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PROGRAM OUTLINE

Automotive Service Technician 1, 2, 3, 4

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PROGRAM OUTLINE

Automotive Service Technician 1

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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

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). 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

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 McFaull	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.

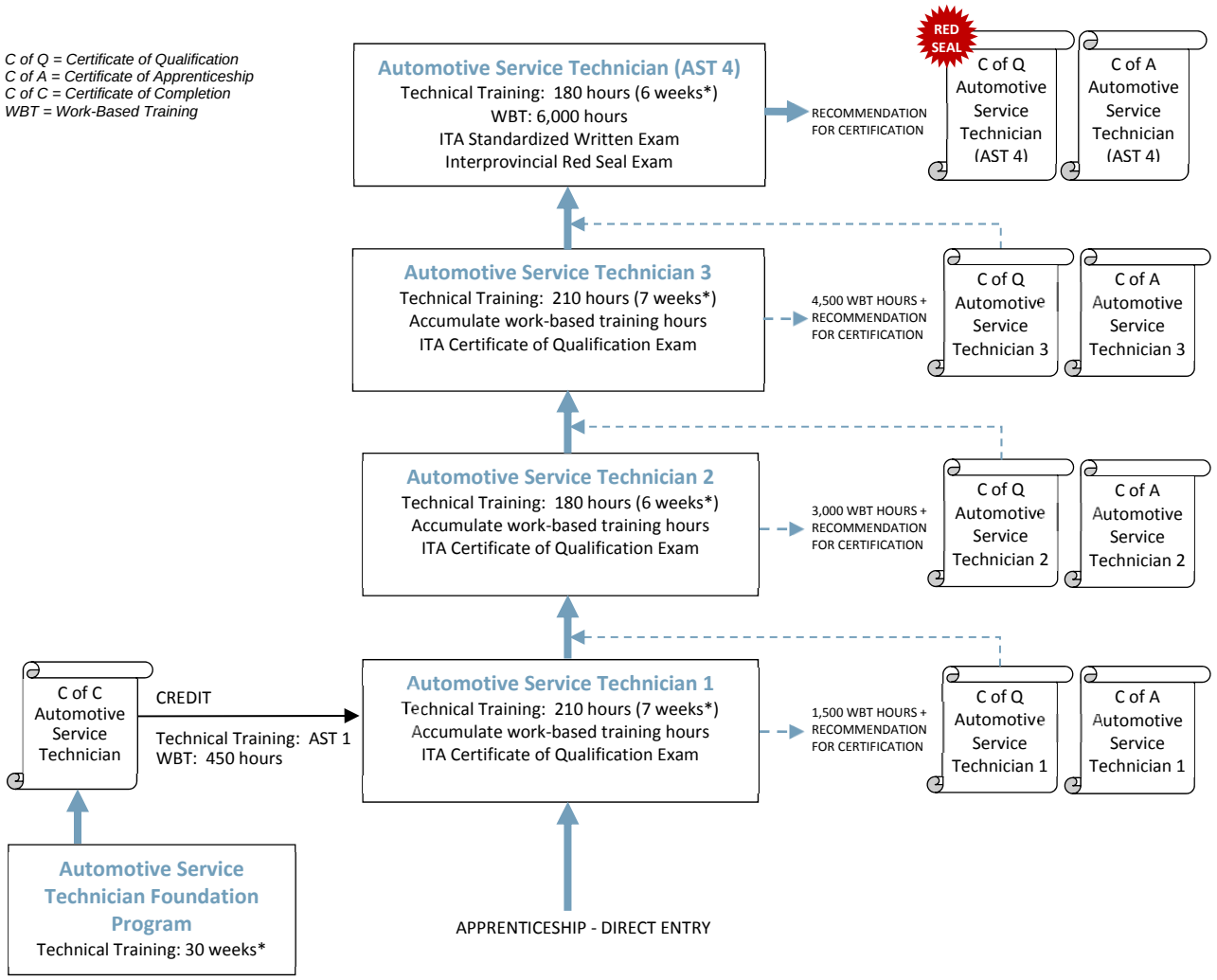
Section	Training Providers	Employers/ Sponsors	Apprentices	Challengers
Program Credentialing Model	Communicate program length and structure, and all pathways to completion	Understand the length and structure of the program	Understand the length and structure of the program, and pathway to completion	Understand challenger pathway to Certificate of Qualification
OAC	Communicate the competencies that industry has defined as representing the scope of the occupation	Understand the competencies that an apprentice is expected to demonstrate in order to achieve certification	View the competencies they will achieve as a result of program completion	Understand the competencies they must demonstrate in order to challenge the program
Training Topics and Suggested Time Allocation	Shows proportionate representation of various GACs at each program level; should map to proportions of time spent on training, practical experience, and assessment	Understand the relative scope of various areas of the occupation, and areas in which the apprentice would require on-the-job experience	Understand the relative scope of various areas of the occupation, and areas in which on-the-job experience would be provided	Understand the relative weightings of various areas of the occupation on which assessment is based
Program Content	Defines the objectives, learning tasks, high level content that must be covered for each competency, as well as defining observable, measureable achievement criteria for objectives with a practical component	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	Provides detailed information on program content and performance expectations for demonstrating competency	Allows individual to check program content areas against their own knowledge and performance expectations against their own skill levels
Training Provider Standards	Defines the facility requirements, tools and equipment, reference materials (if any) and instructor requirements for the program	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	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	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

Section 2

PROGRAM OVERVIEW

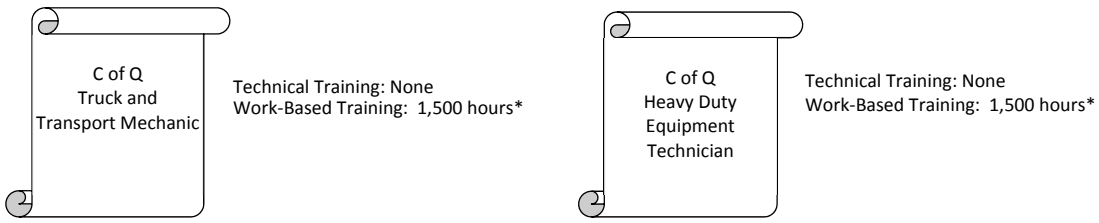
Automotive Service Technician 1

Program Credentialing Model



Suggested duration based on 30-hour week

CROSS-PROGRAM CREDITS



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

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.

WORKPLACE SAFETY A	Describe WorkSafeBC regulations A1	Describe WHMIS regulations A2	Describe safe vehicle operation A3	Demonstrate safe work practices A4	
EMPLOYABILITY SKILLS B	Describe business practices B1	Demonstrate communication skills B2			
TOOLS AND EQUIPMENT C	Use hand tools C1	Use measuring instruments C2	Use power tools C3	Use fasteners C4	Use shop tools and equipment C5	Use reference resources C6
GENERAL AUTOMOTIVE MAINTENANCE D	Select lubricants and fluids D1	Describe belts and hoses D2	Describe exterior lamps D3	Describe body trim and hardware D4	Service tires and wheels D5	Service non-friction bearings D6
	Service spindles and hubs D7					

GENERAL AUTOMOTIVE PRACTICES E	Describe diagnostic procedures E1	Demonstrate welding safety E2			
BASIC ELECTRICAL SYSTEMS F	Describe principles of electricity F1	Use electrical test equipment F2	Service wiring systems F3	Service 12-volt batteries F4	Use scan tools F5
BRAKE SYSTEMS G	Service brake tubing and fittings G1	Service brake hydraulic systems G2	Service drum brake systems G3	Service disc brake systems G4	Inspect power assist systems G5	Service anti-lock brake systems G6
STEERING SYSTEMS H	Service steering gears H1	Service passenger restraint systems H2	Inspect steering columns H3	Service steering linkage H4	Service power steering systems H5	Perform wheel alignment H6
SUSPENSION SYSTEMS I	Describe frame types I1	Describe suspension geometry I2	Describe suspension components I3	Service suspension systems I4	Describe electronic suspension systems I5	

Training Topics and Suggested Time Allocation

AUTOMOTIVE SERVICE TECHNICIAN 1

			% of Time Allocated to:		
		% of Time	Theory	Practical	Total
Line A	**WORKPLACE SAFETY**	**4%**	**70%**	**30%**	**100%**
A1	Describe WorkSafeBC regulations		√		
A2	Describe WHMIS regulations		√		
A3	Describe safe vehicle operation		√		
A4	Demonstrate safe work practices		√	√	
Line B	**EMPLOYABILITY SKILLS**	**1%**	**100%**	**0%**	**100%**
B1	Describe business practices		√		
B2	Demonstrate communication skills		√		
Line C	**TOOLS AND EQUIPMENT**	**8%**	**20%**	**80%**	**100%**
C1	Use hand tools		√	√	
C2	Use measuring instruments		√	√	
C3	Use power tools			√	
C4	Use fasteners		√	√	
C5	Use shop tools and equipment			√	
C6	Use reference resources		√	√	
Line D	**GENERAL AUTOMOTIVE MAINTENANCE**	**11%**	**50%**	**50%**	**100%**
D1	Select lubricants and fluids		√		
D2	Describe belts and hoses		√		
D3	Describe exterior lamps		√		
D4	Describe body trim and hardware		√		
D5	Service tires and wheels		√	√	
D6	Service non-friction bearings		√	√	
D7	Service spindles and hubs		√	√	
Line E	**GENERAL AUTOMOTIVE PRACTICES**	**6%**	**30%**	**70%**	**100%**
E1	Describe diagnostic procedures		√		
E2	Demonstrate welding safety		√	√	
Line F	**BASIC ELECTRICAL SYSTEMS**	**18%**	**30%**	**70%**	**100%**
F1	Describe principles of electricity		√	√	
F2	Use electrical test equipment		√	√	
F3	Service wiring systems		√	√	
F4	Service 12-volt batteries		√	√	
F5	Use scan tools		√	√	

