# RED SEAL

THE INTERPROVINCIAL STANDARDS RED SEAL PROGRAM


## Interprovincial Program Guide

2013

# Automotive Service Technician

Human Resources and Social Development Canada
Ressources humaines et Développement social Canada

Canada

**Interprovincial Program Guide**

# Automotive Service Technician

**2013**


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|---|---|
| Trades and Apprenticeship Division | Division des métiers et de l'apprentissage |
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## Foreword

***The Canadian Council of Directors of Apprenticeship (CCDA) recognizes this Interprovincial Program Guide (IPG) as the national curriculum for the occupation of Automotive Service Technician.***

Jurisdictions have long recognized the benefit of pooling resources in the development and maintenance of apprenticeship training standards. A successful example of this is the Interprovincial Standards Red Seal Program itself. Essential to the establishment of standards is the development of suitable training systems and programs which enable tradespeople to acquire certification based on these standards. While certification is the responsibility of Apprenticeship administrators throughout Canada, the development and delivery of technical training is the responsibility of jurisdictions.

In 1999, work to develop common training for apprenticeship programs within the Atlantic Provinces began. To date, 25 Curriculum Standards have been developed through the Atlantic Standards Partnership (ASP) project to assist programming staff and instructors in the design and delivery of technical training. Similarly, the CCDA embarked on a process for the development of national IPGs for the Boilermaker, Carpenter and Sprinkler System Installer trades. At its January 2005 strategic planning session, the CCDA identified developing common training standards as one of the key activities in moving towards a more cohesive apprenticeship system.

With the support of Human Resources and Skills Development Canada (HRSDC), several provinces and territories have partnered to build on the ASP and the CCDA processes to further develop IPGs to be used across the country. This partnership will create efficiencies in time and resources and promote consistency in training and apprentice mobility.

## Acknowledgements

The CCDA and the IPG Committee wishes to acknowledge the contributions of the following industry and instructional representatives who participated in the development of this document in 2007.

| | |
|---|---|
| Dollard Boisjoli | Nova Scotia |
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In addition to the representatives above, various federal, provincial and territorial representatives contributed to the development of this document including the host province of Manitoba.

In 2012, a review, update and jurisdictional validation of this IPG were completed to ensure adequate coverage of the occupation as outlined in the 2011 National Occupational Analysis (NOA).

As this program guide will be amended periodically, comments or suggestions for improvement should be directed to:

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### PROGRAM CONTENT

## User Guide

According to the Canadian Apprenticeship Forum, the IPG is: "a list of validated technical training outcomes, based upon those sub-tasks identified as common core in the NOA, and validated by industry in the provinces and territories as incorporating the essential tasks, knowledge and skills associated with a given trade."

Learning outcomes contained in the IPG represent the minimum common core content for the development of jurisdictional training standards and outlines. IPGs are developed based on the NOAs and extensive industry consultation. The IPG is intended to assist program development staff in the design of jurisdictional plans for training. Each jurisdiction has the flexibility to add additional content.

The IPG was deliberately constructed for ease of use and flexibility of structure in order to adapt to all delivery requirements. It details units of training, unit outcomes and objectives. It does not impose a delivery model or teaching format.

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

The IPG document includes a recommended levelling structure to facilitate mobility for apprentices moving from one jurisdiction to another. Because of difference in jurisdictional regulations and program durations, levels are offered as suggestions only.

*Structure*

The IPG is divided into units. The unit codes are used as a means of identification and are not intended to convey the order of delivery. Prerequisites have not been detailed. Each unit consists of *Learning Outcomes* and *Objectives and Content.*

The *Learning Outcomes* are the specific performances that must be evaluated. Wording of the learning outcomes, "Demonstrate knowledge of…", acknowledges the broad spectrum of ways in which knowledge can be shown. It is at the discretion of each jurisdiction to determine the manner in which learning outcomes are evaluated; theoretically, practically or a combination of both.

The *Objectives and Content* for the unit details the information to be covered in order to achieve the performances specified in the *Learning Outcomes*. These objectives can be either theoretical or practical in nature, based on the requirements identified through the industry consultation process. The learning activities used to cover the objectives are at the discretion of the jurisdiction; however, practically worded objective statements have been used where industry indicated a need for the apprentices to receive exposure to performing the task or skill outlined while attending technical training. For example, this exposure could be done through instructor demonstration or individual or group performance of the skill or task. This practical training will help to reinforce the theoretical component of the technical training.

Detailed content for each objective has not been developed. Where detail is required for clarity, content has been provided. The content listed within the IPG document is **not** intended to represent an inclusive list; rather, it is included to illustrate the intended direction for the objective. Content may be added or extended in jurisdictional training plans as required.

Jurisdictions are free to deliver the IPG units one at a time or concurrently, provided that all *Learning Outcomes* are met. The IPG does not indicate the amount of time to be spent on a particular unit as the length of time required to deliver the *Learning Outcomes* successfully will depend upon the learning activities and teaching methods used.

## IPG Glossary of Terms

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

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

## IPG Glossary of Terms *(continued)*

| | |
|---|---|
| **TECHNIQUE** | Within a procedure, the manner in which technical skills are applied. |
| **TEST** | v. To subject to a procedure that ascertains effectiveness, value, proper function, or other quality.<br><br>n. A way of examining something to determine its characteristics or properties, or to determine whether or not it is working correctly. |
| **TROUBLESHOOT/ DIAGNOSE** | To follow a systematic procedure to identify and locate a problem or malfunction and its cause. |

## Essential Skills Profiles

Essential Skills are the skills needed for work, learning and life. They provide the foundation for learning all the other skills that enable people to evolve within their jobs and adapt to workplace change.

Over the past several years, the Government of Canada has conducted research examining the skills people use at work. From this research, Essential Skills Profiles have been developed for various occupations.

For more information regarding Essential Skills and to access Essential Skills Profiles for specific occupations, visit HRSDC's Essential Skills website at:

http://www.hrsdc.gc.ca/eng/workplaceskills/LES/profiles/profiles.shtml

## Profile Chart

| | | | |
|---|---|---|---|
| **OCCUPATIONAL SKILLS** | | | |
| **AST-100** Safety | **AST-105** Tools and Equipment | **AST-110** Hoisting and Lifting | **AST-115** Communication |
| **AST-120** Trade Related Documents | **AST-130** Oxy-Acetylene Welding and Cutting (OAW) | **AST-135** Gas Metal Arc Welding (GMAW [MIG]) | **AST-165** Vehicle Maintenance Inspection |
| **ENGINE AND ENGINE SUPPORT SYSTEMS** | | | |
| **AST-145** Accessory Drive Systems | **AST-200** Engine Principles | **AST-205** Cooling Systems | **AST-210** Engine Lubrication Systems |
| **AST-230** Fuel Delivery Systems | **AST-235** Ignition Systems | **AST-300** Engine Repair | **AST-305** Gasoline Fuel Systems |
| **AST-330** Emission Control Systems | **AST-335** Intake and Exhaust Systems | **AST-400** Diesel Fuel Injection Systems | |
| **VEHICLE MANAGEMENT SYSTEMS** | | | |
| **AST-310** Vehicle Management Systems | | | |
| **DRIVE LINE SYSTEMS** | | | |
| **AST-240** Drive Shafts and Axles | **AST-315** Manual Transmissions and Transaxles | **AST-320** Clutches and Flywheels | **AST-325** Transfer Cases and Four-Wheel Drive/All-Wheel Drive (4WD/AWD) Systems |
| **AST-340** Differentials and Final Drive Assemblies | **AST-420** Automatic Transmissions and Transaxles | | |
| **ELECTRICAL AND COMFORT CONTROL SYSTEMS** | | | |
| **AST-155** Electrical and Electronic Principles | **AST-215** Starting Systems | **AST-220** Charging Systems | **AST-225** Lighting and Wiper Systems |
| **AST-425** Electrical Options and Accessories | **AST-430** Instrumentation and Information Displays | **AST-435** Heating, Ventilation and Air Conditioning (HVAC) Systems | |

