gear
     - Planetary gear
     - Torsen
     - Chain drive
     - Gear drive
   - Couplings
     - Viscous
     - Electronic
   - Modes of Operation
     - Loss of traction
       - Front wheels
       - Rear wheels
   - Valves
   - Electronic controls
   - Sensors

2. Describe the design and operation of all-wheel drive systems
LEARNING TASKS

3. Inspect all-wheel drive systems

CONTENT

- Solenoids
- Inspection
  - Road test
  - Visual
  - Audible
  - Mechanical
- Testing
  - Rotational torque of viscous coupling
- Routine maintenance

Achievement Criteria:
Given a written and/or a practical assessment of inspection on four wheel drive systems, the learner will be able to demonstrate knowledge of the trade by achieving 70% or better based on a summative total of Instructor assessment. For suggested practical assessments see Matrix in Appendix A.
Program Content

LINE (GAC): E ALL-WHEEL AND FOUR-WHEEL DRIVE SYSTEMS
Competency: E2 Service mechanical and electronic four-wheel drive systems

Objectives

To be competent in this area, the individual must be able to:
- Describe mechanical and electronic four-wheel drive system components.
- Describe the design and operation of mechanical and electronic four-wheel drive systems.
- Service mechanical and electronic four-wheel drive systems.

LEARNING TASKS CONTENT

1. Describe mechanical and electronic four-wheel drive system components

   CONTENT
   - Housings and mounts
   - Gears
   - Chains and sprockets
   - Shafts
   - Bearings and bushings
   - Control mechanisms
     - Mechanical
     - Vacuum
   - Differentials and clutches
   - Switches, solenoids and sensors
   - Computers
   - Lubricants and additives
   - Gaskets and seals
   - Fasteners
   - Construction materials
LEARNING TASKS

2. Describe the design and operation of mechanical and electronic four-wheel drive systems

CONTENT

- Gears
- Chains and sprockets
- Shafts
- Bearings and bushings
- Power flow
- Control mechanisms
  - Mechanical
  - Vacuum
  - Electrical
- Differentials and clutches
- Switches, solenoids and sensors
- Lubricants and additives
- Modes of operation
  - Two-wheel drive
    - Automatic slip detection
  - Four-wheel drive
    - Low range
- Hi range

3. Service mechanical and electronic four-wheel drive systems

CONTENT

- Inspection
  - Road test
  - Visual
  - Audible
  - Mechanical
- Testing
  - Mechanical
  - Electrical
    - Diagnostic fault codes
  - Hydraulic
- Routine maintenance and adjustments
- Component removal, replacement and service
- Component assembly cleaning
- Diagnostic flow chart

Achievement Criteria:
Given a written and/or a practical assessment on four wheel drive systems, the learner will be able to demonstrate knowledge of the trade by achieving 70% or better based on a summative total of Instructor assessment. For suggested practical assessments see Matrix in Appendix A.
Program Content

LINE (GAC): F HYBRID DRIVE LINE TECHNOLOGY
Competency: F1 Describe hybrid vehicle systems

Objectives

To be competent in this area, the individual must be able to:
- Describe components of hybrid vehicle systems.
- Describe the design and operation of hybrid vehicle systems.

LEARNING TASKS

1. Describe components of hybrid vehicle systems
   - Internal Combustion Engine (ICE)
   - Electric motor / generator
   - Wiring
   - High voltage battery
   - Low voltage battery
   - AC / DC inverter
   - D/C to D/C converter
   - High voltage A/C compressors

2. Describe the design and operation of hybrid vehicle systems
   - Aero-dynamics
   - Safety precautions
   - Gasoline engine (ICE)
   - Types of hybrid drives
     - Series-parallel
     - Parallel
   - Operational modes
     - Idle shut off
     - Lean burn
     - Acceleration assist
   - Electric motor / generator
     - Brushless
     - Induction
     - Generation
   - High-voltage battery
     - Nickel metal hydride (Ni-MH)
     - Lithium ion
   - Regenerative braking
   - AC / DC inverter
   - Cylinder management
LINE (GAC): F HYBRID DRIVELINE TECHNOLOGY
Competency: F2 Describe hybrid drive systems

Objectives
To be competent in this area, the individual must be able to:
- Identify hybrid vehicle drive line components.
- Describe the design and operation of hybrid vehicle drive systems.

