Grade 11A Engine Fundamentals and Service

Course Code	8697
Course Credit	1.0

Senior Years Technology Education Program

Discipline Overview

An approved technical-vocational education (TVE) program cluster comprises departmentally developed and/or approved courses in one specific trade or trained occupation that facilitates the transition from school to either post-secondary training (such as the training provided through Apprenticeship Manitoba) or entry into the workforce (often at an entry-level position).

When learners pursue their studies in an environment modelled after the workplace, they will acquire not only trade-related skills, but will also develop

- employability skills required to make an effective transition from school to work
- an understanding of career development and planning
- an understanding of the importance of becoming autonomous, lifelong learners who can adapt their skills and knowledge to what they will need in the future
- an awareness of safety in school, in the workplace, and at home
- an awareness of sustainability as it relates to the specific skilled trade and society

Course Overview

In this course, learners interested in developing skills in automotive service and repair must understand the basic principles of the internal combustion engine, including the function and interaction of its components and how they contribute to overall vehicle operation. They will continue to build their knowledge of the automotive profession, including safety practices, tools and equipment, and the use of materials and consumables. In addition, learners will study procedures for servicing, repairing, and replacing engines and their components. They will also apply mathematical concepts used in the automotive trade, such as measurements, conversions, and calculations related to components and systems.

This course focuses on the following units in the Apprenticeship Manitoba Level 1 technical training:

- A5 Trade Related Mathematics
- A7 Engine Fundamentals

Manitoba

The learning outcomes in this course may not follow a fixed sequence, as they are organized to align with Apprenticeship Manitoba standards. Only the outcomes relevant to this course are included. A complete list of learning outcomes can be found in the primary learning outcomes resource.

Global Competencies in Automotive Technology

Critical Thinking

Critical thinking in automotive technology involves the intentional process of synthesizing and analyzing ideas using criteria and evidence, making reasoned decisions and judgments, and reflecting on the outcomes and implications of those decisions and judgments.

When critical thinking as a competency is applied in automotive technology, learners

- **find and use** sources strategically, efficiently, and effectively when making safety, environment, and respectful workplace decisions and choices
- **evaluate** sources for bias, relevance, and reliability in trade communications and documents, as well as for the selection and use of materials and consumables
- analyze and synthesize ideas using **criteria and evidence** that demonstrate awareness of emerging trends and issues
- understand that people (customers) come with **varied perspectives based on their own experience**
- demonstrate **flexibility to reconsider** their thinking when faced with new credible information or resources
- enhance comprehension, clarify meaning, make connections, and expand experiences through questioning
- **make judgments** based on observation, experience, and evidence
- **weigh criteria** to apply safe practices and make ethical decisions

Creativity

Creativity in automotive technology involves exploring and playing with ideas and concepts in order to represent thinking, solve problems, explore opportunities, and innovate in unique ways. It is the interaction between intuition and thinking.

When creativity as a competency is applied in automotive technology, learners

- demonstrate initiative, open-mindedness, inventiveness, flexibility, and a willingness to **take prudent risks** in thinking about various processes and while recognizing safety protocols

- demonstrate **curiosity** by exploring new ideas, possibilities, and emerging trends, as well as by **asking relevant questions**
- **use safe strategies** and procedures to make adaptations and adjustments when solving problems or generating innovative ideas
- enhance innovative ideas **by building on** prior knowledge and **the ideas of others**
- **create a plan** for a procedure or process and **adjust** it as needed to achieve the goal of successfully meeting a learning outcome
- **test and adapt** procedures or processes to **persevere** through obstacles to improve process, efficiency, effectiveness, and customer service
- use **reflective practice** by **welcoming feedback** from others to enhance the process

Citizenship

Citizenship in **automotive technology** involves engaging and working toward a more equitable, compassionate, and sustainable world by developing and valuing relationships to self, others, and the natural world.