			% of Time Allocated to:		
		% of Time	Theory	Practical	Total
Line G	**BRAKE SYSTEMS**	**20%**	**20%**	**80%**	**100%**
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		√	√	
Line H	**STEERING SYSTEMS**	**20%**	**30%**	**70%**	**100%**
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		√	√	
Line I	**SUSPENSION SYSTEMS**	**12%**	**30%**	**70%**	**100%**
I1	Describe frame types		√		
I2	Describe suspension geometry		√		
I3	Describe suspension components		√		
I4	Service suspension systems		√	√	
I5	Describe electronic suspension systems		√		

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

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	CONTENT
1. Define terms used in the Worker's Compensation Act	• Definitions, section 1 of the Act
2. Describe the conditions under which compensation will be paid	• Part 1, division 2 of the Act
3. State the general duties of employers, employees and others	• Part 2, division 3, sections 115-124 of the Act
4. State the Worker's Compensation Act requirements for the reporting of accidents	• Part 1, division 5 sections 53 and 54 of the Act

5. State the "Core Requirements" of the Occupational Health and Safety Regulation	• Definitions
	• Application
	• Rights and Responsibilities
	  o Health and safety programs
	  o Investigations and reports
	  o Workplace inspections
	  o Right to refuse work
	• General conditions
	  o Building and equipment safety
	  o Emergency preparedness
	  o Preventing violence
	  o Working alone
	  o Ergonomics
	  o Illumination
	  o Indoor air quality
	  o Smoking and lunchrooms

6. State the "General Hazard Requirements" of the Occupational Health and Safety Regulation	• 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	CONTENT
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 Llist • 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 o Recognition of rights o Workers o Employers o Suppliers o 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 o MSDS o Labels
5. Describe the responsibilities of employers under WHMIS	• Provide o MSDS o Labels o Workplace education programs

LEARNING TASKS	CONTENT
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
	  o Acute toxic effects
	  o Other toxic effects
	  o 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
	  o Solvents
	  o Caustic cleaners
	  o Cleaning solutions
	  o Gasoline
	  o Diesel fuel
	  o L.P.G.
	  o C.N.G.
	  o Asbestos
	  o Battery acid
	  o Refrigerants
	  o Brake fluid
	  o Antifreeze
	  o Lubricants
	  o Tracer dyes

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	CONTENT
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

LINE (GAC): A WORKPLACE SAFETY

Competency: A4 Demonstrate safe work practices

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	CONTENT

1. Apply personal safety precautions and procedures	• Personal apparel
	  o Clothing
	  o Hair and beards
	  o Jewellery
	• Personal protection
	  o Head
	  o Hands
	  o Lungs
	  o Eyes
	  o Ears
	  o 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	CONTENT

3. Describe the conditions and classifications of fires	• Conditions to support fire
	  o Air
	  o Fuel
	  o Heat
	• Classes of fires
	  o A - combustibles
	  o B - liquids
	  o C - electrical
	  o D – metals
	• Symbols and colours

4. Describe fire safety precautions when working near, handling or storing flammables	• Fuels
	  o Diesel
	  o Gasoline
	  o Propane
	  o Natural gas
	• Lubricants
	• Oily rags
	• Combustible metals
	• Aerosols

5. Describe the considerations and procedures to extinguishing a fire	• Warning others and fire department
	• Evacuation of others
	• Fire containment and prevention of spreading
	• Method of exit
	• Training
	• P.A.S.S.
	  o Point
	  o Aim
	  o Squeeze
	  o 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.

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	CONTENT
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

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.

LEARNING TASKS	CONTENT
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	CONTENT

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.

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	CONTENT

1. Describe measuring tools	• Steel rules
	• Tapes
	• Calipers and dividers
	  o Inside
	  o Outside
	  o Dividers
	  o Vernier
	• Micrometers
	  o Inside
	  o Outside
	  o 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.

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

LEARNING TASKS	CONTENT
2. Use air-powered tools	• Ratchet • Gun • Butterfly • Air grinder • Blow nozzle • Drill • Lubrication and care
3. Use electric-powered tools	• Hand drill • Angle grinder • Heat gun • Work light

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.

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	CONTENT

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	CONTENT
3. Torque fasteners to specifications	• Torque definition • Tension • Elastic limit • Distortion • Tensile strength • Torque wrenches o Extensions • Torque to yield • Torque sequence • Torquing in steps

4. Repair damaged threads	• Taps and wrenches
	  o Taper
	  o Plug
	  o 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
	  o Flat
	  o Bevel
	  o Lock
	• Pins
	  o Cotter clevis
	  o Spring or roll
	  o Shear
	  o Taper
	  o Dowel
	• Keys
	  o Woodruff
	  o Tapered
	• Spines
	• Locking plates
	• Safety wire
	• Snap rings
	• Pop rivets

LEARNING TASKS	CONTENT
6. Describe removal of damaged nuts, bolts or studs	• 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.

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	CONTENT
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 o Bearing o Steering component
4. Maintain air compressors	• Construction • Tank • Compressor • Motor / engine • Drives, belts, couplings • Water filter / traps • Lubricators • Pressure regulators • Piping and hoses

LEARNING TASKS	CONTENT
5. Select and use cleaning equipment	• Solvent and chemical cleaning facilities • Pressure washers • Steam cleaners • Abrasive blast machines • Brake cleaning equipment • Flush machines

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.

LINE (GAC): C TOOLS AND EQUIPMENT

Competency: C6 Use reference resources

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	CONTENT
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
	  o Paint codes
	  o Gross vehicle weight
	  o 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.

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	CONTENT
1. Describe and identify lubricants	• Synthetic or mineral • Additives • Greases • Engine oil o API classifications S/C • Aerosols

2. Describe and identify fluids	• Replacement intervals
	• Antifreeze
	  o Ethylene glycol
	  o Propylene glycol based
	  o 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

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	CONTENT
1. Describe and identify drive belts	• Non metallic o V o Serpentine o Gilmer (toothed) o 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 o Pressure o Vacuum o Reinforced o Material compatibility – Fuel – Oil – Coolant – Air / vacuum – Turbo – Brake o Flexibility o 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	CONTENT

1. Describe exterior lamps	• Headlamps
	  o HID
	  o Halogen
	  o Sealed beam
	• Driving lights
	• Tail lights
	• Brake lights
	• Marker lights
	• Turn signals
	• License plate lights
	• Reverse lights
	• Directional headlamps
	• Government regulations

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	CONTENT

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	CONTENT

4. Describe interior and exterior components and trim repair	• Manufacturer's safety precautions and protocols
	• Repair parts and materials
	  o Adhesives
	  o Gaskets
	  o Sealants
	  o Fastening devices
	• Tools
	  o Trim tools
	  o Hand tools
	• Removal
	• Replace
	• Adjust
	• Verify fit, function and performance

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	CONTENT

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

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

3. Repair tires	• Rubber Manufacturer's Association guidelines
	  o Plug patches
	  o Plugs
	  o Patches
	• Sealing tires

LEARNING TASKS	CONTENT
4. Describe wheel construction	• Alloy • Steel • Directional • Offset • Sizing • Bolt pattern • Types and operation of Tire Pressure Monitoring System (TPMS)
5. Inspect wheels	• Curb damage • Run out • Fatigue damage • Lug nut torque
6. Describe Tire Pressure Monitoring System (TPMS)	• Types o Direct o Indirect • Sensor replacement • System service o Reset o Reprogram o Calibrate

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.

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 o Cleaning • Adjustment • Selection • Axial and radial play

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

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	CONTENT
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	CONTENT
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
	  o Communicate with operator
	  o Operational test
	  o 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

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.

LEARNING TASKS	CONTENT
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.

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	CONTENT

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

2. Describe basic electrical concepts and circuits	• Electron theory
	• Conventional theory
	• Basic circuit construction
	  o Power source
	  o Load
	  o Control
	  o Complete path
	• Electrical relationships
	• Ohm's law
	• Watt's law
	• Series circuits
	• Parallel circuits
	• Series parallel circuits

LEARNING TASKS	CONTENT

3. Describe electrical components	• Wire
	• Devices
	• Circuit protection devices
	• Actuators
	• Resistors
	• Switches
	• Conductors
	• Insulators
	• Relays
	• Types of magnets
	  o Permanent
	  o Electromagnet

4. Describe magnetic theory	• Properties of magnetic lines of force
	• Terminology
	  o Flux
	  o Flux density

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.

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	CONTENT
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.

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	CONTENT
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 o Terminal design

LEARNING TASKS	CONTENT
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	CONTENT

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	CONTENT

1. Select and use brake tubing and fittings	• Tubing
	  o Sizing
	  o Material
	  o Application
	• Fittings
	• Flaring
	• SAE
	• ISO
	• Cutting
	• Reaming
	• Bending

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.

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
	  o Force
	  o Pressure
	  o Area

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

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

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.

LEARNING TASKS	CONTENT

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

2. Describe drum brake components	• Drum
	  o Fixed
	  o Floating
	• Shoes
	• Springs
	• Attaching hardware
	• Backing plate
	• Adjusters
	• Parking brake mechanism
	• Wheel cylinder

3. Describe drum brake design and operation	• Non-energizing and self-energizing o Servo-action • Parking

4. Inspect and service drum brakes	• Inspection
	  o Measurement
	  o Fluid leakage
	  o Wheel seals
	  o Hardware condition
	  o Parking brake cable and mechanism
	• Shoe replacement / adjustment
	• Drum service
	  o Machining
	  o Cleaning
	• Parking brake adjustment
	• Road test

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	CONTENT

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	CONTENT

4. Inspect and repair disc brakes	• Inspection
	  o Measurement
	  o Fluid leakage
	  o Wheel seals
	  o Hardware condition
	  o Parking brake cable and mechanism
	• Pad replacement
	• Rotor service
	  o 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	CONTENT

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

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

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	CONTENT
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
	  o Pump
	  o Valves
	  o Accumulators
	  o Fluid
	• Electrical
	  o Sensors
	  o Computer
	  o 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	CONTENT
1. Describe the components of conventional steering gears	• Recirculating ball steering box design o Ball nut assembly o Sector shaft o Thrust bearings o Seals o 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 o Bearing preload o Gear tooth lash o 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	CONTENT
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 o Column o Rack o Pinion • Sensor types o Steering wheel o Torque • Service procedures o Zeroing o 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.