## Profile Chart *(continued)*

| | | | |
|---|---|---|---|
| **STEERING AND SUSPENSION, BRAKING, CONTROL SYSTEMS, TIRES, HUBS AND WHEEL BEARINGS** | | | |
| **AST-125**<br>Tires, Wheels and Hubs | **AST-140**<br>Braking Systems I (Non-ABS) | **AST-160**<br>Suspension Systems I | **AST-245**<br>Steering Systems |
| **AST-410**<br>Braking Systems II (ABS) | **AST-415**<br>Suspension Systems II | | |
| **BODY COMPONENTS, TRIM AND RESTRAINT SYSTEMS** | | | |
| **AST-150**<br>Body Components and Trim | **AST-440**<br>Restraint Systems | | |
| **HYBRID SYSTEMS** | | | |
| **AST-170**<br>Hybrid Systems I | **AST-445**<br>Hybrid Systems II | | |

## Recommended Level Structure

| LEVEL 1 | | | | | |
|---|---|---|---|---|---|
| **Unit Code** | **Title** | **Page** | **Unit Code** | **Title** | **Page** |
| AST-100 | Safety | 18 | AST-140 | Braking Systems I (Non-ABS) | 28 |
| AST-105 | Tools and Equipment | 19 | AST-145 | Accessory Drive Systems | 30 |
| AST–110 | Hoisting and Lifting | 21 | AST-150 | Body Components and Trim | 31 |
| AST-115 | Communication | 22 | AST-155 | Electrical and Electronic Principles | 33 |
| AST-120 | Trade Related Documents | 23 | AST-160 | Suspension Systems I | 35 |
| AST-125 | Tires, Wheels and Hubs | 24 | AST-165 | Vehicle Maintenance Inspection | 37 |
| AST-130 | Oxy-Acetylene Welding (OAW) and Cutting | 26 | AST-170 | Hybrid Systems I | 38 |
| AST-135 | Gas Metal Arc Welding (GMAW [MIG]) | 27 | | | |
| **LEVEL 2** | | | | | |
| **Unit Code** | **Title** | **Page** | **Unit Code** | **Title** | **Page** |
| AST-200 | Engine Principles | 40 | AST-225 | Lighting and Wiper Systems | 48 |
| AST-205 | Cooling Systems | 42 | AST-230 | Fuel Delivery Systems | 49 |
| AST-210 | Engine Lubrication Systems | 44 | AST-235 | Ignition Systems | 51 |
| AST-215 | Starting Systems | 46 | AST-240 | Drive Shafts and Axles | 52 |
| AST-220 | Charging Systems | 47 | AST-245 | Steering Systems | 54 |
| **LEVEL 3** | | | | | |
| **Unit Code** | **Title** | **Page** | **Unit Code** | **Title** | **Page** |
| AST-300 | Engine Repair | 58 | AST-325 | Transfer Cases and Four-Wheel Drive/All-Wheel Drive (4WD/AWD) Systems | 64 |
| AST-305 | Gasoline Fuel Systems | 59 | AST-330 | Emission Control Systems | 65 |
| AST-310 | Vehicle Management Systems | 60 | AST-335 | Intake and Exhaust Systems | 67 |
| AST-315 | Manual Transmissions and Transaxles | 62 | AST-340 | Differentials and Final Drive Assemblies | 69 |
| AST-320 | Clutches and Flywheels | 63 | | | |
| **LEVEL 4** | | | | | |
| **Unit Code** | **Title** | **Page** | **Unit Code** | **Title** | **Page** |
| AST-400 | Diesel Fuel Injection Systems | 72 | AST-430 | Instrumentation and Information Displays | 79 |
| AST-410 | Braking Systems II (ABS) | 74 | AST-435 | Heating, Ventilation and Air Conditioning (HVAC) Systems | 80 |
| AST-415 | Suspension Systems II | 75 | AST-440 | Restraint Systems | 82 |
| AST-420 | Automatic Transmissions and Transaxles | 76 | AST-445 | Hybrid Systems II | 83 |
| AST-425 | Electrical Options and Accessories | 78 | | | |

## 2011 NOA Sub-Task to IPG Unit Comparison

| NOA Sub-task | | IPG Unit | |
|---|---|---|---|
| **Task 1 – Uses and maintains tools and equipment.** | | | |
| 1.01 | Maintains tools and equipment. | AST–105 | Tools and Equipment |
| 1.02 | Uses hoisting and lifting equipment. | AST–110 | Hoisting and Lifting |
| | | AST–100 | Safety |
| 1.03 | Uses personal protective equipment (PPE) and safety equipment. | AST–100 | Safety |
| **Task 2 – Performs common trade activities.** | | | |
| 2.01 | Uses technical information. | AST–120 | Trade Related Documents |
| 2.02 | Estimates preliminary job cost. | AST–120 | Trade Related Documents |
| 2.03 | Maintains safe work environment. | AST–100 | Safety |
| **Task 3 – Diagnoses engine systems.** | | | |
| 3.01 | Diagnoses cooling systems. | AST–205 | Cooling Systems |
| 3.02 | Diagnoses lubricating systems. | AST–210 | Engine Lubricating Systems |
| 3.03 | Diagnoses base engine. | AST-200 | Engine Principles |
| **Task 4 – Repairs engine systems.** | | | |
| 4.01 | Repairs cooling systems. | AST–205 | Cooling Systems |
| 4.02 | Repairs lubricating systems. | AST–210 | Engine Lubricating Systems |
| 4.03 | Repairs base engine. | AST–300 | Engine Repair |
| **Task 5 – Diagnoses engine support systems.** | | | |
| 5.01 | Diagnoses fuel delivery systems. | AST–230 | Fuel Delivery Systems |
| | | AST–305 | Gasoline Fuel Systems |
| | | AST–400 | Diesel Fuel Injection Systems |
| 5.02 | Diagnoses ignition systems. | AST–235 | Ignition Systems |
| 5.03 | Diagnoses intake/exhaust systems. | AST–335 | Intake and Exhaust Systems |
| 5.04 | Diagnoses emission systems. | AST–330 | Emission Control Systems |
| 5.05 | Diagnoses accessory drive systems and mounts. | AST–145 | Accessory Drive Systems |
| | | AST–315 | Manual Transmissions and Transaxles |
| | | AST–420 | Automatic Transmissions and Transaxles |
| 5.06 | Diagnoses diesel engine support systems. | AST–230 | Fuel Delivery Systems |
| | | AST–400 | Diesel Fuel Injection Systems |
| | | AST–235 | Ignition Systems |
| | | AST–335 | Intake and Exhaust Systems |
| | | AST–330 | Emission Control Systems |
| **Task 6 – Repairs engine support systems.** | | | |
| 6.01 | Repairs gasoline delivery systems. | AST–230 | Fuel Delivery Systems |
| | | AST–305 | Gasoline Fuel Systems |
| | | AST–400 | Diesel Fuel Injection Systems |
| 6.02 | Repairs ignition systems. | AST–235 | Ignition Systems |
| 6.03 | Repairs intake/exhaust systems. | AST–335 | Intake and Exhaust Systems |
| 6.04 | Repairs emission systems. | AST–330 | Emission Control Systems |
| 6.05 | Repairs accessory drive systems and | AST–145 | Accessory Drive Systems |