LEARNING TASKS
1. Describe hybrid vehicle drive line components
   - Electric motor / generator
     o Induction
     o Brushless
   - Housings and mountings
   - Gears
   - Planetary gears
   - Lubricants
   - Flywheel

2. Describe the design and operation of hybrid vehicle drive line systems
   - Mechanical power flow of
     o Electric motor / generator
   - Planetary gears
   - Full hybrid
   - Mild hybrid
   - Flywheel connection
Section 4

TRAINING PROVIDER STANDARDS
Facility Requirements

Classroom Area
- Comfortable seating and tables suitable for training, teaching, lecturing.
- Compliance with all local and national fire code and occupational safety requirements.
- Lighting controls to allow easy visibility of projection screen allowing students to take notes.
- Windows must have shades or blinds to adjust sunlight.
- Heating / air conditioning for comfort all year round.
- In-room temperature regulation and ventilation to ensure comfortable room temperature.
- Acoustics in the room must allow the instructor to be heard.
- White marking board with pens and eraser (optional: flipchart in similar size).
- Projection screen or projection area at front of classroom.
- Overhead projector and/or multi-media projector.

Shop Area
- Ceiling shall be a minimum height of 16’ or as varied by good engineering practices and code.
- Appropriate lifting devises (hoists) used in industry.
- Suitable demonstration area.
- Lighting appropriate for good vision in ambient light.
- Compliance with all local and national fire code and occupational safety requirements.
- Must meet Municipal and Provincial bylaws in regards to waste water management and environmental laws.
- Adequate hoist to student ratio.

Lab Requirements
- Does not apply to this program.

Student Facilities
- Does not apply to this program.

Instructor’s Office Space
- Does not apply to this program.
Tools and Equipment

Shop Equipment

Standard Tools

1. Air drills/tools
2. Air hammer/chisel
3. Air ratchet
4. Antifreeze tester
5. Axle boot clamp tool
6. Battery post service and reshape tool
7. Belt tension release tool
8. Blow gun
9. Bolt extractor set (easy outs)
10. Brake service tools (adjusters, spring removal, installation and caliper tools)
11. Caulking gun
12. Centre punch
13. Chisels, punches
14. Creeper/fender covers
15. Crowfoot wrenches (flare and std, SAE and Metric)
16. Dial indicator set (flare and std, SAE and Metric)
17. Die grinder
18. Drill and bits
19. Drill gauge
20. Feeler gauges – SAE and metric
21. Files – bastard cut/half round/mill cut/square and thread file
22. Filter wrenches
23. Flare nut wrenches – SAE and metric
24. Flaring tool (SAE, metric and ISO)
25. Flash lights
26. Fuel line disconnect set
27. Hacksaw
28. Hammers – ball peen/dead blow/rubber
29. Mallet/soffface
30. Hex keys – SAE and metric
31. High voltage safety gloves (0 rated 1000v)
32. Impact driver and bits
33. Impact wrench and impact socket set – SAE and metric, swivel, spark plug, extensions and adapters
34. Inspection mirror
35. Jumper lead
36. Magnetic pick up tool
37. Mechanic’s pick set
38. Multimeter (DVOM)
39. Nut driver set – SAE and metric
40. Pliers – slip joint, needle nose, adjustable, wheel weight, side cutter, snap ring, locking, hog ring and battery types
41. Pry bar
42. Pullers – gear, pulley, battery terminal and steering wheel
43. Ratchet and sockets – ¼, ⅜ and ½ drive – SAE and metric, swivel, spark plug, extensions and adapters
44. Rivet gun
45. Scraper (gasket and carbon)
46. Screwdriver set
47. Seal drivers and extractors
48. Soldering tools
49. Standard test leads and probes
50. Steel rule
51. Stethoscope
52. Straight edge
53. Stud extractor
54. Tamper-proof torx set
55. Tap and die set – SAE and metric
56. Tap extractor
57. Tape and ruler
58. Terminal remover tools
59. Test lamp – electronics safe (powered and non-powered)
60. Thermometer
61. Thread files
62. Thread pitch gauge
63. Tin snips – centre, left and right cut
64. Tire pressure gauge
65. Tool box
66. Torque angle meter/indicator
67. Torque limited sockets (torque sticks)
68. Torque wrenches – various sizes and ranges
69. Torx bits
70. Tread depth gauge (for tires and brakes)
71. Trouble light
72. Tube bending tool
73. Tube cutters
74. Upholstery tools – trim panel tools, hog ring pliers
75. Utility knife
76. Vacuum pump
77. Vacuum/pressure gauge
78. Vernier caliper – SAE and metric
79. Vise grips
80. Wire brush
81. Wire stripper/crimping tool
82. Wrench set – SAE and metric/ various designs