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	CONTENT

1. Describe passenger restraint systems	• Safety
	• Principles of operation
	• Passive
	  o Airbags
	  o Shoulder belts
	  o Whiplash protection
	  o Side impact
	  o Passenger detection
	  o Crash avoidance
	• Active
	  o 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.

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	CONTENT
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	CONTENT
1. Describe the components of steering linkage	• Tie rod ends and sockets • Pitman arm • Idler arm • Centre (drag) link o 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	CONTENT
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	CONTENT
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
	  o Thrust angle
	  o Camber
	  o Toe
	• Front wheels
	  o Caster
	  o Camber
	  o 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.

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	CONTENT
1. Describe unibody frame design	• Advantages/ Disadvantages o Welding construction o Rivet construction o Adhesive bonding o Torque boxes o Material selection o Strength o Accident crush zones
2. Describe conventional frame design	• Advantages/ Disadvantages o Perimeter o Ladder o Sub-frames o Hydroformed o Material selection o Strength o 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	CONTENT

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

2. Describe suspension dynamics	• Forces
	  o Lateral
	  o Acceleration
	  o 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	CONTENT

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): I 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.

LEARNING TASKS	CONTENT
1. Inspect and service shock absorbers and struts	• Safety • Visual inspection • Functional test • Bounce and rebound test • Leaks • Corrosion • Removal and replacement • Alignment
2. Inspect and service ball joints and bushings	• Safety • Lubrication • Visual • Measurements • Removal and replacement • Torquing sequence and procedures
3. Inspect and service suspension systems	• Safety o Unloading springs o Compressing springs • Ride height measurements • Damaged / worn components • Removal and replacement • Torquing sequence and procedures

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.

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	• Basic • Electrically controlled shocks • Load levelling system • Advanced • Air springs / struts • Electronic / computer controlled dynamic systems
2. Describe the inspection and repair of electronic suspension systems	• Safety • Visual inspection • Function test • Electrical test • Diagnostic codes • Removal and replacement • Alignment

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 devises (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
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

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, curser 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

Order #	Alberta Learning Guides
7850001029	Measuring Tools
7850001030	Specialty Hand Tools
7850001031	Fastening Devices
7850001868	Introduction to Scan Tools
7850001034	Oxyacetylene Heating and Cutting
7850001867	Gas Metal Arc Welding
7850001047	Hydraulic System Components
7850001050	Power Brakes
7850001044	Steering Columns
7850001037	Frames
7850001041	Power Steering
7850001042	Steering Angles
7850001039	Wheels, Hubs and Tires

SUGGESTED TEXTS

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

Additional texts

Author	Title	
Erjavec	Automotive Technology + Workbook	Most recent edition
American Lift Institute	Lifting It Right	Most recent edition

Author	Title	ISBN
Halderman	Automotive Electricity and Electronics	Most recent edition
Halderman	Automotive Chassis Systems	

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

Practical Assessment

Competency	CDX Booklet	Reference Number Essential	Reference Number Secondary
A4- Demonstrate safe work practices	Foundation and Safety	C451 C457 C458 C459 C460 C465	
C1- Use hand tools	Foundation and Safety	C468	
C2- Use measuring instruments	Outline instructions		
C5- Use shop tools and equipment	Foundation and Safety	C453 C454	C473 C476
C6- Use reference resources	Foundation and Safety	C471 C513 C594	
D5- Service tires and wheels	Suspension and Steering	C619 C622 C620 C621 C580 C552 C553	C701 C855 C796
D6- Service non-friction bearings	Brakes	C810 C273 C267	
D7- Service spindles and hubs	Brakes	C275 C267	
E2- Demonstrate welding safety	Outline instructions		
F2- Use electrical test equipment	Electrical and Electronic Systems	C641 C291	
F3- Service wiring systems	Electrical and Electronic Systems	C643 C301 C599	
F4- Service 12-volt batteries	Electrical and Electronic Systems	C302 C818 C819 C820 C817	C645 C304 C644
F5- Use scan tools	Electrical and Electronic Systems	C338 C821	C649
G1- Service brake tubing and fittings	Brakes	C624	
G2- Service brake hydraulic systems	Brakes	C239 C625 C705 C622 C704 C235	

		C237			
G3- Service drum brake systems	Brakes	C800 C626 C248 C801 C706		C707 C251 C804 C251	
G4- Service disc brake systems	Brakes	Disc Brakes C802 C803 C632 C627 C805	Rotors C628 C806 C630 or C629	Disc Brakes C708 C262 C631	Rotors C274
G5- Inspect power assist systems	Brakes	C807 C809		C808 C581	
G6- Service anti-lock brake systems	Brakes	C812 C637		C857 C634 C638 C636 C639 C813	
H1- Service steering gears	Suspension and Steering	C851 C882 C883 C881			
H2- Service passenger restraint systems	Suspension and Steering	C168 C169			
H3- Inspect steering columns	Suspension and Steering	C173 C170			
H4- Service steering linkage	Suspension and Steering	C184 C185			
H5- Service power steering systems	Suspension and Steering	C177 C178 C179		C180 C181 C699 C183	
H6- Perform wheel alignment	Suspension and Steering	C206 C617 C618 C213 C214 C216 C217 C795			
I4- Service suspension systems	Suspension and Steering	C793 C193 C192 C790 C616 C794 C791 C194			

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

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

ita
YOUR TICKET.

PROGRAM OUTLINE

Automotive Service Technician 2

The latest version of this document is available in PDF format on the ITA website
www.itabc.ca

To order printed copies of Program Outlines
or learning resources (where available)
for BC trades contact:

Crown Publications, Queen's Printer
Web: www.crownpub.bc.ca
Email: crownpub@gov.bc.ca
Toll Free 1 800 663-6105

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

Automotive Service Technician 2

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.

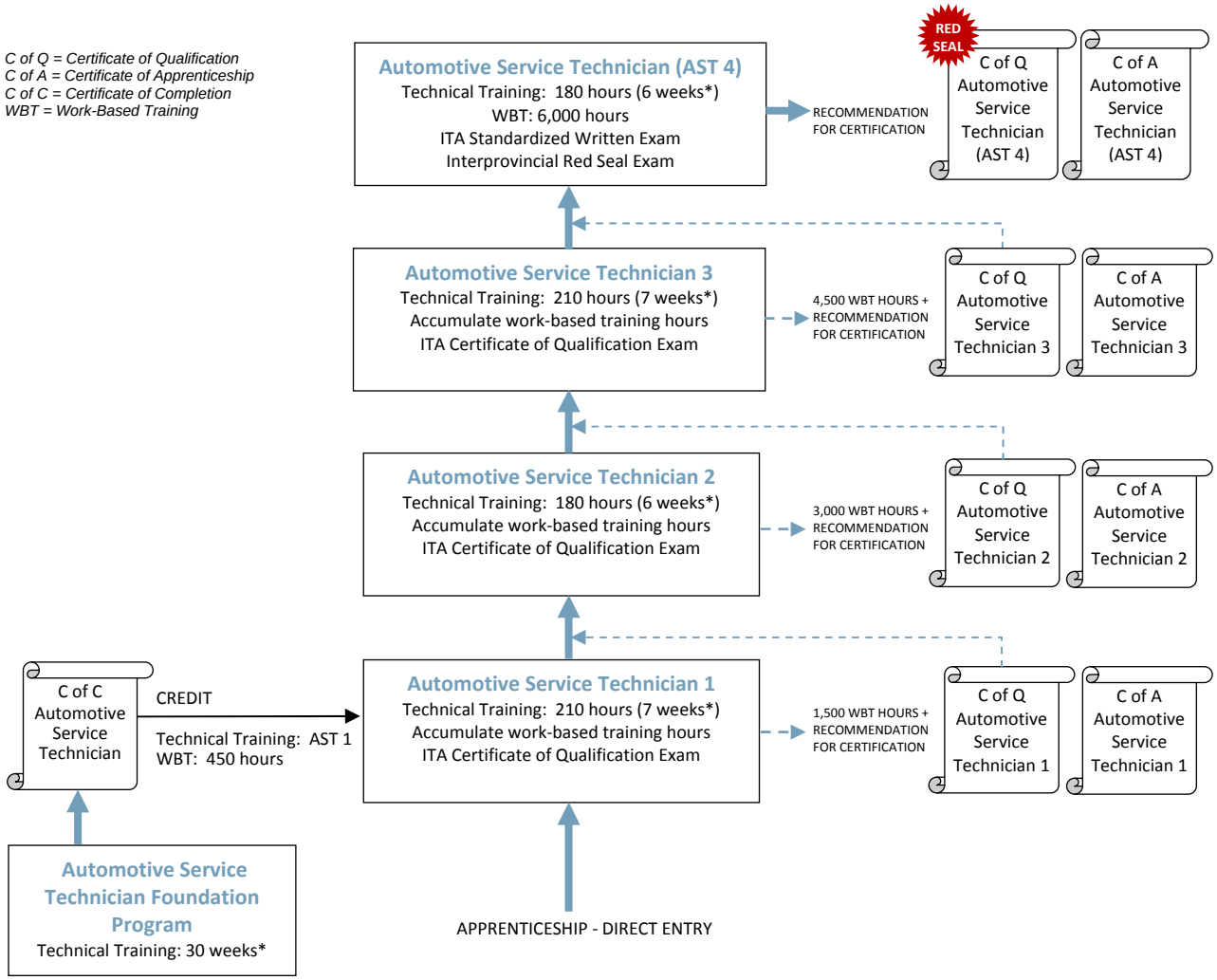
Section	Training Providers	Employers/ Sponsors	Apprentices	Challengers
Program Credentialing Model	Communicate program length and structure, and all pathways to completion	Understand the length and structure of the program	Understand the length and structure of the program, and pathway to completion	Understand challenger pathway to Certificate of Qualification
OAC	Communicate the competencies that industry has defined as representing the scope of the occupation	Understand the competencies that an apprentice is expected to demonstrate in order to achieve certification	View the competencies they will achieve as a result of program completion	Understand the competencies they must demonstrate in order to challenge the program
Training Topics and Suggested Time Allocation	Shows proportionate representation of various GACs at each program level; should map to proportions of time spent on training, practical experience, and assessment	Understand the relative scope of various areas of the occupation, and areas in which the apprentice would require on-the-job experience	Understand the relative scope of various areas of the occupation, and areas in which on-the-job experience would be provided	Understand the relative weightings of various areas of the occupation on which assessment is based
Program Content	Defines the objectives, learning tasks, high level content that must be covered for each competency, as well as defining observable, measureable achievement criteria for objectives with a practical component	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	Provides detailed information on program content and performance expectations for demonstrating competency	Allows individual to check program content areas against their own knowledge and performance expectations against their own skill levels
Training Provider Standards	Defines the facility requirements, tools and equipment, reference materials (if any) and instructor requirements for the program	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	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	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

Section 2

PROGRAM OVERVIEW

Automotive Service Technician 2

Program Credentialing Model



**Suggested duration based on 30-hour week*

CROSS-PROGRAM CREDITS

C of Q
Truck and Transport Mechanic

Technical Training: None
Work-Based Training:

C of Q
Heavy Duty Equipment Technician

Technical Training: None
Work-Based Training: 1,500 hours*

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

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.

