



8700  
AUTOMOTIVE ELECTRICAL  
SYSTEMS (12A)

40S/40E/40M

An Automotive Technology Course



# 8700 AUTOMOTIVE ELECTRICAL SYSTEMS (12A) 40S/40E/40M

## Course Description

A student wanting to develop skills in the automotive industry must have knowledge of the basic principles of automotive electrical systems. The student will understand the principles of electricity and electronics as they relate to automotive systems. The student will be able to diagnose, service, and repair automotive electrical circuits and components. This course focuses on the following unit in the Apprenticeship Manitoba Level 1 technical training:

- Unit A7: Electrical Systems I: Fundamentals

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**Goal 1:** Describe and apply appropriate **health and safety** practices.

**GLO 1.1:** Describe and apply appropriate **health and safety** practices.

SLO 12A.1.1.1 Adhere to safe practices and procedures for facilities, processes, materials, tools, and equipment.

SLO 12A.1.1.2 Identify the process for reporting injuries.

SLO 12A.1.1.3 Identify hazards and adhere to safe work practices pertaining to hoisting and lifting.

SLO 12A.1.1.4 Create and maintain a safe and organized working environment.

SLO 12A.1.1.5 Demonstrate the ability to follow safety information on supplier labels.

SLO 12A.1.1.6 Demonstrate the ability to locate first aid and eyewash stations.

SLO 12A.1.1.7 Identify safety and health requirements. (A2.1)

- overview of *The Workplace Safety and Health Act*
  - rights and responsibilities of employees under the *Act*
  - rights and responsibilities of employers under the *Act*
  - rights and responsibilities of supervisors under the *Act*
- fourteen (14) regulations
- codes of practice
- guidelines

- right to refuse
  - explanation of right to refuse process
  - rights and responsibilities of employees
  - rights and responsibilities of employers
  - rights and responsibilities of supervisors under the *Act*

SLO 11A.1.1.8 Identify personal protective equipment (PPE) and procedures. (A2.2) (TSA 16)

- employer and employee responsibilities as related to personal protective equipment
- standards: ANSI (U.S.A. standards), etc.
- work protective clothing and danger if it fits poorly
- gloves—importance of proper glove selection (when handling chemicals, cold items, slivers, etc.)
- headwear—appropriate protective headwear when required and the approved type of headwear
- eye protection—comparison and distinction of everyday eyeglasses, industrial safety glasses, and safety goggles
- foot protection—when required according to safety standards
- hearing protection
  - hazards of various noise levels (hearing protection must be worn)
  - laws
  - types of hearing protection
- respiratory protection—types, overview of proper selection
- fall protection—Manitoba requirements standards guidelines
  - ANSI (U.S.A. standards), etc.
- ladders and scaffolding
- safety principles for working with or around industrial trucks site-specific (forklifts, pallet trucks, etc.)

- SLO 11A.1.1.9 Outline the safety principles for working on and around electrical or energized equipment. (A2.3) (TSA 18)
- effects of electric current on the human body
  - three factors that affect the severity of an electric shock
  - the effects of ARC and blast on the human body and equipment
  - work with energized equipment
- SLO 11A.1.1.10 Identify fire safety and outline workplace fire safety principles. (A2.4) (TSA 19)
- types of fires
  - types of firefighting equipment
  - classifications of fire extinguishers (A, B, and C)
  - location of fire extinguishers and fire exits
  - fire alarms and drills
- SLO 11A.1.1.11 Identify ergonomics. (A2.5)
- definition of ergonomics and conditions that may affect the body
    - working postures
    - repetition
    - force
    - lifting
    - tools
    - identify tool and safety equipment
    - causes of hand-tool accidents
    - equipment
- SLO 11A.1.1.12 Recognize, report, and control hazards. (A2.6)
- safe-work practices
  - basic risk assessment
  - injury prevention and control measures
  - identification of hazards involved in pneumatic tool use and explanation of how to guard against them

- SLO 11A.1.1.13 Identify the hazards in confined spaces and the preparation needed to work in them. (A2.7) (TSA 20)
- identification of a confined space
  - hazards of a confined space
    - physical
    - biological
  - working in a confined space
  - emergency response plan
  - self-contained breathing apparatus (SCBA)
- SLO 11A.1.1.14 Identify first aid/CPR. (A2.8)
- overview of first-aid regulation
  - obligations of employers regarding first aid
    - Who is certified to provide first aid?
    - What to do while waiting for help?
    - Where is the first-aid kit?
  - describe basic first-aid requirements and techniques
    - scope and limits of first-aid intervention
    - specific interventions (cuts, burns, abrasions, fractures, suffocation, shock, electrical shock, etc.)
    - What is it?
    - interface with other services and agencies (e.g., Workers Compensation claims)
  - describe basic CPR requirements and techniques
    - How do you get certified?
    - scope and limits of CPR intervention (include varieties of CPR certification)
- SLO 11A.1.1.15 Identify the safety requirements as they apply to WHMIS with emphasis on: (A2.9) (TSA 13)
- WHMIS is a system
  - provincial regulation under *The Workplace Safety and Health Act*
    - each province has a WHMIS regulation
  - federal *Hazardous Products Act*
  - WHMIS generic training:
    - WHMIS defined and the format used to convey information about hazardous materials in the workplace