When citizenship as a competency is applied in automotive technology, learners

- understand **their own perspective** on issues related to automotive systems and service
- recognize **discrimination, principles of equity, and human rights** in the workplace
- explore the **interconnectedness** of self, the workplace, and the natural world as they make decisions in the workplace and select materials and consumables
- welcome **diverse viewpoints, experiences, and world views,** and appreciate how they contribute to building relationships and practices
- **empathize** with multiple viewpoints to better understand consumers, markets, workplaces, teams, and co-workers
- connect with others in **responsible, respectful, and inclusive ways,** both in person and in digital contexts
- **realize their potential** in contributing to the betterment of both their workplace and the wider community with the decisions they make
- work to support diversity, inclusivity, and human rights by finding **equitable solutions** in the workplace that support well-being for all
- make **ethical choices** to promote healthy and sustainable outcomes

Connection to Self

Connection to self in automotive technology involves awareness of one's identity, the ability to self-regulate, make and reflect on decisions, and the responsibility for personal growth, well-being, and well-becoming.

When connection to self as a competency is applied in automotive technology, learners

- recognize **personal strengths, gifts, and challenges** in automotive systems and service that support their learning and well-being
- come to know the **factors that shape their identity** as automotive technicians, and see themselves as professionals
- use workplace skills and practices to enhance **self-regulation**, personal comfort, sense of well-being, and efficiency
- **reflect** on their own decisions, effort, and experiences, and others' feedback as they improve their skills as automotive technicians
- **set goals** to strengthen their career and personal aspirations as automotive technicians
- create a **personal plan** that reflects their career goals, encompassing strengths and interests
- value and practise resilience as they work through mistakes and **overcome obstacles** in their skills and understanding of automotive technology
- demonstrate the ability **to change or adapt** to new experiences when presented with obstacles or new information
- recognize and **embrace their role** in lifelong learning, well-being, and well-becoming

Collaboration

Collaboration in automotive technology involves learning with and from others and working together with a shared commitment to a common goal.

When collaboration as a competency is applied in automotive technology, learners

- welcome **diverse viewpoints**, experiences, and world views, and appreciate how they contribute to building relationships and practices
- understand that when they **build on each other's ideas** through discussion, sharing practices, ideas, and stories, their understanding is deepened
- **value** and **put trust in others'** contributions when working together to ensure safe practices
- practise **active listening** and formulate **questions** of themselves and others to generate new ideas and deepen understanding

- **work through differences** and show a willingness to **compromise** or change perspective by demonstrating effective conflict-resolution practices/strategies and appropriate workplace etiquette and protocols
- **co-construct** understanding of current practices and emerging technologies
- **commit** to their roles to maintain a safe work environment, to communicate effectively, and to engage in group procedures

Communication

Communication in automotive technology involves interacting with others and allowing for a message to be received, expressed, and understood in multiple ways and for a variety of purposes.

When communication as a competency is applied in automotive technology, learners

- express ideas while using workplace **cues, conventions**, and professionalism, and while being aware of both word choice and body language
- understand context, adapting to different **audiences and purposes** and conveying information clearly and concisely
- understand how their **words and actions** shape their identity or have an impact on their relationships with colleagues and customers
- are aware of workplace **cues, practices, and protocols,** such as word choice and body language, and use them to understand and interpret messages
- **seek to understand** others' ideas and instructions through use observation, active listening, and questioning as they seek to understand and interpret their peers and customers
- recognize that diverse **contexts** (of language, culture, age, etc.) **can impact and influence understanding**
- make meaning and deepen understanding **through their own language and the languages** of clients and colleagues
- **build relationships** through meaningful interactions using inclusive and respectful language, and correct terminology, both in person and in digital contexts
- recognize the benefits of communication to **build community** in their workplace and broader world

Enduring Understandings

Explore career opportunities.

Technical-vocational education supports learners to understand the unique characteristics, scope, working conditions, and career opportunities of various occupations to make informed choices.

Create safe, healthy, and effective workspaces.

Technical-vocational education provides learners with safe and healthy, effective work practices and protocols that meet industry standards for technical competence and professionalism.

Navigate the world.

Technical-vocational education prepares learners with attitudes, skills, and knowledge to successfully navigate complex, competitive, and collaborative environments to develop an awareness of regulations, cultural competence, and ethical practices.

Experience connected and innovative learning.