ADVANCED ELECTRICAL SYSTEMS A	Perform advanced electrical testing A1	Service starting systems A2	Service charging systems A3	Diagnose passenger restraint systems A4	Service electrical accessories A5
HEATING, VENTILATION AND AIR CONDITIONING SYSTEMS B	Service heating and ventilation systems B1	Service air conditioning systems B2			
ENGINES C	Describe principles of gasoline internal combustion engines C1	Describe principles of diesel internal combustion engines C2	Evaluate engine mechanical condition C3	Describe engine removal and installation procedures C4	Disassemble and assess engines C5	Service gaskets and seals C6
ENGINE SUPPORT SYSTEMS D	Service lubrication systems D1	Service cooling systems D2	Describe air induction and exhaust systems D3		

HYBRID AND ELECTRIC VEHICLE SAFETY **E**	Describe hybrid and electric vehicle safety E1

Training Topics and Suggested Time Allocation

AUTOMOTIVE SERVICE TECHNICIAN 2

			% of Time Allocation to:		
		% of Time	Theory	Practical	Total
Line A	**ADVANCED ELECTRICAL SYSTEMS**	**28%**	**30%**	**70%**	**100%**
A1	Perform advanced electrical testing		√	√	
A2	Service starting systems		√	√	
A3	Service charging systems		√	√	
A4	Diagnose passenger restraint systems		√	√	
A5	Service electrical accessories		√	√	
Line B	**HEATING, VENTILATION AND AIR CONDITIONING SYSTEMS**	**19%**	**40%**	**60%**	**100%**
B1	Service heating and ventilation systems		√		
B2	Service air conditioning systems		√	√	
Line C	**ENGINES**	**39%**	**30%**	**70%**	**100%**
C1	Describe principles of gasoline internal combustion engines		√		
C2	Describe principles of diesel internal combustion engines		√		
C3	Evaluate engine mechanical condition		√	√	
C4	Describe engine removal and installation procedures		√		
C5	Disassemble and assess engines		√	√	
C6	Service gaskets and seals		√	√	
Line D	**ENGINE SUPPORT SYSTEMS**	**12%**	**30%**	**70%**	**100%**
D1	Service lubrication systems		√	√	
D2	Service cooling systems		√	√	
D3	Describe air induction and exhaust systems		√		
Line E	**HYBRID AND ELECTRIC VEHICLE SAFETY**	**2%**	**100%**	**0%**	**100%**
E1	Describe hybrid and electrical vehicle safety		√		
	Total Percentage for Automotive Service Technician 2	**100%**			

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	CONTENT

1. Define electrical terminology applied to electronic components	• Volts
	• Amps
	• Resistance
	• Voltage drop
	• Frequency
	• Duty cycle
	• Pulse width modulation
	• Solid state components
	  o Transistors
	  o 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.

LINE (GAC): A ADVANCED ELECTRICAL SYSTEMS

Competency: A2 Service starting systems

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	CONTENT
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
	  o Motor
	  o Solenoid and relays
	  o 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
	  o Visual
	  o Audible
	• On-vehicle testing
	  o Electrical
	  o 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.

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

3. Service charging systems	• On-vehicle inspection
	  o Visual
	  o Audible
	• On-vehicle testing
	  o Electrical
	  o 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	CONTENT
1. Describe the design and operation of passenger restraint systems	o • Safing sensors • Impact sensors • Computer • Wiring • Clock spring • Passive o Airbags o Side impact protection o Whiplash protection o Automatic seatbelts o Body structure o Pyrotechnical seatbelts o Passenger detection o Clock spring • Active o Mechanical seatbelts o Seatbelt warning system • Criteria for deployment o Frontal impact o Side impact • Progressive deployment • Construction of components • Chemical reaction of airbag deployment • Passenger detection sensors

LEARNING TASKS	CONTENT
2. Diagnose and service passenger restraint systems	• Airbag system disarming procedures • Airbag rearming procedures o 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
	  o Windows
	  o Door locks
	  o Wipers
	  o Power seats
	• Instruments
	  o Speedometer
	  o Tachometer
	  o Gauges
	• Displays
	  o Temperature
	  o Engine monitoring
	• Remote alarm systems
	• Radio / infotainment
	  o Displays
	  o Speakers
	  o Power antennae
	• Lighting
	  o HID
	  o LED
	  o Conventional

LEARNING TASKS	CONTENT
2. Describe the design and operation of electrical accessories	• Power accessories o Windows o Door locks o Wipers o Power seats • Instruments o Speedometer o Tachometer o Gauges • Displays o Temperature o Engine monitoring • Remote alarm systems • Radio / infotainment o Displays o Speakers o Power antennae • Lighting o HID o LED o Conventional
3. Service electrical accessories	• Power accessories o Continuity tests o Voltage drop o Identify circuit operation o 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	CONTENT
1. Describe the principles of heating and ventilation systems.	• Principles of heat transfer

2. Identify components of heating and ventilation systems	• 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

LEARNING TASKS	CONTENT

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
	  o Damper
	• Mode controls
	  o Vacuum
	  o Electrical
	  o Mechanical
	• Cabin filters
	• Air quality control systems
	• Sensors
	• Automatic climate control

4. Inspect and repair heating and ventilation systems	• Inspection
	  o Visual
	  o Audible
	  o Smell
	• Testing
	  o Vacuum
	  o Electrical
	  – Diagnostic codes
	  o Mechanical
	• Removing and replacing components
	• Bleeding
	• Environmental considerations
	• Automatic climate control
	  o 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	CONTENT
1. Describe the principles of air conditioning systems	• Describe the laws of thermodynamics
2. Identify components of air conditioning systems	• Compressor o 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
	  o Compressor
	  o Evaporator
	  o Condenser
	  o Receiver drier / accumulator
	  o Orifice tubes / expansion valves
	  o Refrigerant
	  o Lubricants
	  o Controls
	  o Sensors

LEARNING TASKS	CONTENT

4. Inspect and repair air conditioning systems	• Inspection
	  o Visual
	  o Audible
	  o Smell
	• Testing
	  o Vacuum
	  o Electrical
	  o 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	CONTENT
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
	  o Inline
	  o V
	  o Rotary
	  o Opposed
	• Cooling method(s)
	• Lubrication
	• Design variations
	  o Diesel
	  o Miller
	  o Wankel rotary
	  o Variable valve timing
	• Engine Measurements
	  o Horse power
	  o Torque
	  o Volumetric efficiency
	  o Thermal efficiency
	  o Compression ratio
	  o Area
	  o 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	CONTENT

1. Describe the operating principles of a diesel engine	• Four stroke cycle
	• Compression ignition
	• Compression ratio
	• Fuel properties
	• Intake manifold design
	• Forced induction
	• Compare component construction to gasoline internal combustion engines
	• Engine Measurements
	  o Horse power
	  o Torque
	  o Volumetric efficiency
	  o 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	CONTENT
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
	  o Spark ignition
	  o 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	CONTENT
1. Describe engine mounting methods	• Front wheel drive • Rear wheel drive

2. Describe engine removal	• Safety
	  o Jacking and hoisting
	  o Weight distribution
	  o Rigging
	• Systems removal
	• Identification for reinstallation
	  o Electrical
	  o Vacuum
	  o Air conditioning
	  o Cooling
	  o Oil
	  o Drive train
	  o Air intake
	  o Exhaust
	• Body component removal
	• Engine mount removal
	• Care and inspection of lifting and blocking equipment
	• Engine hoisting
	  o Engine crane
	• Mounting on engine stand

LEARNING TASKS	CONTENT

3. Describe engine installation procedures	• Safety
	  o Jacking and hoisting
	  o Weight distribution
	  o Rigging
	• Engine mount removal
	• Engine hoisting
	• Systems installation
	  o Electrical
	  o Vacuum
	  o Air conditioning
	  o Cooling
	  o Oil
	  o Drive train
	  o Air intake
	  o Exhaust
	• Body component installation

4. Describe engine initial start-up and break-in procedures	• Lubrication • Install and adjust ignition timing • Camshaft break-in • Ring seating

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	CONTENT

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

LEARNING TASKS	CONTENT
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 o Cylinder head o Pistons o Crankshaft o Camshaft o Bearings • Cleaning • Measuring and evaluating o Thread repair o Crack detection o Piston fitting o Bearing installation o Mating surfaces o Block o Crankshaft o Camshaft o Valvetrain
4. Perform engine assembly procedures	• Preassembly cleaning • Assemble short block o Fitting parts o Measuring and torquing o Lubrication • Install cylinder head • Assemble valvetrain o Sprockets o Belt o Chain o Tensioners o Balance shafts • Assemble associated parts and fasteners • Gasket installation

LEARNING TASKS	CONTENT
	• Seal installation • Liquid sealants

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.