| NOA Sub-task | | IPG Unit | |
|---|---|---|---|
| | mounts. | AST–315 | Manual Transmissions and Transaxles |
| | | AST–420 | Automatic Transmissions and Transaxles |
| 6.06 | Repairs diesel engine support systems. | AST–230 | Fuel Delivery Systems |
| | | AST–400 | Diesel Fuel Injection Systems |
| | | AST–235 | Ignition Systems |
| | | AST–335 | Intake and Exhaust Systems |
| | | AST–330 | Emission Control Systems |
| **Task 7 – Diagnoses vehicle management systems.** | | | |
| 7.01 | Reads diagnostic trouble codes (DTCs). | AST–310 | Vehicle Management Systems |
| 7.02 | Monitors parameters. | AST–310 | Vehicle Management Systems |
| 7.03 | Interprets test results. | AST–310 | Vehicle Management Systems |
| 7.04 | Tests system circuitry and components. | AST–310 | Vehicle Management Systems |
| **Task 8 – Repairs vehicle management systems.** | | | |
| 8.01 | Updates component software. | AST–310 | Vehicle Management Systems |
| 8.02 | Replaces components. | AST–310 | Vehicle Management Systems |
| 8.03 | Verifies vehicle management system repair. | AST–310 | Vehicle Management Systems |
| | | AST–155 | Electrical and Electronic Principles |
| **Task 9 – Diagnoses drive line systems.** | | | |
| 9.01 | Diagnoses drive shafts and axles. | AST–240 | Drive Shafts and Axles |
| 9.02 | Diagnoses manual transmissions/trans-axles. | AST–315 | Manual Transmissions and Transaxles |
| 9.03 | Diagnoses automatic transmissions/transaxles. | AST–420 | Automatic Transmissions and Transaxles |
| 9.04 | Diagnoses clutches. | AST–320 | Clutches and Flywheels |
| 9.05 | Diagnoses transfer cases. | AST–325 | Transfer Cases and Four-Wheel Drive/All-Wheel Drive (4WD/AWD) Systems |
| 9.06 | Diagnoses final drive assemblies. | AST-340 | Differentials and Final Drive Assemblies |
| **Task 10 – Repairs drive line systems.** | | | |
| 10.01 | Repairs drive shafts and axles. | AST–240 | Drive Shafts and Axles |
| 10.02 | Repairs manual transmissions/transaxles. | AST–315 | Manual Transmissions and Transaxles |
| 10.03 | Repairs automatic transmissions/transaxles. | AST–420 | Automatic Transmissions and Transaxles |
| 10.04 | Repairs clutches. | AST–320 | Clutches and Flywheels |
| 10.05 | Repairs transfer cases. | AST–325 | Transfer Cases and Four-Wheel Drive/All-Wheel Drive (4WD/AWD) Systems |
| 10.06 | Repairs final drive assemblies. | AST-340 | Differentials and Final Drive Assemblies |
| **Task 11 – Diagnoses electrical systems and components.** | | | |
| 11.01 | Diagnoses starting/charging systems and batteries. | AST–215 | Starting Systems |
| | | AST–220 | Charging Systems |
| 11.02 | Diagnoses basic wiring and electrical systems. | AST–155 | Electrical and Electronic Principles |
| | | AST–425 | Electrical Options and Accessories |

| NOA Sub-task | | IPG Unit | |
|---|---|---|---|
| 11.03 | Diagnoses lighting and wiper systems. | AST–225 | Lighting and Wiper Systems |
| 11.04 | Diagnoses entertainment systems. | AST–425 | Electrical Options and Accessories |
| 11.05 | Diagnoses electrical options. | AST–425 | Electrical Options and Accessories |
| 11.06 | Diagnoses instrumentation and information displays. | AST–155 | Electrical and Electronic Principles |
| | | AST–430 | Instrumentation and Information Displays |
| 11.07 | Diagnoses electrical accessories. | AST–155 | Electrical and Electronic Principles |
| | | AST–425 | Electrical Options and Accessories |
| **Task 12 – Repairs electrical systems and components.** | | | |
| 12.01 | Repairs starting/charging systems and batteries. | AST–215 | Starting Systems |
| | | AST–220 | Charging Systems |
| 12.02 | Repairs basic wiring and electrical systems. | AST–155 | Electrical and Electronic Principles |
| | | AST–425 | Electrical Options and Accessories |
| 12.03 | Repairs lighting and wiper systems. | AST–225 | Lighting and Wiper Systems |
| 12.04 | Repairs entertainment systems. | AST–425 | Electrical Options and Accessories |
| 12.05 | Repairs electrical options. | AST–425 | Electrical Options and Accessories |
| 12.06 | Repairs electrical accessories. | AST–155 | Electrical and Electronic Principles |
| | | AST–425 | Electrical Options and Accessories |
| 12.07 | Installs electrical accessories. | AST–155 | Electrical and Electronic Principles |
| | | AST–425 | Electrical Options and Accessories |
| 12.08 | Repairs instrumentation and information displays. | AST–155 | Electrical and Electronic Principles |
| | | AST–430 | Instrumentation and Information Displays |
| **Task 13 – Diagnoses heating, ventilation and cooling (HVAC) and comfort control systems.** | | | |
| 13.01 | Diagnoses air flow control systems. | AST–435 | Heating, Ventilation and Air Conditioning (HVAC) Systems |
| 13.02 | Diagnoses refrigerant systems. | AST–435 | Heating, Ventilation and Air Conditioning (HVAC) Systems |
| 13.03 | Diagnoses heating systems. | AST–435 | Heating, Ventilation and Air Conditioning (HVAC) Systems |
| **Task 14 – Repairs heating, ventilation and cooling (HVAC) and comfort control systems.** | | | |
| 14.01 | Repairs air flow control systems. | AST–435 | Heating, Ventilation and Air Conditioning (HVAC) Systems |
| 14.02 | Repairs refrigerant systems. | AST–435 | Heating, Ventilation and Air Conditioning (HVAC) Systems |
| 14.03 | Repairs heating systems. | AST–435 | Heating, Ventilation and Air Conditioning (HVAC) Systems |
| **Task 15 – Diagnoses steering and suspension, braking, control systems, tires, wheels, hubs and wheel bearings.** | | | |
| 15.01 | Diagnoses steering, suspension and control systems. | AST–245 | Steering Systems |
| 15.02 | Diagnoses braking and control systems. | AST–140 | Braking Systems I (Non ABS) |
| | | AST–410 | Braking Systems II (ABS) |
| 15.03 | Diagnoses tires, wheels, hubs, and | AST–125 | Tires, Wheels and Hubs |

| NOA Sub-task | | IPG Unit | |
|---|---|---|---|
| | wheel bearings. | | |
| **Task 16 – Repairs steering and suspension, braking, control systems, tires, wheels, hubs and wheel bearings.** | | | |
| 16.01 | Repairs steering, suspension and control systems. | AST–245 | Steering Systems |
| 16.02 | Repairs braking and control systems. | AST–140 | Braking Systems I (Non-ABS) |
| | | AST–410 | Braking Systems II (ABS) |
| 16.03 | Repairs tires, wheels, hubs and wheel bearings. | AST–125 | Tires, Wheels and Hubs |
| **Task 17 – Diagnoses body components, trim and restraint systems.** | | | |
| 17.01 | Diagnoses restraint systems. | AST–440 | Restraint Systems |
| 17.02 | Diagnoses wind noise, rattles and water leaks. | AST–150 | Body Components and Trim |
| 17.03 | Diagnoses interior and exterior components and trim. | AST–150 | Body Components and Trim |
| 17.04 | Diagnoses latches, locks and movable glass. | AST–150 | Body Components and Trim |
| **Task 18 – Repairs body components, trim, restraint systems and installed accessories.** | | | |
| 18.01 | Repairs restraint systems. | AST–440 | Restraint Systems |
| 18.02 | Repairs problems with wind noise, rattles and water leaks. | AST–150 | Body Components and Trim |
| 18.03 | Repairs interior and exterior components and trim. | AST–150 | Body Components and Trim |
| 18.04 | Repairs latches, locks and movable glass. | AST–150 | Body Components and Trim |
| 18.05 | Install interior and exterior accessories. | AST–150 | Body Components and Trim |
| **Task 19 – Diagnoses hybrid and alternate fuel systems.** | | | |
| 19.01 | Implements hybrid safety protocols. | AST-170 | Hybrid Systems I |
| 19.02 | Diagnoses hybrid systems. | AST–445 | Hybrid Systems II |
| 19.03 | Diagnoses alternate fuel systems. | AST–445 | Hybrid Systems II |
| **Task 20 – Repairs hybrid and alternate fuel systems.** | | | |
| 20.01 | Repairs hybrid systems. | AST-445 | Hybrid Systems II |
| 20.02 | Repairs alternate fuel systems. | AST–445 | Hybrid Systems II |

# LEVEL 1

## AST-100 Safety

**Learning Outcomes:**

- Demonstrate knowledge of safety equipment, their applications, maintenance and procedures for use.
- Demonstrate knowledge of safe work practices.
- Demonstrate knowledge of regulatory requirements pertaining to safety.