**Shop Tools and Equipment**

1. Acetylene torches
2. Airbag for alignment adjustments
3. Airbag removal tools
4. Airbag simulators
5. Air buffer
6. Air compressor – hoses – inline filter and water separators
7. Alignment lift
8. And equipment- 4 wheel
9. Angle grinder
10. Anti-static devices
11. Arbor press
12. Ball joint press and adapters
13. Battery charger/boosting equipment
14. Battery hydrometer
15. Battery tester/alternator and starter tester (AVR)
16. Bearing remover
17. Belt tension gauge
18. Bench grinders
19. Bench vises
20. Bottle jacks (2)
21. Brake adjustment calipers
22. Brake bleeder wrenches
23. Brake cylinder hone
24. Brake fluid moisture tester
25. Lathe
26. Brake pedal depressor
27. Brake pressure tester
28. Brake rotor gauge/micrometer
29. Brake system bleeder
30. Calibrated vessel
31. Caliper tools for rear-wheel disc
32. Chassis ears
33. Brake washer system (for 2 and 4 post hoists)
34. Computer – PC
35. Drill press
36. Electrical short detector
37. Floor jack
38. Funnels
39. Grease gun and fluid suction pump
40. Heat gun
41. Heli-coil kits
42. Hub service kit
43. Hydraulic press
44. Jack stands and supports
45. Leak detection equipment (refrigerants)
46. Leak detection tank (tires)
47. Oil drain barrels and disposal system
48. Parts washers
49. Pickle-fork tool set
50. Pitman arm pullers
51. Power steering pressure tester
52. Presses
53. Pressure washer
54. Reamer
55. Vacuum
56. Slide hammer
57. Smoke machine
58. Spreaders (tire)
59. Spring compressors – coil spring and strut
60. Spring
61. Steering wheel holder
62. Steering wheel puller set
63. Steering lock plate removal tool
64. Steering tilt pin removal tool
65. Tie-rod end puller
66. Tie-rod sleeve tools
67. Tire changing machine (run-flat capable)
68. Tire balancer equipment (road force type recommended)
69. Tire repair equipment
70. TPMS system service tools
71. Transmission fixtures
Program Content

72. U-joint press
73. Door trim tools
74. Vehicle lifts
75. Vehicle service information system
76. Water hose
77. Welding equipment – GMAW welder and oxy fuelled

Measuring Tools and Equipment

1. ABS pressure tester
2. Ball joint dial indicator set
3. Brake drum gauge (for brake shoe adjusting)
4. Brake drum micrometer
5. Battery tester (electronic)
6. DVOM (Digital Volt Ohm Meter) (CAT III)
7. Headlight aiming equipment
8. Infrared thermometer
9. Lab scope or graphing multi-meter; 8 per class of 16 (channel, digital, cursor function with time capture capability)
10. Lab scope accessories (shielded cables and back probes)
11. Low amp probe
12. Logic probe
13. Micrometer – SAE and metric
14. Power steering pressure tester
15. Pressure gauges
16. Scan tools; 8 per class of 16 [CAN (Controller Area Network) bus capable with appropriate software no older than 5 years of current vehicles]
17. Spring scale
## Reference Materials