LINE (GAC): C ENGINES

Competency: C6 Service gaskets and seals

Objectives

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	CONTENT

1. Describe gasket and seal construction	• Gaskets
	  o Cylinder head
	  o Other gaskets
	  – Rubber
	  – Paper
	  – Copper
	  – Reusable
	  – Form in place
	• Sealers
	  o Aerobic
	  o Anaerobic
	  o Sensor safe
	• Seals
	• Sealing washers

2. Diagnose cause of failure	• Incorrect assembly • Excessive heat • Over pressurization • Lack of lubrication • Seal deterioration • Mating surface damage
3. Describe leak detection methods	• Visual • Audible • Black light • Fluid analysis • Pressurization / vacuum • Smoke generator

LEARNING TASKS	CONTENT
4. Assess leak relevance	• Cost of repair • Potential damage
5. Service gaskets and seals	• 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	CONTENT

1. Describe components of lubrication systems	• Oil
	  o Grades
	  o Types
	• Pumps
	  o Gerotor
	  o Vane
	  o 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
	  o Variable valve timing
	  o Cylinder deactivation
	• Piston cooling
	• Crank case ventilation systems
	• Sumps and strainers
	• Coolers
	• Associated plumbing and hardware
	• Gauges

LEARNING TASKS	CONTENT

3. Inspect and repair lubrication systems	• Inspection
	  o Visual
	  o 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	CONTENT

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	CONTENT

3. Inspect and repair cooling systems	• Inspection
	  o Audible
	  o Visible
	• Depressurization
	• Testing
	  o Pressure / vacuum
	  o Air flow
	  o Temperature
	  o 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	CONTENT
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	CONTENT
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 – Cones – Insulated work bench – Caution signs o Personal equipment – Gloves – CAT III DVOM – 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 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

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, curser 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

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

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

Appendices

APPENDIX A -

Practical Assessment

Practical Assessment

Competency	CDX Booklet	Reference Number Essential	Reference Number Secondary
A1- Perform advanced electrical testing	Electrical and Electronic Systems	C 641	
A2- Service starting systems	Electrical and Electronic Systems	C309 C310 C313 C311	C312 C314
A3- Service charging systems	Electrical and Electronic Systems	C317 C315 C319 C318 C316	
A4- Diagnose passenger restraint systems	Electrical and Electronic Systems	C335 C335	
A5- Service electrical accessories	Electrical and Electronic Systems	C336 C310	
B2- Service heating and ventilation systems	HVAC	C362 C833 C366 C834 C367	C364 C834
B3- Service air conditioning systems	HVAC	C350 C654 C863 C356 C830	C653 C826 C355 C829 C873 C831 C832
C3- Evaluate engine mechanical condition	ENGINE REPAIR	C004 C007 C715 C716 C005 C670	
C5- Perform engine repairs	ENGINE REPAIR	C676, C673, C674, C677, C723, C021, C722, C719, C720 C679, C029, C030, C736, C678, C727, C728, C036, C729, C733, C597, C731	C886, C671, C012, C025, C721, C724, C027, C718, C730, C039, C596

C6- Service gaskets and seals	ENGINE REPAIR		C541, C675
D1- Service lubrication systems	ENGINE REPAIR	C737 C732 C736	
D2- Service cooling systems	ENGINE REPAIR	C578 C734 C048 C735 C050 C053 C598	C680 C052 C871

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

PROGRAM: IN-SCHOOL TRAINING: ITA DIRECT ACCESS CODE:	AUTOMOTIVE SERVICE TECHNICIAN (AST 2) LEVEL 2 0002AM201		
LINE	**TRAINING TOPICS & SUGGESTED TIME ALLOCATION**	**THEORY WEIGHTING**	**PRACTICAL WEIGHTING**
2A	Advanced Electrical Systems	20%	31%
2B	Heating, Ventilation and Air Conditioning Systems	22%	17%
2C	Engines	38%	39%
2D	Engine Support Systems	18%	13%
2E	Hybrid Vehicle Safety	2%	0%
	Total	100%	100%
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.		X%	

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

ita
YOUR TICKET.

PROGRAM OUTLINE

Automotive Service Technician 3

The latest version of this document is available in PDF format on the ITA website
www.itabc.ca

To order printed copies of Program Outlines
or learning resources (where available)
for BC trades contact:

Crown Publications, Queen's Printer
Web: www.crownpub.bc.ca
Email: crownpub@gov.bc.ca
Toll Free 1 800 663-6105

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

Automotive Service Technician 3

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). 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.

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.

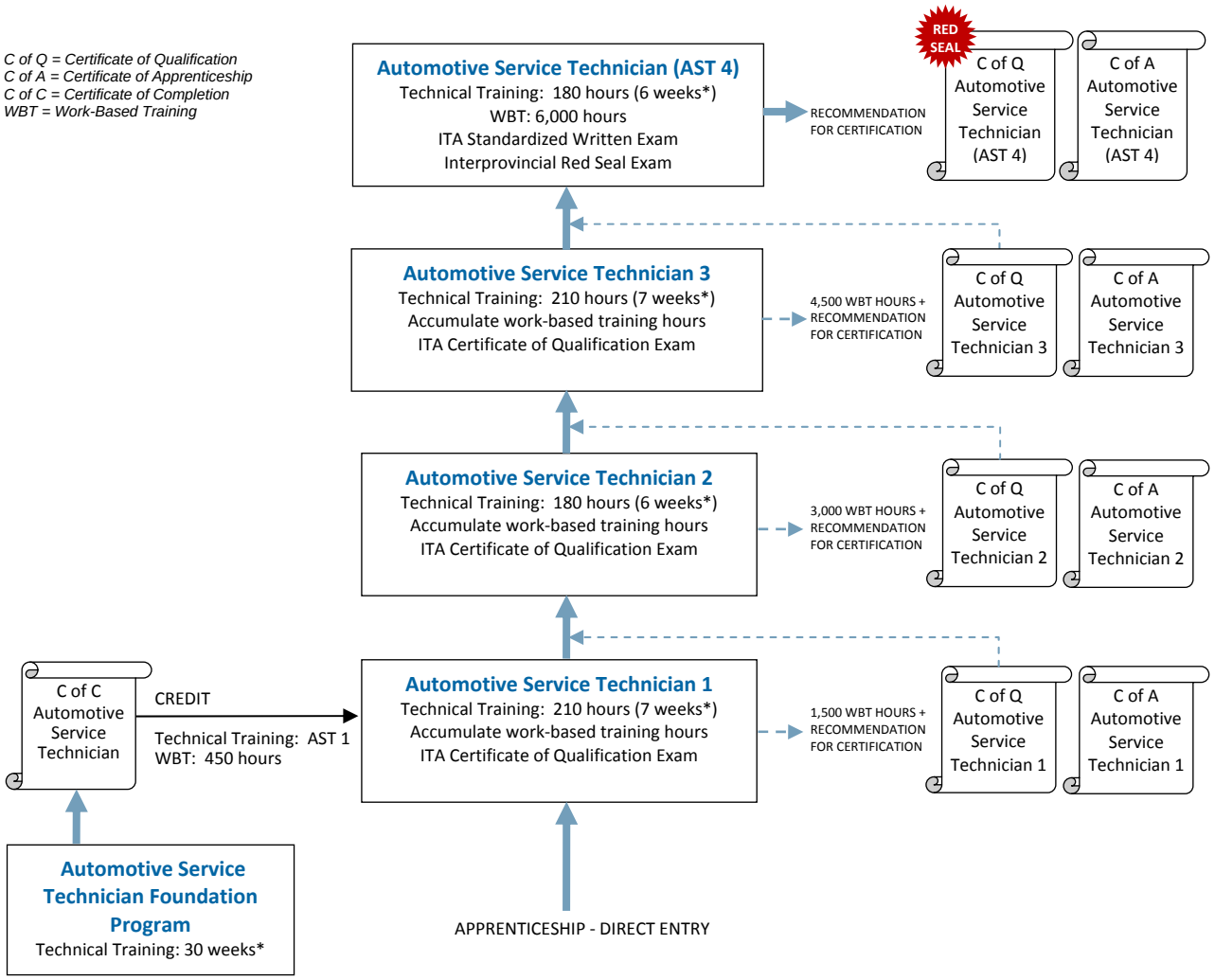
Section	Training Providers	Employers/ Sponsors	Apprentices	Challengers
Industry Training Model	Communicate program length and structure, and all pathways to completion	Understand the length and structure of the program	Understand the length and structure of the program, and pathway to completion	Understand challenger pathway to Certificate of Qualification
OAC	Communicate the competencies that industry has defined as representing the scope of the occupation	Understand the competencies that an apprentice is expected to demonstrate in order to achieve certification	View the competencies they will achieve as a result of program completion	Understand the competencies they must demonstrate in order to challenge the program
Training Topics and Suggested Time Allocation	Shows proportionate representation of various GACs at each program level; should map to proportions of time spent on training, practical experience, and assessment	Understand the relative scope of various areas of the occupation, and areas in which the apprentice would require on-the-job experience	Understand the relative scope of various areas of the occupation, and areas in which on-the-job experience would be provided	Understand the relative weightings of various areas of the occupation on which assessment is based
Program Outline	Defines the objectives, learning tasks, high level content that must be covered for each competency, as well as defining observable, measureable achievement criteria for objectives with a practical component	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	Provides detailed information on program content and performance expectations for demonstrating competency	Allows individual to check program content areas against their own knowledge and performance expectations against their own skill levels
Training Provider Standards	Defines the facility requirements, tools and equipment, reference materials (if any) and instructor requirements for the program	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	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	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

Section 2

PROGRAM OVERVIEW

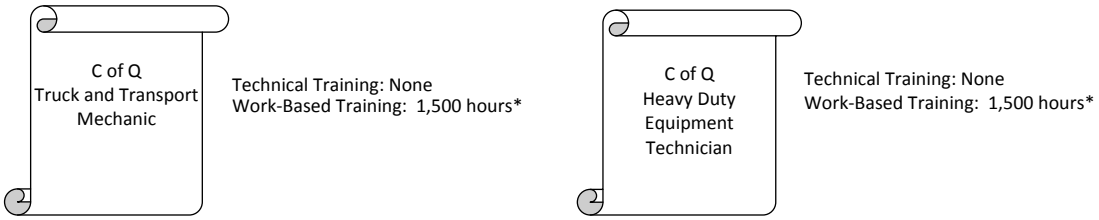
Automotive Service Technician 3

Program Credentialing Model



**Suggested duration based on 30-hour week*

CROSS-PROGRAM CREDITS



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

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.