**Objectives and Content:**

1. Identify types of personal protective equipment (PPE) and clothing and describe their applications and limitations.

2. Describe the procedures used to care for and maintain PPE.

3. Identify workplace hazards and describe safe work practices and equipment.
   - i) personal
   - ii) shop/facility
     - fire
     - explosion
     - gases
   - iii) environmental awareness
   - iv) vehicle
     - restraint systems
     - high voltage systems
     - high pressure fuel systems
     - high pressure gasses in AC

4. Identify and interpret workplace safety and health regulations.
   - i) federal
     - Material Safety Data Sheets (MSDS)
     - Workplace Hazardous Material Information System (WHMIS)
   - ii) provincial/territorial
     - Occupational Health and Safety (OH&S)
   - iii) municipal

## AST-105 Tools and Equipment

**Learning Outcomes:**

- Demonstrate knowledge of tools and equipment, their applications, maintenance and procedures for use.

**Objectives and Content:**

1. Identify hazards and describe safe work practices pertaining to the use of tools and equipment.

2. Identify types of hand tools and describe their applications and procedures for use.

3. Describe the procedures used to inspect, maintain and store hand tools.

4. Identify types of power tools and describe their applications and procedures for use.
   i) electric
   ii) pneumatic
   iii) hydraulic

5. Describe the procedures used to inspect, maintain and store power tools.

6. Identify types of measuring tools and describe their applications and procedures for use.
   i) micrometers
   ii) vernier calipers
   iii) pressure gauges

7. Identify types of scan tools and digital volt ohmmeters (DVOM) and describe their applications.

8. Describe the procedures used to inspect, maintain and store measuring tools.

9. Identify types of shop equipment and describe their applications and procedures for use.

10. Describe the procedures used to inspect, maintain and store shop equipment.

11. Identify types of welding, cutting and heating equipment and describe their applications.
    i) oxy-acetylene heating and cutting
    ii) gas metal arc welding (GMAW)
        - metal inert gas welding (MIG)
    iii) shielded metal arc welding (SMAW)

12. Identify types of fasteners and describe their applications and procedures for use.

13. Identify types of tubing and hoses and describe their applications and procedures for use.

14. Identify types of fittings and describe their applications and procedures for use.

## AST-110 Hoisting and Lifting

**Learning Outcomes:**

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

**Objectives and Content:**

1. Define terminology associated with hoisting and lifting.

2. Identify hazards and describe safe work practices pertaining to hoisting and lifting.

3. Interpret information pertaining to hoisting and lifting found on drawings and specifications.

4. Identify types of hoisting and lifting equipment and accessories and describe their applications.

5. Describe the procedures used when hoisting and lifting.

6. Describe the procedures used to inspect, maintain and store hoisting and lifting equipment.

## AST-115 Communication

**Learning Outcomes:**

- Demonstrate knowledge of effective communication practices.

**Objectives and Content:**

1. Identify audiences and describe techniques for effective verbal and non-verbal communication.
   i) apprentices
   ii) other tradespersons
   iii) colleagues
   iv) supervisors
   v) clients

2. Identify types of communication devices and describe their purpose and operation.
   i) portable and stationary radios
   ii) cellular phones and mobility devices
   iii) computers
   iv) digital camera

3. Describe the importance of communicating job requirements.

## AST-120 Trade Related Documents

**Learning Outcomes:**

- Demonstrate knowledge of trade related documents and their use.
- Demonstrate knowledge of the procedures used to prepare and complete documentation.

**Objectives and Content:**

1. Identify sources of related information.

2. Identify and interpret identification codes found on the vehicle and vehicle components.
   i) vehicle identification number (VIN)

3. Identify types of trade related documents and describe their applications.
   i) work orders/repair orders
   ii) schematics and service information
   iii) technical service bulletins (TSB)
   iv) preventative maintenance schedules
   v) estimates
   vi) industry standard labour guides
   vii) manufacturers' specifications
   viii) codes and standards
   ix) company policies

4. Describe the procedures used to prepare and/or complete trade related documents.
   i) work orders/repair orders
   ii) estimates
   iii) pre-delivery inspection
   iv) preventative maintenance

## AST-125 Tires, Wheels and Hubs

**Learning Outcomes:**

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

**Objectives and Content:**

1. Define terminology associated with tires, wheels and hubs.

2. Identify hazards and describe safe work practices pertaining to tires and wheels.
   i) tire inflation
   ii) tire sizing

3. Interpret tire codes and sidewall markings.

4. Identify tools and equipment relating to tires, wheels and hubs and describe their applications and procedures for use.

5. Identify types of tires and describe their construction.

6. Describe the importance of tire rotation and maintenance.

7. Identify types of wheels and describe their components and operation.

8. Identify types of hubs and bearing assemblies and describe their components and operation.

9. Identify types of tire pressure monitoring systems and describe their applications.

10. Identify types of lubricants and describe their applications and procedures for use.

11. Describe the relationship between the suspension system and wheel assemblies.

12. Describe the procedures used to diagnose tires, wheels and hubs.

13. Describe the procedures used to repair and/or replace tires and wheel assemblies.
    i) index and balance

14. Describe the procedures used to adjust, repair and/or replace hubs and bearings.

## AST-130 Oxy-Acetylene Welding (OAW) and Cutting

**Learning Outcomes:**

- Demonstrate knowledge of oxy-acetylene welding and cutting equipment, their applications, maintenance and procedure for use.
- Demonstrate knowledge of weld defects, their causes and the procedures to prevent and correct them.

**Objectives and Content:**

1. Define terminology associated with oxy-acetylene welding and cutting.

2. Identify hazards and describe safe work practices pertaining to oxy-acetylene welding and cutting.
   i) personal
   ii) shop/facility
   iii) equipment

3. Identify oxy-acetylene welding and cutting equipment and accessories and describe their applications.

4. Identify types of oxy-acetylene processes and describe their characteristics and applications.
   i) brazing/welding
   ii) cutting
   iii) heating

5. Describe the procedures used to set-up, adjust and shut-down oxy-acetylene welding and cutting equipment.

6. Describe the procedures used to inspect, maintain and store oxy-acetylene welding and cutting equipment.

7. Describe the procedures used to operate oxy-acetylene equipment.

8. Identify types of weld defects and describe their causes.

9. Describe the procedures used to prevent and correct weld defects.

## AST-135 Gas Metal Arc Welding (GMAW [MIG])

**Learning Outcomes:**

- Demonstrate knowledge of gas metal arc welding equipment, their applications, maintenance and procedure for use.
- Demonstrate knowledge of weld defects, their causes and the procedures to prevent and correct them.

**Objectives and Content:**

1. Define terminology associated with gas metal arc welding GMAW (MIG).

2. Identify hazards and describe safe work practices pertaining to GMAW (MIG).
   i) personal
   ii) shop/facility
   iii) equipment

3. Identify GMAW (MIG) equipment and accessories and describe their applications.

4. Identify types of GMAW (MIG) processes and describe their characteristics and applications.

5. Describe the procedures used to set-up, adjust and shut-down GMAW (MIG) equipment.

6. Describe the procedures used to operate GMAW (MIG) equipment.

7. Describe the procedures used to inspect, maintain and store GMAW (MIG) equipment.

8. Identify types of weld defects and describe their causes.

9. Describe the procedures used to prevent and correct weld defects.

## AST-140 Braking Systems I (Non-ABS)

**Learning Outcomes:**

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

**Objectives and Content:**

1. Define terminology associated with braking systems.

2. Identify hazards and describe safe work practices pertaining to braking systems.
   i) hydraulic pressure

3. Explain hydraulic principles related to braking systems.
   i) Pascal's law

4. Identify tools and equipment relating to braking systems and describe their applications and procedures for use.

5. Identify types of braking systems and describe their components and operation.
   i) disc
   ii) drum
   iii) parking

6. Identify types of power assists and describe their components and operation.
   i) vacuum
   ii) hydraulic
   iii) electric

7. Identify types of fluids and describe their applications and procedures for use.

8. Identify types of fittings, flaring, tubing and hoses and describe their applications and procedures for use.

9. Describe the procedures used to diagnose braking systems.

10. Describe the procedures used to flush and bleed hydraulic brakes.

11. Describe the procedures used to measure and machine components.

12. Describe the procedures used to adjust, repair and/or replace braking system components.

## AST-145 Accessory Drive Systems

**Learning Outcomes:**

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

**Objectives and Content:**

1. Define terminology associated with accessory drive systems.

2. Identify hazards and describe safe work practices pertaining to accessory drive systems.

3. Identify tools and equipment relating to accessory drive systems and describe their applications and procedures for use.