### SUGGESTED TEXTS

**Alberta Learning Guides: Product Number- 7850000383**

<table>
<thead>
<tr>
<th>Topic</th>
<th>Product Number</th>
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<tbody>
<tr>
<td>Clutches</td>
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<td>7850001036</td>
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<td>Axles and Bearings</td>
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<td>Differentials</td>
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<td>Final Drive Gear Sets</td>
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<td>Torque Converters</td>
<td>7850001128</td>
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<td>Oil Pumps</td>
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<td>Governors</td>
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<td>Electronic Shift and Controls</td>
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<td>Manual Transaxles</td>
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<td>Manual Transfer Cases</td>
<td>7850001143</td>
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<td>All Wheel Drive (AWD)</td>
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<tr>
<td>Electronic Transfer Case</td>
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<td>4x4 Front Axle Control</td>
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SUGGESTED TEXTS

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<thead>
<tr>
<th>CDX Automotive Tasksheet Manuals</th>
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<tr>
<td>CDX Automotive</td>
<td>Manual Drive Train and Axles</td>
<td>978-0-7637-8511-6</td>
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<td>CDX Automotive</td>
<td>Automatic Transmission and Transaxle</td>
<td>978-0-7637-8499-7</td>
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Additional References

Automotive Fundamentals
By Martin W. Stockel/Martin T. Stockel
Goodheart-Wilcox, publishers

Automotive Electrical and Electronic Systems
By Check-Chart, H.M. Gousha Company
Harper and Row, publishers

Manual Transmissions and Drive Trains
Delmar/White

Automatic Transmissions and Transaxles
By Check-Chart, H.M. Gousha Company
Harper and Row, publishers
: Electronic Transfer Cases

Automatic Transmissions and Transaxles
By Tom D. Birch and Chuck Rockwood

Automotive Technology (4th Edition)
By Jack Erjavec
Instructor Requirements

Occupation Qualification
The instructor must possess:

- An Automotive Service Technician Certificate of Qualification with a Red Seal Endorsement
- A recognized “Advanced Automotive Electrical” certification

Work Experience

- Must have a minimum of five years experience as a journeyperson
- Must have diverse industry experience including that which would cover all the competencies in this program

Instructional Experience and Education

It is preferred that the instructor possesses one of the following:

- Instructors Certificate (minimum 30-hour course)
- Instructors must have or be registered in an Instructor’s Diploma Program, to be completed within a five year period
- Hold a Bachelors or Masters Degree in Education
APPENDIX A –
Practical Assessment
<table>
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<th>Competency</th>
<th>CDX Booklet</th>
<th>Reference Number Essential</th>
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<tr>
<td>B1- Calculate gear ratios</td>
<td>Outline instructions</td>
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<td>B2- Service transmission shifting linkages</td>
<td>Manual Drive Train and Axles</td>
<td>C768</td>
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<td>B3- Overhaul manual transmissions</td>
<td>Manual Drive Train and Axles</td>
<td>C765, C767, C769, C773, C772, C771, C776, C768, C775</td>
<td>C610, C770, C774</td>
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<td>C3- Overhaul automatic transmissions</td>
<td>Automatic Transmission and Transaxle</td>
<td>C684, C688, C752, C751, C750, C759, C690, C753, C686, C760, C756, C757, C758, C754</td>
<td>C685, C755</td>
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<td>C4- Service hydraulic and electrical control systems</td>
<td>Automatic Transmission and Transaxle</td>
<td>C075, C601</td>
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<td>D1- Service drive lines</td>
<td>Manual Drive Train and Axles</td>
<td>CV Shafts: C132, C134, C849, C778</td>
<td>Drive Shaft: C133, C779, C778</td>
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<tr>
<td>Task Description</td>
<td>Task Notes</td>
<td>Regular</td>
<td>Limited Slip</td>
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<tr>
<td>------------------------------------------------------</td>
<td>------------------------------------------------</td>
<td>----------</td>
<td>--------------</td>
</tr>
<tr>
<td>D2- Service final drives, differentials and axles</td>
<td>Manual Drive Train and Axles</td>
<td>C138</td>
<td>C784</td>
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<tr>
<td></td>
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<td>C888</td>
<td>C785</td>
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<td>C889</td>
<td>C612</td>
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<td></td>
<td></td>
<td>C783</td>
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<td>E1- Inspect all-wheel drive systems</td>
<td>Manual drive train and axles</td>
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<td>C788</td>
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<td>C613</td>
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<tr>
<td>E2- Service mechanical and electronic four-wheel drive systems</td>
<td>Manual drive train and axles</td>
<td>C787</td>
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<td></td>
<td>C875</td>
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<td>C789 C613</td>
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</table>
APPENDIX B –
Assessment Guidelines
Program: Automotive Service Technician (AST 4)

Training providers delivering Automotive Service Technician (AST 4) apprenticeship in-school technical training are required to enter the following information in ITA Direct Access for each apprentice:

- An in-school mark in the form of a percentage
  (Minimum 70% is required for a pass)

Training Provider Component: In-School Technical Training

The in-school mark for each level is derived from a combination of theory and practical assessments. This mark is then combined with the ITA Standard Level Examination to determine a final mark for the level.