ELECTRICAL AND ELECTRONIC SYSTEMS **A**	Describe advanced electrical and electronic principles A1	Interpret advanced wiring diagrams A2	Describe advanced diagnostic procedures A3	Use advanced electrical test equipment A4	Describe computer control systems A5	Describe multiplex and network systems A6
FUEL DELIVERY SYSTEMS **B**	Describe fuel types B1	Service fuel delivery components B2	Service gasoline fuel injection components B3	Describe electronic diesel fuel injection systems B4		
ELECTRONIC IGNITION SYSTEMS **C**	Describe electronic ignition principles C1	Service electronic distributor ignition systems C2	Service electronic ignition systems C3			
ENGINE MANAGEMENT SYSTEMS **D**	Describe engine management systems D1	Test engine management input sensors D2	Test engine management output actuators D3	Analyze on-board diagnostic system data D4	Describe gasoline direct injection D5	

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

Training Topics and Suggested Time Allocation

AUTOMOTIVE SERVICE TECHNICIAN 3

			% of Time Allocated to:		
		% of Time	Theory	Practical	Total
Line A	**ELECTRICAL AND ELECTRONIC SYSTEMS**	**17%**	**50%**	**50%**	**100%**
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		√	√	
Line B	**FUEL DELIVERY SYSTEMS**	**23%**	**40%**	**60%**	**100%**
B1	Describe fuel types		√		
B2	Service fuel delivery components		√	√	
B3	Service gasoline fuel injection components		√	√	
B4	Describe electronic diesel fuel injection systems		√		
Line C	**ELECTRONIC IGNITION SYSTEMS**	**17%**	**30%**	**70%**	**100%**
C1	Describe electronic ignition principles		√	√	
C2	Service electronic distributor ignition systems		√	√	
C3	Service electronic ignition systems			√	
Line D	**ENGINE MANAGEMENT SYSTEMS**	**29%**	**80%**	**20%**	**100%**
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		√		
Line E	**EMISSION CONTROL SYSTEMS**	**14%**	**30%**	**70%**	**100%**
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		√	√	

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

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	CONTENT

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

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

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

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	CONTENT

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.

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	CONTENT
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 o Gather information from customer o Verify complaint o Brainstorm possible causes o Fault trace most likely cause o Locate root cause of problem o Repair root cause o Verify repair • Baseline test
3. Describe troubleshooting resources for technicians	• Factory service manuals o Diagnostic flow charts – By code – By symptom • Technical Service Bulletins • Aftermarket resources • Internet forums • Peer groups o Shop foreman o Other technicians

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	CONTENT

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

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

LEARNING TASKS **CONTENT**

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.

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

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

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	CONTENT

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

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

LEARNING TASKS	CONTENT

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

3. Describe operations of Multiplexed Electronic System	• Inputs
	• Outputs
	• Relay control
	• Testing
	  o Headlight
	  o Wiper
	  o Window control
	  o 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	CONTENT
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	CONTENT
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

LEARNING TASKS	CONTENT

3. Inspect and service fuel delivery systems	• Safety
	• Inspection
	  o Visual
	  o Audible
	  o Smell
	• Testing
	  o Pressure
	  o Vacuum
	  o Volume
	  o Electrical
	  o Mechanical
	• Routine maintenance
	• Parts removal and replacement
	• Depressurize and recover fuel

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.

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	CONTENT

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

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

LEARNING TASKS	CONTENT

3. Inspect and service fuel injection systems	• Safety
	• Inspection
	  o Visual
	  o Audible
	  o Smell
	• Testing
	  o Pressure
	  o Vacuum
	  o Volume
	  o Electrical
	  o 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.

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	CONTENT

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

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.

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	CONTENT

1. Describe the components of electronic distributor ignition systems	• Coil
	  o Primary circuit
	  o Secondary circuit
	• Triggering devices
	  o Engine position
	  o Engine speed
	• Sensors
	  o Knock
	  o Temperature
	  o Load
	• Modules
	• Distributor
	  o Cap
	  o Rotor
	  o Housing
	• High tension wires
	• Spark plugs
	  o Temperature
	  o Reach
	  o Thread diameter
	  o Resistance
	  o Electrode design

LEARNING TASKS	CONTENT

2. Inspect and repair electronic distributor ignition systems	• Inspection
	  o Visual
	  o Audible
	• Testing
	  o Electrical
	  – Primary
	  – Secondary wave pattern
	  – Diagnostic codes
	  – Data stream
	  o Mechanical
	• Component removal and replacement
	• Adjustments
	  o Timing

Achievement Criteria:
Given a written and/or a practical assessment on electronic distributer 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): 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	CONTENT

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

2. Inspect and repair electronic ignition systems	• Inspection
	  o Visual
	• Testing
	  o Electrical
	  – Ignition patterns
	  – Primary
	  – Secondary
	  – Diagnostic codes
	  – Data stream
	  o 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	CONTENT
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 o Emissions o Fuel economy o Drive-ability o Warranty data collection o Trouble shooting • Modes of operation o Open loop o Closed loop o Limp home • Communication with other systems o Ignition o Transmission o Brakes – Traction control – Dynamic stability o Air conditioning / climate control

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	CONTENT

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

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

LEARNING TASKS	CONTENT

3. Inspect, test and repair engine management input sensors	• Vehicle speed
	• Inputs from other computer systems
	  o Transmission
	  o Ignition (non-integral)
	  o Air conditioning
	  o Brake system
	• Safety
	• Inspection
	  o Visual
	• Testing
	  o Vacuum
	  o Electrical
	  o 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.

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	CONTENT

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

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

LEARNING TASKS	CONTENT

3. Inspect, test and repair engine management output sensors	• Safety
	• Inspection
	  o Visual
	• Testing
	  o Electrical
	  o 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.

LINE (GAC): D ENGINE MANAGEMENT SYSTEMS

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	CONTENT

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

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

LEARNING TASKS	CONTENT

	• Self diagnostics
	  o Passive
	  o Active
	  o Rational
	• Fault codes
	  o Identification
	  o Types 0,1,2,3
	  o 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
	  o Hard
	  o Pending
	  o Clearing codes
	  o Use resources to look up codes
	• Freeze frame information
	• Live data stream information
	• Parameters
	• Two-way communication
	  o Activating output actuators
	• Upgrading software
	• Readiness status
	• Reset adaptations
	• Drive cycles
	• Scan tool interfacing
	  o OEM interface
	  o Global OBD II interface
	  o 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.

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.

LEARNING TASKS	CONTENT

1. Describe components of gasoline direct injection	• Cylinder deactivation systems
	• High pressure fuel pump
	  o Mechanical
	  o Electrical
	• Lean burn
	• Throttle body less systems

2. Describe the design and operation of gasoline direct injection	• Cylinder deactivation systems
	• High pressure fuel pump
	  o Mechanical
	  o Electrical
	• Lean burn
	• Throttle-less systems
	• Modes
	  o Homogeneous
	  o Stratified
	• Injector timing
	• Spray pattern
	• Compression ratio

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	CONTENT
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 o Smog • Hydrocarbons o Smog o Haze o Respiratory health • Carbon monoxide o Poisonous gas • Carbon dioxide o Global warming o Greenhouse effect • Oxides of sulfur o Acid rain • Particulates o Smog o Haze o Respiratory health • Ground level ozone

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	CONTENT

1. Describe legislation pertaining to vehicle emissions	• Federal
	  o Canadian Environmental Assessment Agency
	• Provincial
	  o AirCare program
	• American
	  o Environmental Protection Agency (EPA)
	  o California Air Resource Board (CARB)
	• Federal Test Procedure (FTP)
	• Inspection / Maintenance (I/M) test
	• Acceleration Simulation Mode (ASM) test
	• On-board Diagnostic (OBD) test

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	CONTENT
1. Identify components of pre-combustion emission systems	• 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	CONTENT
2. Describe the design and operation of pre-combustion emission systems	• Engine design o Miller cycle o Forced induction o Cooling system – Quick warm-up – Regulating temperature o Compression ratio o Combustion chamber shape • Camshaft o Profile o Variable camshaft timing – Cold start – Power enrichment – Cruising • Exhaust gas recirculation o Vacuum controls o Electric controls • Fuel control o Closed loop o Stoichiometric operation • Positive crank case ventilation o Operating cycle o Open systems o Closed systems
3. Service pre-combustion emission systems	• Inspection o Visual o Audible • Testing o Electrical o 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.

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	CONTENT
1. Identify components of post-combustion emission systems	• Catalyst o 2 way o 3 way o Reduction • Secondary air injection • Air pump o Electric o Mechanical • Pulse air systems • Piping and passages • Sensors • Valves
2. Describe the design and operation of post-combustion emission systems	• Catalyst o 2 way o 3 way o Reduction • Secondary air injection • Air pump o Electric o Mechanical • Pulse air systems • Piping and passages • Sensors • Valves • Modes of operation o Open loop o Closed loop o Cold start o Warm up o Operating temperature o Load o Deceleration o Cruising

LEARNING TASKS	CONTENT

3. Service post-combustion emission systems	• Inspection
	  o Visual
	  o Audible
	• Testing
	  o Electrical
	  o 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.

LINE (GAC): E EMISSION CONTROL SYSTEMS

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.

LEARNING TASKS	CONTENT
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

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	CONTENT

1. Describe the components of OBD II evaporative emission systems	• Fuel tank
	• Vent lines
	• Valves
	  o Roll over
	  o Purge
	  o Vent
	• Computer
	• Sensors
	  o Tank pressure
	  o Fuel temperature
	• Charcoal canister
	• Vacuum system
	• Leakage detection system
	  o Sensors
	  o Leakage detection pump

2. Describe the design and operation of OBD II evaporative emission systems	• Fuel tank
	• Valves
	  o Roll over
	  o Purge
	  o Vent
	• Computer
	• Sensors
	  o Tank pressure
	  o Fuel temperature
	• Charcoal canister
	• Vacuum system
	• Leakage detection system
	  o Modes of self-diagnostics
	  o Criteria for leakage detection
	  o Sensors
	  o Leakage detection pump
	  o Fuel cap

LEARNING TASKS	CONTENT

3. Service OBD II evaporative emission systems	• Inspection
	  o Visual
	  o Audible
	• Testing
	  o Electrical
	  – Scan tool
	  o 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.