4. Identify types of accessory drive systems and describe their components and operation.
   i) belt tension/tensioners
   ii) belts
   iii) drives
      - electric
      - hydraulic
      - gear

5. Describe the procedures used to diagnose accessory drive systems.

6. Describe the procedures used to adjust, repair and/or replace accessory drive system components.

## AST-150 Body Components and Trim

**Learning Outcomes:**

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

**Objectives and Content:**

1. Define terminology associated with body components and trim.

2. Identify hazards and describe safe work practices pertaining to body components and trim.
   i) restraint systems

3. Identify tools and equipment relating to body components and trim and describe their applications and procedures for use.

4. Explain the principles of basic aerodynamics related to body design.

5. Identify body components and accessories and describe their purpose and operation.
   i) interior
   ii) exterior

6. Identify types of electrical/electronic systems and describe their components and operation.
   i) locks
   ii) latches
   iii) windows
   iv) remote entry

7. Identify types and sources of noise, vibration and harshness (NVH).
   i) chuckles
   ii) rattles
   iii) knocks and whines
   iv) offensive noises

8. Identify materials used to dampen or interrupt vibration.
   i) tapes
   ii) adhesives
   iii) insulators

9. Identify types and sources of wind and water leaks.

10. Identify types of seals, adhesives, cleaners and sealing materials and describe their applications and procedures for use.

11. Describe the procedures used to diagnose body components and trim.

12. Describe the procedures used to adjust, repair and/or replace body components and trim.

## AST-155 Electrical and Electronic Principles

**Learning Outcomes:**

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

**Objectives and Content:**

1. Define terminology associated with electrical, electronic, and magnetic principles.

2. Identify hazards and describe safe work practices pertaining to electrical and electronic components.
   i) personal
   ii) vehicle

3. Interpret information pertaining to electrical and electronic components found on drawings and specifications.
   i) diagnostic flowcharts
   ii) schematics

4. Explain basic electrical theory.
   i) conventional theory
   ii) electron theory

5. Explain Ohm's law and its applications to electrical circuits.
   i) series circuit
   ii) parallel circuit
   iii) series-parallel circuits

6. Identify tools and equipment used to test and charge batteries and describe their applications and procedures for use.

7. Identify types of batteries and describe their characteristics.

8. Identify types of wire and describe their characteristics, composition and applications.

9. Identify types of electrical components and describe their purpose and operation.
   i) circuit protection
   ii) control devices
   iii) load devices

10. Identify types of electronic components and describe their purpose and operation.
   i) diodes
   ii) transistors
   iii) resistors
   iv) integrated circuits
   v) capacitors
   vi) photo-electric devices

11. Identify tools and equipment used to test circuits and components and describe their applications and procedures for use.
   i) scan tools
   ii) DVOM

12. Describe the procedures used to diagnose circuits and components.

13. Identify methods of wire repair and describe their associated procedures.
   i) splicing
   ii) terminal replacement
   iii) soldering
   iv) crimping

14. Describe the procedures used to repair and/or replace circuits and components.

## AST-160 Suspension Systems I

**Learning Outcomes:**

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

**Objectives and Content:**

1. Define terminology associated with suspension systems.

2. Identify hazards and describe safe work practices pertaining to suspension systems.
   i) springs

3. Interpret codes, standards and regulations pertaining to suspension systems.
   i) manufacturers' specifications

4. Identify tools and equipment relating to suspension systems and describe their applications and procedures for use.

5. Identify types of suspension systems and describe their components and operation.
   i) independent
   ii) solid axle

6. Identify types of frames and body construction.

7. Identify types of springs and describe their purpose and operation.
   i) coil
   ii) leaf
   iii) torsion bar
   iv) air

8. Identify types of dampers and describe their components and operation.
   i) struts
   ii) shocks

9. Describe the procedures used to diagnose suspension systems.

10. Describe the procedures used to adjust, repair and/or replace suspension system components.

11. Identify types of ball-joints and describe their purpose and operation.

## AST-165 Vehicle Maintenance Inspection

**Learning Outcomes:**

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

**Objectives and Content:**

1. Define terminology associated with vehicle maintenance inspections.

2. Identify hazards and describe safe work practices pertaining to vehicle maintenance inspections.

3. Identify tools and equipment used to perform vehicle maintenance inspections and describe their applications and procedures for use.

4. Identify types of vehicle components and accessories requiring operational checks.
   i) brakes
   ii) tires
   iii) lights and wipers
   iv) steering linkage and suspension
   v) belts and filters
   vi) exhaust

5. Identify types of lubricants and fluids requiring service checks.

6. Describe the procedures used to perform vehicle maintenance inspections.

7. Describe the importance of regular vehicle maintenance inspections.

## AST-170 Hybrid Systems I

**Learning Outcomes:**

- Demonstrate knowledge of hybrid systems, their components and operation.

**Objectives and Content:**

1. Define terminology associated with hybrid systems.

2. Identify hazards and describe safe work practices pertaining to hybrid systems.
   i) PPE
   ii) high voltage
   iii) extreme cold temperatures

3. Identify tools and equipment relating to hybrid vehicles and describe their applications and procedures for use.

4. Identify types of hybrid vehicles and their related components.
   i) series
   ii) parallel
   iii) series-parallel
   iv) plug-in

5. Describe high voltage vehicle disconnect procedures.

# LEVEL 2

## AST-200 Engine Principles

**Learning Outcomes:**

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

**Objectives and Content:**

1. Define terminology associated with engines.

2. Explain internal combustion principles.

3. Identify types of engine classifications.
   - i) fuel
     - diesel
     - gasoline
     - alternate fuels
   - ii) stroke

4. Identify types of engine configurations and describe their construction.
   - i) inline
   - ii) rotary
   - iii) opposed
   - iv) V

5. Identify types of valve train configurations and describe their construction.
   - i) push rod
   - ii) overhead cam
   - iii) multi-valve
   - iv) solenoid operated valve

6. Identify engine components and describe their design, purpose and operation.
   i) block assembly
   ii) cylinder head assembly
   iii) timing
      - gears
      - belts
      - chains
      - variable
   iv) mounts

7. Identify types of fasteners, gaskets, seals and sealants and describe their applications and procedures for use.

8. Calculate engine displacement, compression ratios, horsepower, area and volume.

## AST-205 Cooling Systems

**Learning Outcomes:**

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

**Objectives and Content:**

1. Define terminology associated with cooling systems.

2. Identify hazards and describe safe work practices pertaining to cooling systems.
   i) environmental

3. Identify tools and equipment relating to cooling systems and describe their applications and procedures for use.

4. Identify types of cooling systems and describe their purpose, characteristics and applications.
   i) liquid
   ii) air cooled

5. Identify cooling system components and describe their purpose and operation.

6. Identify warning systems and indicators and describe their purpose and operation.
   i) lights
   ii) gauges
   iii) audible

7. Identify types of fan systems and describe their components and operation.
   i) mechanical
   ii) electric
   iii) hydraulic

8. Identify related systems and describe their relationship to cooling systems.
   i) heating, ventilation and air conditioning (HVAC)
   ii) coolers and auxiliary coolers
   iii) coolant heaters

9. Identify types of coolants and chemical additives and describe their characteristics and applications.

10. Describe the procedures used to handle, store and dispose of coolants.

11. Identify types of hoses, tubing, belts, gaskets, seals and sealants and describe their applications.

12. Describe the procedures used to diagnose cooling systems.

13. Describe the procedures used to adjust, repair and/or replace cooling system components.

## AST-210 Engine Lubrication Systems

**Learning Outcomes:**

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

**Objectives and Content:**

1. Define terminology associated with engine lubrication systems.

2. Identify hazards and describe safe work practices pertaining to engine lubrication systems.

3. Identify tools and equipment related to engine lubrication systems and describe their applications and procedures for use.