Technical-vocational education readies learners to be entrepreneurial and innovative thinkers while making cross-curricular connections and transdisciplinary experiences (STEAM), utilizing industry-standard digital tools and technologies and fostering awareness of industry trends.

Promote inclusive and responsive systems.

Technical-vocational education promotes equity, diversity, and inclusion; is responsive to global challenges; and promotes environmental stewardship to prepare learners for an interconnected world.

Prepare for evolving economies.

Technical-vocational education equips learners with relevant and adaptable skills to become lifelong learners in an ever-changing world.

Learning Outcomes

With teacher guidance and emerging independence, learners can achieve the following learning outcomes.

Strand A: Trade Safety (A2)

AUT-11A-A2 Identify, describe, and demonstrate personal protective equipment (PPE) requirements and standards in the workplace.

AUT-11A-A2-1 Identify various **personal protective equipment** (PPE), including

- eye protection
- face protection
- hearing protection
- foot protection
- head protection
- hand protection
- skin protection
- respiratory protection
- protective clothing
- fall protection (trade-specific)

AUT-11A-A2-2 Describe various **personal protective equipment** (PPE), including

- selection of the appropriate PPE
- characteristics and key features
- application (i.e., role or utility in specific scenarios)
- limitations in scope or performance

AUT-11A-A2-3 Demonstrate how to use the required **personal protective equipment** (PPE), ensuring

- a proper fit
- a proper seal
- it is worn properly
- an understanding of the procedures for reporting any damage or malfunctions

AUT-11A-A5 Identify and describe injury prevention.

AUT-11A-A5-1 Identify, describe, and demonstrate the **SAFE acronym**.

- **S**pot the hazard
- **A**ssess the risk
- **F**ind a safer way
- **E**very day

AUT-11A-A5-12 Demonstrate knowledge of the **locations of various fire emergency safety equipment** and evacuation safety measures, including

- fire extinguisher
- alarm pull stations
- emergency exits
- muster points

AUT-11A-A6 Identify and describe injury response.

AUT-11A-A6-1 Describe how to **manage a scene** when responding to an injury, such as by

- staying calm
- keeping the area safe
- providing support until trained help arrives

AUT-11A-A6-2 Describe how to **report an injury**, including reporting the injury to

- a teacher or supervisor
- Workers Compensation Board of Manitoba (WCB)

AUT-11A-A6-3 Demonstrate knowledge of the **locations of various emergency safety equipment**, including

- first aid kit
- eyewash station
- automated external defibrillator (AED)

Strand B: Career Education (A1)

AUT-11A-B1 Describe the structure and scope of the automotive service technician trade.

AUT-11A-B1-1 Describe opportunities and future **career paths** in the trade, including

- becoming a specialist
- moving into leadership
- working in different locations
- growing with new technology

AUT-11A-B2 Describe the levels of workplace competency.

AUT-11A-B2-1 Describe **job competencies** workers and learners need to know related to **workplace culture**, including

- understanding tools and materials
- using the right skills to do the job well

AUT-11A-B2-2 Describe the **social competencies** workers and learners need to know related to **workplace culture**, including

- working well with others
- using appropriate language
- respecting different beliefs
- understanding workplace rules
- supporting fairness and inclusion

Strand C: Trade-Related Communications (A4)

AUT-11A-C1 Describe and demonstrate techniques for effective verbal and non-verbal communication.

AUT-11A-C1-1 Describe how to communicate clearly and respectfully with various people at school and/or work, using both **words and body language**.

AUT-11A-C1-2 Demonstrate how to communicate clearly and respectfully with various people at school and/or work, using both **words and body language**.

AUT-11A-C2 Identify workplace behaviours and communication that constitute bullying, as defined by the Canadian Human Rights Act and jurisdictional human rights laws.

AUT-11A-C2-1 Identify what **respectful workplace** values look like and what kinds of behaviour are considered bullying, harassment, or discrimination under Canadian law.

AUT-11A-C3 Demonstrate effective communication skills, and practise active listening and response.

AUT-11A-C3-1 Demonstrate **effective communication and active listening,** including

- listening carefully
- responding clearly
- using appropriate body language
- asking questions
- being open to feedback

AUT-11A-C6 Identify types of trade-related documents and describe their applications.