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	CONTENT

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 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/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. 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) (CAT III)
7. Headlight aiming equipment
8. Infrared thermometer
9. Lab scope or graphing multi-meter; 8 per class of 16 (channel, digital, curser 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
  ISBN:978-0-13-505481-9

- *Automotive Electricity and Electronics*
  James D Halderman
  ISBN:978-0-13-512406-2

- *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

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	

APPENDIX B –

Assessment Guidelines

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:	AUTOMOTIVE SERVICE TECHNICIAN (AST 3) LEVEL 3 0002AM301		
LINE	**TRAINING TOPICS & SUGGESTED TIME ALLOCATION**	**THEORY WEIGHTING**	**PRACTICAL WEIGHTING**
3A	Electrical and Electronic Systems	18%	14%
3B	Fuel Delivery Systems	24%	18%
3C	Electronic Ignition Systems	18%	22%
3D	Engine Management Systems	28%	26%
3E	Emission Control Systems	12%	20%
	Total	100%	100%
Calculated by the Training Provider **AUTOMOTIVE SERVICE TECHNICIAN (AST 3)** 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%

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:

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  (Minimum 70% is required for a pass)

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Automotive Service Technician (AST 3):

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- 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.

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

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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%

ita
YOUR TICKET.

PROGRAM OUTLINE

Automotive Service Technician (Automotive Service Technician 4)

The latest version of this document is available in PDF format on the ITA website
www.itabc.ca

To order printed copies of Program Outlines
or learning resources (where available)
for BC trades contact:

Crown Publications, Queen's Printer
Web: www.crownpub.bc.ca
Email: crownpub@gov.bc.ca
Toll Free 1 800 663-6105

AUTOMOTIVE SERVICE TECHNICIAN 4

PROGRAM OUTLINE

MAY 2012

BASED ON

NOA 2009

Developed by
Industry Training Authority
Province of British Columbia

TABLE OF CONTENTS

Section 1

INTRODUCTION

Automotive Service Technician 4

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 Administative 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.

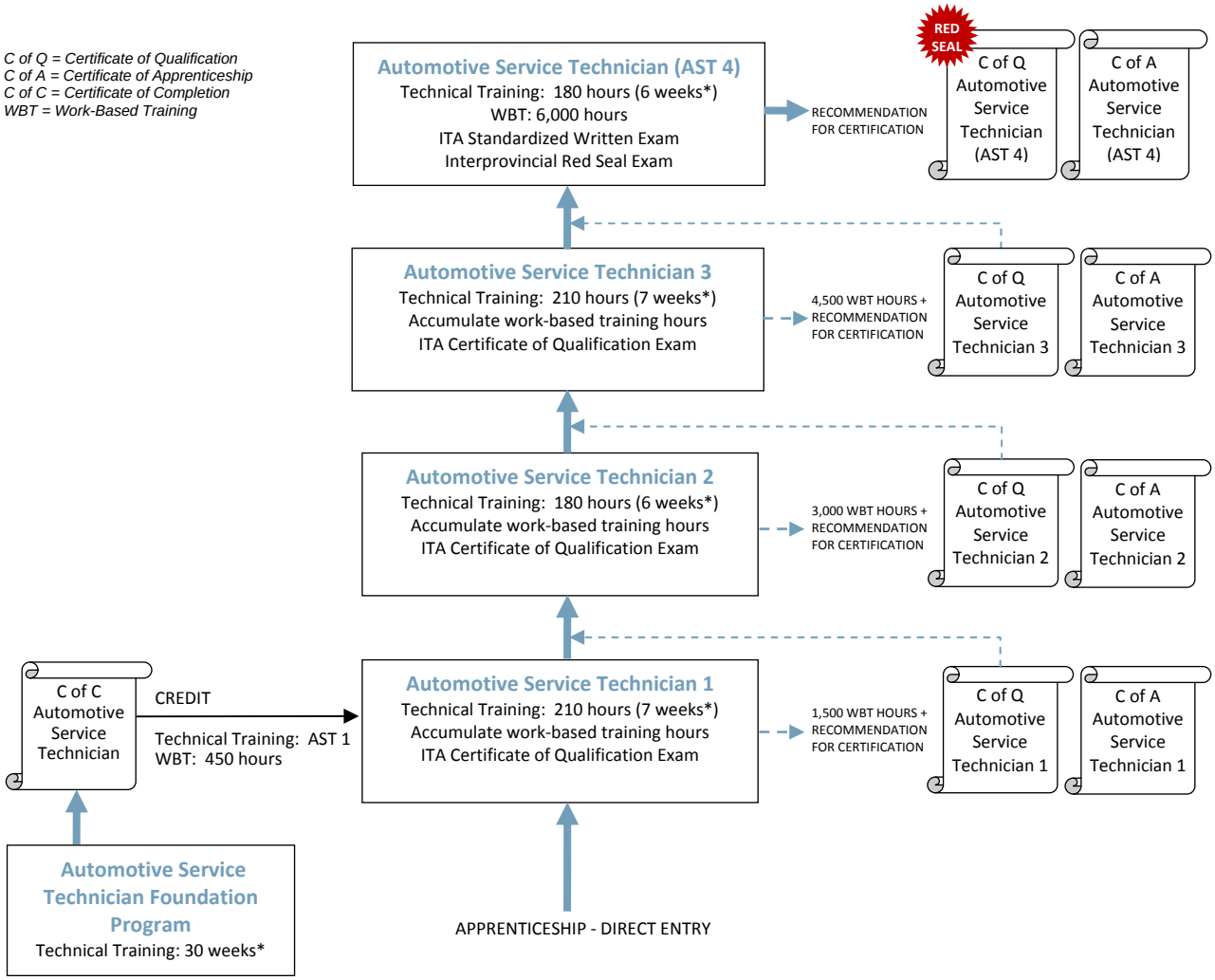
Section	Training Providers	Employers/ Sponsors	Apprentices	Challengers
Industry Training Model	Communicate program length and structure, and all pathways to completion	Understand the length and structure of the program	Understand the length and structure of the program, and pathway to completion	Understand challenger pathway to Certificate of Qualification
OAC	Communicate the competencies that industry has defined as representing the scope of the occupation	Understand the competencies that an apprentice is expected to demonstrate in order to achieve certification	View the competencies they will achieve as a result of program completion	Understand the competencies they must demonstrate in order to challenge the program
Training Topics Suggested Time Allocation	Shows proportionate representation of various GACs at each program level; should map to proportions of time spent on training, practical experience, and assessment	Understand the relative scope of various areas of the occupation, and areas in which the apprentice would require on-the-job experience	Understand the relative scope of various areas of the occupation, and areas in which on-the-job experience would be provided	Understand the relative weightings of various areas of the occupation on which assessment is based
Program Outline	Defines the objectives, learning tasks, high level content that must be covered for each competency, as well as defining observable, measureable achievement criteria for objectives with a practical component	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	Provides detailed information on program content and performance expectations for demonstrating competency	Allows individual to check program content areas against their own knowledge and performance expectations against their own skill levels
Training Provider Standards	Defines the facility requirements, tools and equipment, reference materials (if any) and instructor requirements for the program	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	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	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

Section 2

PROGRAM OVERVIEW

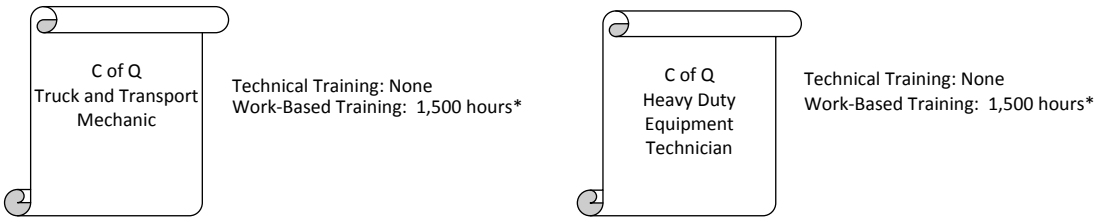
Automotive Service Technician 4

Program Credentialing Model



**Suggested duration based on 30-hour week*

CROSS-PROGRAM CREDITS



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

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 A	Service clutch systems A1	Describe transmission removal and installation procedures A2		
MANUAL TRANSMISSIONS B	Calculate gear ratios B1	Service transmission shifting linkages B2	Overhaul manual transmissions B3	
AUTOMATIC TRANSMISSIONS C	Describe torque converters C1	Describe planetary gear trains C2	Overhaul automatic transmissions C3	Service hydraulic and electrical control systems C4
DRIVE LINES D	Service drive lines D1	Service final drives, differentials and axles D2		
ALL-WHEEL AND FOUR-WHEEL DRIVE SYSTEMS E	Inspect all-wheel drive systems E1	Service mechanical and electronic four-wheel drive systems E2		

HYBRID DRIVE LINE TECHNOLOGY F	Describe hybrid vehicle systems F1	Describe hybrid drive systems F2