4. Identify types of engine lubricants and describe their characteristics and applications.
   i) grades and classifications
   ii) synthetics
   iii) additives

5 Identify types of oil pumps and drives and describe their purpose and operation.
   i) rotor pump
   ii) vane type
   iii) gear type

6. Identify types of oil coolers and describe their purpose and operation.
   i) oil-to-air
   ii) oil-to-coolant

7. Identify types of hoses, tubing, gaskets, seals and sealants and describe their applications.

8. Describe oil flow, filtration and pressure regulation.

9. Identify types of warning systems and indicators and describe their purpose and operation.
   i) lights
   ii) gauges
   iii) audible

10. Describe the procedures used to perform oil and filter changes.
   i) super/turbocharger precautions

11. Describe the procedures used to diagnose engine lubrication systems.

12. Describe the procedures used to adjust, repair and/or replace engine lubrication systems and their related components.

## AST-215 Starting Systems

**Learning Outcomes:**

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

**Objectives and Content:**

1. Define terminology associated with starting systems.

2. Identify hazards and describe safe work practices pertaining to starting systems.

3. Identify tools and equipment relating to starting systems and describe their applications and procedures for use.

4. Identify types of starting systems and describe their components and operation.

5. Identify types of starting control systems and describe their components and operation.
   i) anti-theft
   ii) safety
   iii) keyless start/stop

6. Describe the procedures used to diagnose starting systems.

7. Describe the procedures used to adjust, repair and/or replace starting system components.

## AST-220 Charging Systems

**Learning Outcomes:**

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

**Objectives and Content:**

1. Define terminology associated with charging systems.

2. Identify hazards and describe safe work practices pertaining to charging systems.

3. Identify tools and equipment relating to charging systems and describe their applications and procedures for use.

4. Identify types of charging systems and describe their components and operation.

5. Describe the procedures used to diagnose charging systems.

6. Describe the procedures used to adjust, repair and/or replace charging system components.

## AST-225 Lighting and Wiper Systems

**Learning Outcomes:**

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

**Objectives and Content:**

1. Define terminology associated with lighting and wiper systems.

2. Identify hazards and describe safe work practices pertaining to lighting and wiper systems.
   i) high intensity discharge (HID)

3. Identify tools and equipment relating to lighting and wiper systems and describe their applications and procedures for use.

4. Identify types of lighting systems and describe their components and operation.

5. Identify types of wiper systems and describe their components and operation.

6. Describe the procedures used to diagnose lighting and wiper systems.

7. Describe the procedures used to adjust, repair and/or replace lighting and wiper system components.

## AST-230 Fuel Delivery Systems

**Learning Outcomes:**

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

**Objectives and Content:**

1. Define terminology associated with fuel delivery systems.

2. Identify hazards and describe safe work practices pertaining to fuel delivery systems.
   i) handling, disposal and storage of fuels
   ii) depressurize fuel systems and fuel recovery
   iii) alternate fuel high pressure and flammability

3. Identify types of fuels and describe their characteristics and properties.
   i) gasoline
   ii) diesel
   iii flex/E85
   iv) hydrogen
   v) bio-diesel
   vi) LPG
   vii) CNG

4. Identify types of fuel delivery systems and describe their components and operation.
   i) mechanical
   ii) electrical

5. Identify types of fasteners, tubing, hoses, gaskets, seals and sealants and describe their applications.

6. Describe the procedures used to diagnose fuel delivery systems and their components.
   i) gasoline

ii) diesel

7. Describe the procedures used to adjust, repair and/or replace fuel delivery systems and their components.
   i) gasoline
   ii) diesel

## AST-235 Ignition Systems

**Learning Outcomes:**

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

**Objectives and Content:**

1. Define terminology associated with ignition systems.

2. Identify hazards and describe safe work practices pertaining to ignition systems.
   i) high voltage

3. Identify tools and equipment relating to ignition systems and describe their applications and procedures for use.

4. Identify types of ignition systems and describe their components and operation.
   i) distributor
   ii) distributorless
   iii) coil on plug

5. Identify types of ignition circuits and describe their purpose and operation.
   i) primary
   ii) secondary

6. Describe the procedures used to diagnose ignition systems and their components.

7. Describe the procedures used to adjust, repair and/or replace ignition systems and their components.

## AST-240 Drive Shafts and Axles

**Learning Outcomes:**

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

**Objectives and Content:**

1. Define terminology associated with drive shafts and axles.

2. Identify hazards and describe safe work practices pertaining to drive shafts and axles.

3. Identify tools and equipment relating to drive shafts and axles and describe their applications and procedures for use.
   i) dial indicators
   ii) inclinometer

4. Identify types of drive shafts and describe their composition.

5. Identify types of drive shaft components and describe their purpose and operation.
   i) slip yokes and flanges
   ii) flex joints
   iii) single cardan joints
   iv) double cardan joints
   v) support bearing
   vi) viscous coupling

6. Identify types of axles and describe their components and operation.
   i) half shafts
   ii) floating
   iii) semi-floating

7. Describe axle disconnects, locking hubs and their purpose.

8. Describe the importance of multiple piece drive shaft phasing and indexing.

9. Identify types of lubricants, fasteners, gaskets, seals and sealants and describe their applications.

10. Describe the procedures used to diagnose drive shafts and axles systems.

11. Describe the procedures used to adjust, repair and/or replace drive shafts and axles and their related components.

## AST-245 Steering Systems

**Learning Outcomes:**

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

**Objectives and Content:**

1. Define terminology associated with steering systems.

2. Identify hazards and describe safe work practices pertaining to steering systems.
   i) passive restraints
      - air bags
      - clock springs
      - procedures used to disarm
   ii) collapsible columns

3. Identify tools and equipment relating to steering systems and describe their applications and procedures for use.

4. Identify types of steering columns and describe their components and operation.
   i) tilt
   ii) telescopic
   iii) collapsible

5. Identify types of steering systems and describe their components and operation.
   i) linkage
   ii) rack-and-pinion
   iii) four-wheel steering

6. Identify types of steering gears and describe their components and operation.
   i) recirculating ball
   ii) rack-and-pinion

7. Identify types of assist systems and describe their components and operation.
   i) electric
   ii) hydraulic
   iii) variable

8. Identify types of power steering pumps and describe their components and operation.

9. Identify types of fluids and lubricants, fasteners, tubing, hoses, gaskets and seals and describe their applications.

10. Describe the procedures used to diagnose steering systems.

11. Describe the procedures used to adjust, repair and/or replace steering system components.

# LEVEL 3

## AST-300 Engine Repair

**Learning Outcomes:**

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

**Objectives and Content:**

1. Define terminology associated with engine repair.

2. Identify hazards and describe safe work practices pertaining to engine repair.

3. Identify tools and equipment relating to engine repair and describe their applications and procedures for use.

4. Identify types and sources of engine problems.
   - i) low power
   - ii) smoke
   - iii) oil consumption
   - iv) fluid contamination
   - v) rough running
   - vi) internal/external leaks
   - vii) noises

5. Describe the procedures used to diagnose mechanical engine problems.

6. Describe the procedures used to remove and reinstall engines.

7. Describe the procedures used to adjust, repair and/or replace engine components.

## AST-305 Gasoline Fuel Systems

**Learning Outcomes:**

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

**Objectives and Content:**

1. Define terminology associated with gasoline fuel systems.

2. Identify hazards and describe safe work practices pertaining to gasoline fuel systems.
   i) high pressure
   ii) flammability

3. Identify tools and equipment relating to gasoline fuel systems and describe their applications and procedures for use.