Calculation tables showing the subject competencies, theory and practical percentage weightings for each competency are shown in the Grading Sheet: “Subject Competencies and Weightings” section of this document.

Automotive Service Technician (AST 4):

- The theory competency result is calculated based on 100% on accumulated competencies;
- The practical competency result is calculated based on 100% on accumulated competencies;
- The final in-school result is calculated by applying a weighting of 80% to the final theory result and a weighting of 20% to the practical result and then adding the two results together.

Successful completion of the in-school training for each level is defined as an in-school mark of 70% or greater.

ITA Component: ITA Standardized Level Examinations Level 4

AST 4 apprentices are required to write the ITA AST 4 standardized level examination after completing their in-school training, in order to acquire a final mark for AST 4.

The ITA standardized level exam is not a C of Q exam and the percentage mark will be blended with the in-school mark to determine a final AST 4 level mark.

The AST 4 standardized level exam may be requested by training providers via the usual ITA procedure.

The ITA will administer and invigilate the AST 4 standardized level exam and score and record exam results in ITA Direct Access.

ITA Direct Access (ITADA) will automatically calculate the final level mark for AST 4 once the in-school training and standardized level exam marks are entered into the system.

In-school technical training (combined theory & practical) is weighted at 80% and the ITA standardized exam is weighted at 20%. These two scores are combined to determine the final level mark. This result is the final mark that is recorded in ITA Direct Access.

- A mark of 70% or greater is required to pass the level when combining the final in-school percentage score and the final ITA standardized level exam percentage score.
Interprovincial Red Seal Exam

In order to achieve certification with the Red Seal Endorsement, Automotive Service Technician (AST 4) apprentices are required to write the Automotive Service Technician (AST 4) Interprovincial Red Seal exam after completing all levels of in-school technical training. Apprentices must have passed all levels of in-school technical training or be approved challengers to sit the exam. A score of 70% or greater is required for a pass.

Interprovincial Red Seal exams should be requested by training providers via the usual ITA procedure.

The ITA will administer and invigilate Interprovincial Red Seal exams and score and record exam results in ITA Direct Access.
### Grading Sheet: Subject Competency and Weightings

<table>
<thead>
<tr>
<th>LINE</th>
<th>TRAINING TOPICS &amp; SUGGESTED TIME ALLOCATION</th>
<th>THEORY WEIGHTING</th>
<th>PRACTICAL WEIGHTING</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Clutch Systems</td>
<td>6%</td>
<td>5%</td>
</tr>
<tr>
<td>B</td>
<td>Manual Transmissions</td>
<td>8%</td>
<td>14%</td>
</tr>
<tr>
<td>C</td>
<td>Automatic Transmissions</td>
<td>55%</td>
<td>46%</td>
</tr>
<tr>
<td>D</td>
<td>Drive Lines</td>
<td>7%</td>
<td>13%</td>
</tr>
<tr>
<td>E</td>
<td>All-Wheel Drive/Four Wheel Drive Systems</td>
<td>12%</td>
<td>22%</td>
</tr>
<tr>
<td>F</td>
<td>New Drive Line Technology</td>
<td>12%</td>
<td>0%</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>100%</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

Calculated by the Training Provider

**AUTOMOTIVE SERVICE TECHNICIAN (AST 4) in-school theory & practical subject competency weighting**

<table>
<thead>
<tr>
<th>In-school Mark</th>
<th>The percentage weighting is calculated once the in-school mark is entered. Combined theory and practical subject competency are multiplied by 80%.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Final Level Mark</td>
<td>ITA Direct Access calculates the final mark for determining credit for AST 4. A score of 70% or higher is required for a pass.</td>
</tr>
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</table>