- information found on supplier and workplace labeling using WHMIS
- hazardous materials in accordance with WHMIS
- compliance with government safety standards and regulations
- description of WHMIS (include varieties of WHMIS certification)
  - typology of WHMIS labels, symbols, and classifications
  - scope and use of Materials Safety Data Sheets (MSDS)

SLO 11A.1.1.16 Identify and control hazards. (A2.10)

- basic control measures (injury prevention)
- safe-work procedures
- explanation on the importance of industrial housekeeping
- employer responsibilities
- how and where to store materials
- safety measures related to walkways, stairs, and floor openings
- explanation of how to protect the worker and others when working in traffic paths

SLO 12A.1.1.17 Identify hazards and describe safe work practices pertaining to the use of tools and equipment. (A3.1)

SLO 12A.1.1.18 Describe hybrid vehicle safety hazards. (A13.2)

- properly tag out the vehicle
- fire hazards
- electrocution hazards
- electrolyte hazards
- use of hybrid identification markers
- working environment
  - dry floor
  - with a partner

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**GLO 1.2:** Demonstrate awareness of safety as it pertains to the ***Trade Safety Awareness Curriculum for Level 1 Apprentices.***

No applicable SLOs.

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**Goal 2: Select, use, and manage tools, equipment, materials, and consumables.**

**GLO 2.1: Select, use, and manage tools and equipment.**

SLO 12A.2.1.1 Describe hand tools, power tools, and specialized test equipment, and procedures for their use. (A3.2)  
(Note: This SLO is repeated in 8696.)

- types and applications, including:
  - electric, pneumatic, and hydraulic
  - scan tools and digital voltage ohmmeters (DVOM)
- inspection, maintenance, and storage procedures

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**GLO 2.2: Select, use, and manage materials and consumables.**

No applicable SLOs.

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**Goal 3: Describe, inspect, diagnose, service, and repair automotive components and systems.**

**GLO 3.1: Describe automotive components and systems.**

**Starting Systems:**

- SLO 12A.3.1.1 Demonstrate an understanding of the purpose and operation of the starter motor.
- SLO 12A.3.1.2 Demonstrate an understanding of the starting system components.
- SLO 12A.3.1.3 Demonstrate an understanding of the components of the starter motor.

**Electrical Systems:**

- SLO 12A.3.1.4 Define terminology associated with electrical, electronic, and magnetic principles. (A7.1)
- SLO 12A.3.1.5 Identify hazards and describe safe work practices pertaining to electrical and electronic components. (A7.2)
- personal
  - vehicle
- SLO 12A.3.1.6 Interpret information pertaining to electrical and electronic components found on drawings and specifications. (A7.3)
- diagnostic flowcharts
  - schematics



- SLO 12A.3.1.7 Explain basic electrical theory. (A7.4)
- conventional theory
  - electron theory
- SLO 12A.3.1.8 Explain Ohm's law and its applications to electrical circuits. (A7.5)
- series circuit
  - parallel circuit
  - series-parallel circuits
- SLO 12A.3.1.9 Describe batteries and their characteristics. (A7.7)
- function
  - service ratings
  - construction
  - charging and boosting
  - servicing and diagnosing
- SLO 12A.3.1.10 Identify types of wire and describe their characteristics, composition, and applications. (A7.8)
- SLO 12A.3.1.11 Identify types of electrical components and describe their purpose and operation. (A7.9)
- circuit protection
  - control devices
  - load devices
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**GLO 3.2: Inspect and diagnose** automotive components and systems.

- SLO 12A.3.2.1 Demonstrate the ability to inspect and diagnose batteries.
- SLO 12A.3.2.2 Demonstrate the ability to inspect and diagnose starting systems.
- SLO 12A.3.2.3 Demonstrate the ability to inspect and diagnose charging systems.
- SLO 12A.3.2.4 Demonstrate the ability to diagnose wiring harnesses.
- SLO 12A.3.2.5 Demonstrate the ability to diagnose electrical protection devices.
- SLO 12A.3.2.6 Demonstrate the ability to inspect and diagnose automotive electrical systems.
- SLO 12A.3.2.7 Demonstrate the ability to calculate circuit values using Ohm's law.
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**GLO 3.3: Service and repair** automotive components and systems.