4. Identify types of gasoline fuel injection systems and describe their components and operation.
   i) electronic injection
   ii) direct injection

5. Identify types of tubing, hoses, gaskets, seals and sealants and describe their applications.

6. Describe the procedures used to diagnose gasoline fuel injection systems.

7. Describe the procedures used to adjust, repair and/or replace gasoline fuel injection system components.

## AST-310 Vehicle Management Systems

**Learning Outcomes:**

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

**Objectives and Content:**

1. Define terminology associated with vehicle management systems.

2. Explain basic computer operation and its relationship to vehicle management systems.

3. Identify tools and equipment used to diagnose network and electronic circuitry and describe their applications and procedures for use.
   i) digital volt ohmmeter (DVOM)
   ii) scopes
   iii) probes
   iv) break out boxes
   v) scan tools

4. Identify on-board diagnostic (OBD) systems and describe their components and operation.
   i) OBD I
      - diagnostic trouble codes (DTC)
   ii) OBD II
      - drive cycles and monitors
      - DTC

5. Identify types of network protocols and describe their purpose.

6. Describe the networking of modules and multi-plexing.
   i) wiring designs
   ii) wireless

7. Identify the parameters of inputs and outputs and describe their relationships.

8. Describe the procedures used to diagnose vehicle management systems.

9. Identify methods used to access/transfer and reprogram software and describe their associated procedures.

10. Describe the procedures used to repair and/or replace vehicle management system components.

## AST-315 Manual Transmissions and Transaxles

**Learning Outcomes:**

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

**Objectives and Content:**

1. Define terminology associated with manual transmissions and transaxles.

2. Identify hazards and describe safe work practices pertaining to manual transmissions and transaxles.

3. Identify tools and equipment relating to manual transmissions and transaxles and describe their applications and procedures for use.

4. Identify types of manual transmissions and transaxles and describe their components and operation.

5. Explain power flow as it relates to manual transmissions and transaxles.

6. Describe gear ratios, their purpose and calculation.

7. Identify types of lubricants, fasteners, gaskets, seals and sealants and describe their applications.

8. Describe the procedures used to diagnose manual transmissions and transaxles.

9. Describe the procedures used to adjust, repair and/or replace manual transmissions and transaxles and their related components.

## AST-320 Clutches and Flywheels

**Learning Outcomes:**

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

**Objectives and Content:**

1. Define terminology associated with clutches and flywheels.

2. Identify hazards and describe safe work practices pertaining to clutches and flywheels.

3. Identify tools and equipment relating to clutches and flywheels and describe their applications and procedures for use.

4. Identify types of clutches and describe their components and operation.

5. Identify types of flywheels and describe their components and operation.

6. Identify mechanical and hydraulic clutch operating systems and describe their components and operation.

7. Identify types of fluids, fasteners, tubing, hoses and seals and describe their applications.

8. Describe the procedures used to diagnose clutches and flywheels.

9. Describe the procedures used to adjust, repair and/or replace clutches and flywheels and their related components.

## AST-325 Transfer Cases and Four-Wheel Drive/All-Wheel Drive (4WD/AWD) Systems

**Learning Outcomes:**

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

**Objectives and Content:**

1. Define terminology associated with transfer cases and four-wheel drive/all-wheel drive (4WD/AWD) systems.

2. Identify types of transfer cases and 4WD/AWD systems and describe their components and operation.

3. Describe the relationship between transfer cases, locking hubs, and axle disconnects.

4. Identify tools and equipment relating to transfer cases and 4WD/AWD systems and describe their applications and procedures for use.

5. Identify types of transfer case and 4WD/AWD systems control systems and describe their components and operation.
   i) vacuum
   ii) manual
   iii) electronic

6. Explain power flow as it relates to transfer cases and 4WD/AWD systems.

7. Describe gear ratios, their purpose and calculations.

8. Identify types of lubricants, fasteners, gaskets, seals and sealants and describe their applications.

9. Describe the procedures used to diagnose transfer cases and 4WD/AWD systems.

10. Describe the procedures used to adjust, repair and/or replace transfer cases and 4WD/AWD systems and their related components.

## AST-330 Emission Control Systems

**Learning Outcomes:**

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

**Objectives and Content:**

1. Define terminology associated with emission control systems.

2. Identify hazards and describe safe work practices pertaining to emission control systems.

3. Identify tools and equipment relating to emission control systems and describe their applications and procedures for use.

4. Identify types of on-board diagnostic systems and describe their applications.
   i) OBD I
   ii) OBD II

5. Identify types of emission gases.
   i) CO
   ii) $CO^2$
   iii) NOx
   iv) HC
   v) $O^2$

6. Identify emission control systems and describe their components and operation.
   i) exhaust gas recirculation (EGR)
   ii) evaporative emission control systems (EVAP)
   iii) secondary air injection
   iv) exhaust system
   v) positive crankcase ventilation (PCV)
   vi) induction system

vii) variable cam-timing (VCT)
viii) particulate filter
ix) diesel exhaust fluid (DEF)

7. Identify types of fasteners, tubing, hoses, gaskets, seals and sealants and describe their applications.

8. Describe the procedures used to diagnose emission control systems and their components.
   i) gasoline
   ii) diesel

9. Describe the procedures used to adjust, repair and/or replace emission control systems and their components.
   i) gasoline
   ii) diesel

## AST-335 Intake and Exhaust Systems

**Learning Outcomes:**

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

**Objectives and Content:**

1. Define terminology associated with intake and exhaust systems.

2. Identify hazards and describe safe work practices pertaining to intake and exhaust systems.

3. Identify tools and equipment relating to intake and exhaust systems and describe their applications and procedures for use.

4. Identify types of intake systems and describe their components and operation.

5. Identify types of exhaust systems and describe their components and operation.

6. Identify intake air systems and describe their components and operation.
   i) forced air
      - turbocharged
      - supercharged
   ii) naturally aspirated (NA)

7. Identify types and sources of induction and exhaust system problems.
   i) leaks
   ii) blockages
   iii) noise
   iv) vibration

8. Identify types of fasteners, tubing, hoses, gaskets, seals and sealants and describe their applications.

9. Describe the procedures used to diagnose intake and exhaust systems and their components.

10. Describe the procedures used to adjust, repair and/or replace intake and exhaust systems and their components.

## AST-340 Differentials and Final Drive Assemblies

**Learning Outcomes:**

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

**Objectives and Content:**

1. Define terminology associated with differentials and final drive assemblies.

2. Identify hazards and describe safe work practices pertaining to differentials and final drive assemblies.

3. Identify tools and equipment relating to differentials and final drive assemblies and describe their applications and procedures for use.

4. Identify types of differentials and final drive assemblies and describe their components and operation.
   i) locking
   ii) non-locking

5. Identify types of differential housings.
   i) integral
   ii) non-integral

6. Identify types of differential control systems and final drive assemblies and describe their components and operation.
   i) electronically controlled/electric
   ii) vacuum
   iii) mechanical

7. Explain power flow as it relates to differentials and final drive assemblies.

8. Describe gear ratios, their purpose and calculations.

9. Identify types of lubricants, additives, fasteners, gaskets, seals and sealants and describe their applications.

10. Describe the procedures used to diagnose differentials and final drive assemblies.

11. Describe the procedures used to adjust, repair and/or replace differentials and final drive assemblies their related components.

# LEVEL 4

## AST-400 Diesel Fuel Injection Systems

**Learning Outcomes:**

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

**Objectives and Content:**

1. Define terminology associated with diesel fuel injection systems.

2. Identify hazards and describe safe work practices pertaining to diesel fuel injection systems.
   i) high pressure
   ii) high amperage/voltage
   iii) starting fluids
   iv) emergency shut-off

3. Identify tools and equipment relating to diesel fuel injection systems and describe their applications and procedures for use.