AUT-11A-C6-1 Identify various **documents** used in trade, including

- codes and standards
- company policies
- vehicle identification number (VIN)
- schematics, service information, and manufacturers' specifications
- technical service bulletins (TSB)
- industry standard labour guides

AUT-11A-C6-2 Describe various **documents** used in trade, including

- selection of the appropriate document
- its characteristics and key features
- its application (i.e., role or utility in specific scenarios)
- its limitations in scope

AUT-11A-C7 Describe the procedures used to prepare and/or complete trade-related documents.

AUT-11A-C7-1 Describe the procedures used to prepare and/or complete trade-related documents, such as

- work and repair orders
- pre-delivery inspection
- preventative maintenance
- estimates

AUT-11A-C8 Describe the importance of communicating job requirements.

AUT-11A-C8-1 Describe the importance of clearly defining what a job entails so that each team member understands exactly what is expected of them.

Strand D: Trade-Related Mathematics (A5)

AUT-11A-D1 Use mathematical properties to solve problems involving whole, fractional, decimal, and percentage numbers, with an emphasis on trade-related problems.

AUT-11A-D1-1 Demonstrate how to solve math problems with both **positive and negative numbers**, indicating how the signs (+ or –) affect the answer, when

- adding
- subtracting
- multiplying
- dividing

AUT-11A-D1-2 Identify various **types of fractions**, including

- proper fractions
- improper fractions
- mixed fractions

AUT-11A-D1-3 Describe various **types of fractions**, including

- a proper fraction has a smaller number on top (like $\frac{3}{4}$)
- an improper fraction has a bigger number on top (like $\frac{5}{3}$)
- a mixed fraction combines a whole number and a fraction (like $1\frac{2}{3}$)

AUT-11A-D1-4 Demonstrate how to add and subtract **fractions**.

AUT-11A-D1-5 Demonstrate how to multiply, divide, simplify (reduce), and expand **fractions.**

AUT-11A-D1-6 Demonstrate how to change a fraction into a **decimal** and a decimal into a fraction.

AUT-11A-D1-7 Demonstrate how to calculate **percentages** in trade situations, such as

- when material costs increase by 10%
- when applying a 15% discount

AUT-11A-D2 Demonstrate how to communicate measurements.

AUT-11A-D2-1 Demonstrate how to **measure.**

AUT-11A-D2-2 Demonstrate how to **measure** using both **metric and customary** (imperial) measurement systems, such as when

- measuring length
- measuring materials

AUT-11A-D2-3 Demonstrate how to provide **measurements,** including how much the measurements can vary (e.g., torque specs).

AUT-11A-D3 Calculate the perimeter, area, and volume of simple and complex shapes, using both metric and customary units of measurement.

AUT-11A-D3-1 Demonstrate how to calculate various **circumference and area**, including

- circles
- arc lengths
- sectors
- segments

AUT-11A-D3-2 Demonstrate how to calculate various **areas**, including

- circles
- arc lengths
- sectors
- segments

AUT-11A-D3-3 Demonstrate how to calculate various **volumes**, including

- prisms
- spheres
- cylinders

AUT-11A-D4 Solve problems using ratio and proportion.

AUT-11A-D4-1 Demonstrate how to use **ratios and proportions** to solve problems, including

- direct proportion (as one value increases, the other also increases)
  - If a car uses seven litres of fuel to travel 110 km, how much fuel will it use to travel 250 km?
- indirect (inverse) proportion (as one value increases, the other decreases)
  - If a car takes four hours to travel a certain distance at 60 km/h, how long will it take at 70 km/h?
- Use of Pascal's law

Strand E: Tools and Equipment (A3)

AUT-11A-E1 Identify, describe, and demonstrate an understanding of terminology associated with tools and equipment.

AUT-11A-E1-1 Identify **key terms** and names of various tools and equipment.

AUT-11A-E1-2 Describe the **names and purposes** of various tools and equipment.

AUT-11A-E1-3 Demonstrate an understanding of the **names** and **purposes** of various tools and equipment.

AUT-11A-E2 Identify the various hazards associated with tools and equipment, and describe and demonstrate the related safe work practices.