- SLO 12A.3.3.1 Demonstrate the ability to service and repair starting systems.
- SLO 12A.3.3.2 Demonstrate the ability to service and repair charging systems.
- SLO 12A.3.3.3 Demonstrate the ability to service and/or replace electrical protection devices.
- SLO 12A.3.3.4 Demonstrate the ability to measure and interpret electrical values in automotive circuits.
- SLO 12A.3.3.5 Demonstrate the ability to retrieve and interpret wiring diagrams (e.g., colour coding systems, wire size).
- SLO 12A.3.3.6 Identify types of tools and equipment used to test and charge batteries, and describe/demonstrate their applications and procedures for use. (A7.6)
- SLO 12A.3.3.7 Identify tools and equipment used to test circuits and components, and describe/demonstrate their applications and procedures for use. (A7.10)
  - scan tools
  - DVOM
- SLO 12A.3.3.8 Identify methods of wire repair and describe/demonstrate their associated procedures. (A7.11)
  - splicing
  - terminal replacement
  - soldering
  - crimping

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**Goal 4:** Describe and apply transferable **cross-curricular** knowledge and skills.

**GLO 4.1:** Describe and apply knowledge and skills from **information and communication technologies**.

- SLO 12A.4.1.1 Demonstrate the ability to use automotive service information retrieval systems unique to the automotive service and repair industry.
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**GLO 4.2:** Describe and apply knowledge and skills from the **sciences**.

- SLO 12A.4.2.1 Demonstrate an understanding of atomic structure.
- SLO 12A.4.2.2 Demonstrate an understanding of electricity.
- SLO 12A.4.2.3 Demonstrate an understanding of conventional and electron theory.

- SLO 12A.4.2.4 Demonstrate an understanding of the principles of magnetism.
  - SLO 12A.4.2.5 Demonstrate an understanding of Ohm's law.
  - SLO 12A.4.2.6 Demonstrate an understanding of the properties of electromagnetism related to automotive components.
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**GLO 4.3: Read, interpret, and communicate** information.

No applicable SLOs.

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**GLO 4.4: Describe and apply knowledge and skills from mathematics.**

No applicable SLOs.

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**Goal 5: Demonstrate an understanding of sustainability.**

**GLO 5.1: Demonstrate an understanding of sustainability.**

- SLO 12A.5.1.1 Demonstrate an understanding of efficient materials usage and disposal practices.
  - SLO 12A.5.1.2 Comply with efficient materials usage and disposal practices.
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**Goal 6: Demonstrate awareness of ethical and legal standards.**

**GLO 6.1: Demonstrate awareness of ethical and legal standards.**

- SLO 12A.6.1.1 Demonstrate awareness of liability concerns related to automotive systems and service.
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**Goal 7: Demonstrate employability skills.**

**GLO 7.1: Demonstrate employability skills.**

- SLO 12A.7.1.1 Demonstrate problem-solving skills.
- SLO 12A.7.1.2 Demonstrate critical-thinking skills.
- SLO 12A.7.1.3 Demonstrate regular attendance and punctuality.
- SLO 12A.7.1.4 Demonstrate accountability by taking responsibility for their actions.
- SLO 12A.7.1.5 Demonstrate adaptability, initiative, and effort.
- SLO 12A.7.1.6 Demonstrate the ability to accept and follow directions and feedback.
- SLO 12A.7.1.7 Demonstrate teamwork skills.
- SLO 12A.7.1.8 Demonstrate the ability to stay on task and effectively use time in class and shop environments.

SLO 12A.7.1.9 Communicate respectfully and effectively with coworkers and customers.

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**GLO 7.2:** Demonstrate an understanding of the **business operation** of a repair/service facility.

No applicable SLOs.

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**Goal 8:** Demonstrate an understanding of **educational and career opportunities**.

**GLO 8.1:** Demonstrate an understanding of **educational and career opportunities**.

SLO 12A.8.1.1 Demonstrate awareness of specialized occupations in automotive electrical systems.

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**Goal 9:** Demonstrate awareness of the **evolution, technological progression, and emerging trends** in the automotive industry.

**GLO 9.1:** Demonstrate awareness of the **evolution, technological progression, and emerging trends** in the automotive industry.

SLO 12A.9.1.1 Demonstrate an understanding of the evolution, technological progression, and emerging trends in automotive electrical systems.

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