4. Identify types of diesel fuel injection systems and describe their components and operation.
   i) electronic
   ii) mechanical

5. Identify types of tubing, hoses, gaskets, seals and sealants and describe their applications.

6. Identify types of cold start systems, such as pre-heaters, and describe their purpose and operation.

7. Identify methods to test fuel quality and describe their associated procedures.

8. Describe the procedures used to diagnose diesel fuel injection systems.

9. Describe the procedures used to adjust, repair and/or replace diesel fuel injection system components.

## AST-410 Braking Systems II (ABS)

**Learning Outcomes:**

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

**Objectives and Content:**

1. Identify hazards and describe safe work practices pertaining to ABS and their components.

2. Identify tools and equipment relating to ABS and describe their applications and procedures for use.

3. Identify types of ABS and describe their components and operation.

4. Describe ABS and their modes of operation.

5. Identify types of braking control systems and describe their components and operation.
   i) traction control system (TCS)
   ii) anti-lock brake system (ABS)
   iii) stability control
   iv) types of trailer brakes and controls

6. Describe the procedures used to diagnose ABS.

7. Describe the procedures used to flush and bleed ABS.

8. Describe the procedures used to adjust, repair and/or replace ABS components.

## AST-415 Suspension Systems II

**Learning Outcomes:**

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

**Objectives and Content:**

1. Explain steering geometry principles and their applications.
   i) alignment angles
   ii) Ackerman principle

2. Identify tools and equipment relating to electronically controlled suspension systems and describe their applications and procedures for use.

3. Identify types of electronically controlled suspension systems and describe their components and operation.
   i) ride control
   ii) height control

4. Describe the procedures used to diagnose wheel alignment and electronically controlled suspension systems.

5. Describe the procedures used to adjust, repair and/or replace electronically controlled suspension systems components.

6. Describe the procedures to perform wheel alignment.

## AST-420 Automatic Transmissions and Transaxles

**Learning Outcomes:**

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

**Objectives and Content:**

1. Define terminology associated with automatic transmissions and transaxles.

2. Identify hazards and describe safe work practices pertaining to automatic transmissions and transaxles.

3. Identify tools and equipment relating to automatic transmissions and transaxles and describe their applications and procedures for use.

4. Identify types of automatic transmissions and transaxles and describe their components and operation.
   i) electrically controlled
   ii) hydraulically controlled
   iii) continuously variable transmission (CVT)

5. Explain hydraulic principles related to automatic transmissions and transaxles.
   i) Pascal's law

6. Explain power flow as it relates to automatic transmissions and transaxles.

7. Interpret electric and hydraulic schematics.

8. Describe gear ratios, their purpose and calculation.

9. Identify types of lubricants, fasteners, tubing, hoses, gaskets, seals and sealants and describe their applications.

10. Describe the procedures used to diagnose automatic transmissions and transaxles.

11. Describe the procedures used to adjust, repair and/or replace automatic transmissions and transaxles and their related components.

## AST-425 Electrical Options and Accessories

**Learning Outcomes:**

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

**Objectives and Content:**

1. Define terminology associated with electrical options and accessories.

2. Identify hazards and describe safe work practices pertaining to electrical options and accessories.

3. Identify tools and equipment relating to electrical options and accessories and describe their applications and procedures for use.

4. Identify types of electrical options and accessories and describe their components and operation.
   i) accessories
   ii) theft deterrents
   iii) audio/video
   iv) navigation
   v) remote starter

5. Describe the procedures used to diagnose electrical options and accessories.

6. Describe the procedures used to adjust, repair and/or replace electrical options and accessories and their related components.

## AST-430 Instrumentation and Information Displays

**Learning Outcomes:**

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

**Objectives and Content:**

1. Define terminology associated with instrumentation and information displays.

2. Identify hazards and describe safe work practices pertaining to instrumentation and information displays.

3. Identify tools and equipment relating to instrumentation and information displays and describe their applications and procedures for use.

4. Identify types of instrumentation systems and describe their components and operation.
   i) gauges
   ii) warning indicators

5. Identify types of information displays and describe their purpose and operation.

6. Describe the procedures used to diagnose instrumentation and information displays.

7. Describe the procedures used to adjust, repair and/or replace instrumentation and information displays and their related components.

## AST-435 Heating, Ventilation and Air Conditioning (HVAC) Systems

**Learning Outcomes:**

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

**Objectives and Content:**

1. Define terminology associated with HVAC systems.

2. Identify hazards and describe safe work practices pertaining to HVAC systems.
   i) personal
   ii) shop/facility
   iii) environmental

3. Explain the principles of the refrigeration cycle.

4. Identify tools and equipment relating to HVAC systems and describe their applications and procedures for use.

5. Identify types of heating systems and describe their components and operation.

6. Identify types of refrigerants and lubricants and describe their applications and procedures for use.

7. Identify types of refrigeration systems and describe their components and operation.
   i) orifice tube
   ii) thermal expansion valve

8. Identify types of HVAC systems and describe their components and operation.
   i) manual
   ii) automatic

9. Identify types of fasteners, tubing, hoses, gaskets, seals and sealants and describe their applications.

10. Describe the procedures used to retrofit A/C systems.

11. Describe the procedures used to identify, recover, evacuate and recharge refrigerant systems.

12. Describe the procedures used to diagnose HVAC systems.

13. Describe the procedures used to adjust, repair and/or replace HVAC system components.

## AST-440 Restraint Systems

**Learning Outcomes:**

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

**Objectives and Content:**

1. Define terminology associated with restraint systems.

2. Identify hazards and describe safe work practices related to restraint systems.
   i) handling
   ii) disposal

3. Identify tools and equipment relating to restraint systems and describe their applications and procedures for use.

4. Identify types of restraint systems and describe their components and operation.
   i) active
   ii) passive

5. Identify types of restraint system warning indicators and describe their purpose.

6. Describe the procedures used to diagnose restraint systems.

7. Describe the procedures to adjust, repair and/or replace restraint system components.

## AST-445 Hybrid Systems II

**Learning Outcomes:**

- Demonstrate knowledge of the procedures used to diagnose and repair hybrid systems.

**Objectives and Content:**

1. Describe electrical concepts and components.
   i) DC/DC converters
   ii) AC/DC inverters
   iii) capacitors
   iv) snubbers
   v) 3 phase electricity

2. Describe electric motors and concepts.
   i) magnetic principles
      - induction
      - generation
   ii) brushless motors
      - AC induction motors
      - AC synchronous motors

3. Describe hybrid vehicle components.
   i) gasoline engine
   ii) wiring and cables
   iii) hybrid control modules
   iv) driver information center/instrument panel

4. Describe modes of operation.
   i) idle shut off
   ii) lean burn
   iii) acceleration assist
   iv) full electric
   v) high voltage battery charging
   vi) vehicle towing

5. Describe regenerative braking.

i) advantages and disadvantages
ii) types of regeneration
    - series
    - parallel
iii) brake electronic control unit operation
    - pressure sensors
    - travel sensors
iv) engine cylinder shut off
v) safety procedures
    - disabling self-test before pad replacement

6. Describe high voltage battery operation.
    i) dual-voltage system
    ii) disconnect procedures for different manufacturers
    iii) re-connect procedures for different manufacturers
    iv) high voltage interrupt relays
    v) state of charge
    vi) battery cooling
        - fans
        - temperature sensors
    vii) testing
    viii) battery control module
    ix) charging procedures
    x) boosting procedures

7. Describe transmission operation and design.
    i) constant variable transmissions
        - power-split system
        - belt and pulley system
    ii) motor/generators
    iii) auxiliary transmission fluid pump
    iv) driving modes

8. Describe HVAC system components and operation.
    i) motor generator cooling
    ii) ECU cooling
    iii) electric water pump
    iv) coolant heater storage system
    v) PTC heaters
    vi) A/C electric compressor

- POE oil to prevent loss of high voltage isolation
- preventing oil cross-contamination

vii) A/C modes

viii) auxiliary A/C for battery cooling

9. Describe electric power steering operation and components.

i) electric motor

ii) torque sensor

iii) reduction gear

iv) intermediate voltage