AUT-11A-E2-1 Identify various **hazards of tools and equipment**, including

- harmful noise levels
- lacerations caused by sharp tools or materials
- crush injury hazards
- moving parts on machines that can catch and trap hands or garments
- flying debris hazards

AUT-11A-E2-2 Describe **safe work practices** for various tools and equipment, including

- wearing appropriate personal protective equipment (PPE)
- inspecting tools and equipment before use
- using the correct tool for the job
- keeping the work area clean and organized
- following manufacturer instructions and safety guidelines
- disconnecting power tools when not in use or during maintenance
- reporting and removing damaged tools from service
- staying alert and avoiding distractions while working
- using guards and safety devices as intended
- storing tools properly after use

AUT-11A-E2-3 Demonstrate **safe work practices** related to tools and equipment.

Strand F: Materials and Consumables

AUT-11A-F1 Share and discuss Indigenous perspectives and environmental impacts.

AUT-11A-F1-1 Share and discuss an **Indigenous perspective** on material selection, emphasizing sustainability, respect for natural resources, and cultural significance, such as

- principles of the honourable harvest
- four sacred elements (earth, wind, water, fire)
- inviting an Elder to teach sustainability

AUT-11A-F1-2 Share and discuss the **environmental impact** of selecting and disposing of various materials.

AUT-11A-F2 Identify the various hazards associated with consumables and materials, and describe and demonstrate the related safe work practices.

AUT-11A-F2-1 Identify various hazards of **consumables and materials,** including

- harmful noise levels
- lacerations caused by sharp tools or materials
- crush injury hazards
- moving parts on machines that can catch and trap hands or garments
- flying debris hazards

AUT-11A-F2-2 Describe **safe work practices** for various consumables and materials, including

- wearing appropriate personal protective equipment (PPE)
- inspecting consumables and materials before use
- using the correct consumables and materials for the job
- keeping the work area clean and organized
- following manufacturer instructions and safety guidelines
- reporting and removing damaged consumables and materials from service
- staying alert and avoiding distractions while working
- storing consumables and materials properly after use

AUT-11A-F2-3 Demonstrate safe work practices related to **consumables and materials**.

AUT-11A-F3 Identify and describe organizing materials, including their characteristics, applications, and procedures.

AUT-11A-F3-1	Identify various **materials and consumables**.
AUT-11A-F3-2	Describe various **materials and consumables**, including • selection of the appropriate materials or consumables • characteristics and key features • application (i.e., role or utility in specific scenarios) • limitations in scope or performance • procedures for conducting a thorough inspection • procedures for regular maintenance • guidelines for proper storage
AUT-11A-F3-3	Demonstrate how to safely and properly use various types of **materials and consumables**.

Strand H: Engine Fundamentals (A7)

AUT-11A-H1 Identify, define, and demonstrate an understanding of terminology associated with engine fundamentals.

AUT-11A-H1-1	Identify **key terms** and **names** of various engine fundamentals.
AUT-11A-H1-2	Describe the **names** and **purposes** of various engine fundamentals.
AUT-11A-H1-3	Demonstrate an understanding of the **names** and **purposes** of various engine fundamentals.

AUT-11A-H2 Identify the various hazards associated with engine systems, and describe and demonstrate the related safe work practices.

AUT-11A-H2-1	Identify various engine system **hazards** and describe the **safe work practices** for each of the following: • personal (e.g., use proper lifting techniques and wear PPE) • facility (e.g., ensure the vehicle is securely lifted) • vehicle (e.g., follow manufacturer guidelines) • environmental (e.g., dispose of old parts and fluids properly)
AUT-11A-H2-2	Demonstrate **safe work practices** related to engine systems.

AUT-11A-H3 Identify tools and equipment related to engine fundamentals, and describe their applications and procedures for use.

AUT-11A-H3-1 Identify various **tools and equipment** used for engine fundamentals.