Training Topics and Suggested Time Allocation

AUTOMOTIVE SERVICE TECHNICIAN 4

			% of Time Allocated to:		
		% of Time	Theory	Practical	Total
Line A	**CLUTCH SYSTEMS**	**6%**	**30%**	**70%**	**100%**
A1	Service clutch systems		✓	✓	
A2	Describe transmission removal and installation procedures		✓	✓	
Line B	**MANUAL TRANSMISSIONS**	**13%**	**20%**	**80%**	**100%**
B1	Calculate gear ratios		✓	✓	
B2	Service transmission shifting linkages		✓	✓	
B3	Overhaul manual transmissions		✓	✓	
Line C	**AUTOMATIC TRANSMISSIONS**	**45%**	**40%**	**60%**	**100%**
C1	Describe torque converters		✓		
C2	Describe planetary gear trains		✓		
C3	Overhaul automatic transmissions		✓	✓	
C4	Service hydraulic and electrical control systems		✓	✓	
Line D	**DRIVE LINES**	**12%**	**20%**	**80%**	**100%**
D1	Service drive lines		✓	✓	
D2	Service final drives, differentials and axles		✓	✓	
Line E	**ALL-WHEEL AND FOUR-WHEEL DRIVE SYSTEMS**	**20%**	**20%**	**80%**	**100%**
E1	Inspect all-wheel drive systems		✓	✓	
E2	Service mechanical and electronic four-wheel drive systems		✓	✓	
Line F	**HYBRID DRIVE LINE TECHNOLOGY**	**4%**	**100%**	**0%**	**100%**
F1	Describe hybrid vehicle systems		✓		
F2	Describe hybrid drive systems		✓		

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	CONTENT
1. Describe clutch components	• Flywheel o Conventional o Dual mass • Pressure plate • Clutch disc • Bearings and bushings • Safety switch • Operating hardware o Mechanical o Hydraulic • Clutch housing • Fasteners • Construction materials
2. Describe the design and operation of clutches	• Flywheel o Conventional o Dual mass – Machine surface • Pressure plate • Clutch disc • Safety switch circuit • Bearings and bushings • Operating hardware o Mechanical o Hydraulic • Clutch housing • Fasteners • Construction materials

LEARNING TASKS	CONTENT
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.

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

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	CONTENT
1. Describe principles of gear ratios	• Torque o Multiplication o Reduction • Speed o Multiplication o 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.

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	CONTENT

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

3. Service transmission shifting linkage	• Inspection
	  o Road test
	  o 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	CONTENT

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	CONTENT

3. Overhaul manual transmissions and transaxles	• Inspection
	  o Road test
	  o Visual
	  o 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.

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	CONTENT
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

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	CONTENT

1. Describe planetary gear train components	• Gears
	  o Sun
	  o Ring
	  o Planets
	• Planet carrier

2. Describe the design and operation of planetary gear train	• Gears
	  o Sun
	  o Ring
	  o Planets
	• Planet carrier
	• Gear ratios
	  o Reduction
	  o Overdrive
	  o Direct
	  o Reverse
	  o Stall
	  o Neutral
	• Compound planetary gear trains
	  o Simpson
	  o Ravigneaux
	  o Lepelletier

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	CONTENT
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
	  o Simpson
	  o Ravigneaux
	  o 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	CONTENT
	• Construction materials

3. Overhaul automatic transmissions and transaxles	• Inspection
	  o Road test
	  o Visual
	  o Audible
	  o 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.

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	CONTENT
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 o Forward gears o Reverse gear o Acceleration o Coast o Deceleration o Manual shift positions o Electronic index shifting

LEARNING TASKS	CONTENT

3. Service automatic transmission and transaxle hydraulic and electrical control systems	• Inspection
	  o Visual
	  o Testing
	  o Electrical
	• Electrical Testing
	  o Scan tools
	  o Diagnostic codes
	  o Break out box
	  o Data stream
	  o 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.

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	CONTENT

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

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

LEARNING TASKS	CONTENT

3. Service drive shafts	• 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.

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	CONTENT

1. Describe final drive, differential and axle components	• Housings and mounts
	  o Integral
	  o 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
	  o Hypoid
	  o Bevel
	  o Spiral bevel
	• Power flow
	• Shafts
	  o Full floating
	  o Semi floating
	• Bearings and bushings
	• Spindles and hubs
	• Differentials
	• Locking devices
	  o Clutch type
	  o Cone type
	  o Centrifugal
	  o Torsen

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
	  o Road test
	  o Visual
	  o Audible
	  o Smell
	  o Mechanical
	• Testing
	  o Gear tooth contact patterns
	  o Pinion depth
	  o 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.

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	CONTENT

1. Describe all-wheel drive system components	• Housings and mounts
	• Transfer case
	• Torque splitting device
	  o Bevel gear
	  o Planetary gear
	  o Torsen
	  o Chain drive
	  o Gear drive
	• Couplings
	  o Viscous
	  o Electronic
	• Valves
	• Electronic controls
	• Sensors
	• Solenoids

2. Describe the design and operation of all-wheel drive systems	• Transfer case
	• Torque splitting device
	  o Bevel gear
	  o Planetary gear
	  o Torsen
	  o Chain drive
	  o Gear drive
	• Couplings
	  o Viscous
	  o Electronic
	• Modes of Operation
	  o Loss of traction
	  – Front wheels
	  – Rear wheels
	• Valves
	• Electronic controls
	• Sensors

LEARNING TASKS	CONTENT
	• Solenoids

3. Inspect all-wheel drive systems	• Inspection
	  o Road test
	  o Visual
	  o Audible
	  o Mechanical
	• Testing
	  o 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.

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

LEARNING TASKS	CONTENT

2. Describe the design and operation of mechanical and electronic four-wheel drive systems	• Gears
	• Chains and sprockets
	• Shafts
	• Bearings and bushings
	• Power flow
	• Control mechanisms
	  o Mechanical
	  o Vacuum
	  o Electrical
	• Differentials and clutches
	• Switches, solenoids and sensors
	• Lubricants and additives
	• Modes of operation
	  o Two-wheel drive
	  – Automatic slip detection
	  o Four-wheel drive
	  – Low range
	• Hi range

3. Service mechanical and electronic four-wheel drive systems	• Inspection
	  o Road test
	  o Visual
	  o Audible
	  o Mechanical
	• Testing
	  o Mechanical
	  o Electrical
	  – Diagnostic fault codes
	  o 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.

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	CONTENT
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
	  o Series-parallel
	  o Parallel
	• Operational modes
	  o Idle shut off
	  o Lean burn
	  o Acceleration assist
	• Electric motor / generator
	  o Brushless
	  o Induction
	  o Generation
	• High-voltage battery
	  o Nickel metal hydride (Ni-MH)
	  o 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	CONTENT

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/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. 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
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, curser 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

Clutches	7850001035
Drivelines	7850001036
Axles and Bearings	7850001078
Differentials	7850001079
Final Drive Gear Sets	7850001080
Drive Axle Assembly Diagnosis & Service	7850001081
Automatic Transmission Fundamentals	7850001126
Planetary Gear Sets	7850001127
Torque Converters	7850001128
Oil Pumps	7850001129
Clutches and Bands	7850001130
Hydraulic Valve Fundamentals	7850001131
Pressure Regulator Valves	7850001132
Throttle and Modulator Valves	7850001133
Governors	7850001134
Shift Valves	7850001135
Hydraulic Circuits	7850001136
Electronic Shift and Controls	7850001137
Automatic Transmission Testing and Adjustments	7850001138
Automatic Transmission Service and Repair	7850001139
Manual Transmission Fundamentals	7850001140
Manual Transmissions	7850001141
Manual Transaxles	7850001142
Manual Transfer Cases	7850001143
All Wheel Drive (AWD)	7850001870
Electronic Transfer Case	7850001877
4x4 Front Axle Control	7850001878

SUGGESTED TEXTS

CDX Automotive Tasksheet Manuals

CDX Automotive	Manual Drive Train and Axles	978-0-7637-8511-6
CDX Automotive	Automatic Transmission and Transaxle	978-0-7637-8499-7

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
Prentice Hall publishers - ISBN: 0131197290

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

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

Practical Assessment

Competency	CDX Booklet	Reference Number Essential		Reference Number Secondary
A1- Service clutch systems	Manual Drive Train and Axles	C107 C108 C111 C106 C847 C608		C764 C687 C692
B1- Calculate gear ratios	Outline instructions			
B2- Service transmission shifting linkages	Manual Drive Train and Axles	C768		
B3- Overhaul manual transmissions	Manual Drive Train and Axles	C765 C767 C769 C773 C772 C771 C776 C768 C775		C610 C770 C774
C3- Overhaul automatic transmissions	Automatic Transmission and Transaxle	C684 C688 C752 C751 C750 C759 C690 C753 C686 C760 C756 C757 C758 C754		C685 C755
C4- Service hydraulic and electrical control systems	Automatic Transmission and Transaxle	C075 C601		
D1- Service drive lines	Manual Drive Train and Axles	**CV Shafts** C132 C849 C134 C778	**Drive Shaft** C133 C779 C778	

D2- Service final drives, differentials and axles	Manual Drive Train and Axles	**Regular** C138 C888 C889 C780 C890 C147 C781 C782 C148 C145 C783	**Limited Slip** C784 C785 C612 C786	
E1- Inspect all-wheel drive systems	Manual drive train and axles	C787 C788 C876 C877 C613		
E2- Service mechanical and electronic four-wheel drive systems	Manual drive train and axles	C787 C875 C878		C789 C613

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

PROGRAM: IN-SCHOOL TRAINING: ITA DIRECT ACCESS CODE:	AUTOMOTIVE SERVICE TECHNICIAN (AST 4) LEVEL 4 0002AM401		
LINE	**TRAINING TOPICS & SUGGESTED TIME ALLOCATION**	**THEORY WEIGHTING**	**PRACTICAL WEIGHTING**
A	Clutch Systems	6%	5%
B	Manual Transmissions	8%	14%
C	Automatic Transmissions	55%	46%
D	Drive Lines	7%	13%
E	All-Wheel Drive/Four Wheel Drive Systems	12%	22%
F	New Drive Line Technology	12%	0%
	Total	100%	100%
Calculated by the Training Provider **AUTOMOTIVE SERVICE TECHNICIAN (AST 4)** 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%	

Calculated by ITA:	
In-school Mark ITA Direct Access calculates *the percentage weighting* once the in-school mark is entered. Combined theory and practical subject competency multiplied by	80%
Standardized Level Exam Mark ITA Direct Access will calculate *the percentage weighting* once the standard level exam marks have been entered. The exam score is multiplied by	20%
Final Level Mark ITA Direct Access calculates the final mark for determining credit for AST 4. A score of 70% or higher is required for a pass.	FINAL %