AUT-11A-H3-2 Describe various **tools and equipment** used for engine fundamentals, including

- selection of the appropriate tool or equipment
- characteristics and key features
- application (i.e., role or utility in specific scenarios)
- limitations in scope or performance
- procedures for conducting a thorough inspection
- procedures for regular maintenance
- guidelines for proper storage

AUT-11A-H3-3 Demonstrate how to safely and properly use various **tools and equipment** for engine fundamentals.

AUT-11A-H6 Describe internal combustion principles.

AUT-11A-H6-1 Describe various principles of **internal combustion** for different engines, including

- two-stroke
- four-stroke
- rotary

AUT-11A-H7 Describe types of engine classifications, configurations, and their construction.

AUT-11A-H7-1 Describe the various types of **classification** and construction of different engines, including

- diesel
- gasoline
- alternate fuels

AUT-11A-H7-2 Describe the various types of **classification** and construction of different engines, including

- selection of the appropriate engine
- characteristics and key features
- application (i.e., role or utility in specific scenarios)
- limitations in scope or performance
- procedures for conducting a thorough inspection

- procedures for regular maintenance
- guidelines for proper storage

AUT-11A-H7-3 Describe the various types of **configuration** and construction of different engines, including

- inline
- rotary
- opposed
- v-type
- w-type

AUT-11A-H7-4 Describe the various types of **configuration** and construction of different engines, including

- selection of the appropriate configuration and construction
- characteristics and key features
- application (i.e., role or utility in specific scenarios)
- limitations in scope or performance
- procedures for conducting a thorough inspection
- procedures for regular maintenance
- guidelines for proper storage

AUT-11A-H8 Identify and describe types of valvetrain configurations and their construction.

AUT-11A-H8-1 Identify the various configurations and construction of different **valvetrains**, including

- push rod
- overhead cam
- multi-valve
- solenoid-operated valve

AUT-11A-H8-2 Describe the various configurations and construction of different **valvetrains**, including

- selection of the appropriate valvetrain configuration
- characteristics and key features
- application (i.e., role or utility in specific scenarios)
- limitations in scope or performance
- procedures for conducting a thorough inspection
- procedures for regular maintenance
- guidelines for proper storage

AUT-11A-H9 Identify engine components, and describe their design, purpose, and operation.

AUT-11A-H9-1 Identify various engine **components**, including

- block assembly
- cylinder head assembly
- timing gear
- timing belt
- timing chain
- variable valve timing

AUT-11A-H9-2 Describe various engine **components**, including

- selection of the appropriate component
- characteristics and key features
- application (i.e., role or utility in specific scenarios)
- limitations in scope or performance
- procedures for conducting a thorough inspection
- procedures for regular maintenance
- guidelines for proper storage

AUT-11A-H9-3 Demonstrate how to safely and properly use procedures for **repairing or replacing** various engine components.

AUT-11A-H10 Identify types of fasteners, gaskets, seals, and sealants, and describe their applications and procedures in relation to engine fundamentals.

AUT-11A-H10-1 Identify various engine **fasteners, gaskets, seals, and sealants**, such as

- fasteners: head bolts, main bearing bolt
- gaskets: head gasket, oil pan gasket
- seals: crankshaft seal, valve stem seal
- sealants: RTV silicone, thread sealant

AUT-11A-H10-2 Describe various engine **fasteners, gaskets, seals, and sealants**, including

- selection of the appropriate fasteners, gaskets, seals, and sealants
- characteristics and key features
- application (i.e., role or utility in specific scenarios)
- limitations in scope or performance
- procedures for conducting a thorough inspection
- procedures for regular maintenance
- guidelines for proper storage

AUT-11A-H10-3 Demonstrate how to safely and properly use procedures for **repairing or replacing** various fasteners, gaskets, seals, and sealants.

AUT-11A-H11 Calculate engine displacement, compression ratios, horsepower, area, and volume.

AUT-11A-H11-1 Demonstrate the calculations of various engine parameters, including

- engine displacement
- compression ratio
- horsepower
- area
- volume

AUT-11A-H12 Demonstrate how to safely and properly use procedures for repairing various engine systems.

AUT-11A-H12-1 Demonstrate how to safely and properly use procedures for **repairing** various engine systems.

Curriculum Implementation Resources

Curriculum implementation resources are frequently added. You are encouraged to visit the website regularly.