MODIFIED LESSON INSTRUCTIONS AND INSTRUCTIONAL GUIDES – TP 1 OF EO M232.01

A-CR-CCP-802/PG-001

EO M232.01 – IDENTIFY TYPES OF AIRCRAFT ENGINES

1. **Performance.** Identify Types of Aircraft Engines.

2. **Conditions**

   a. Given:

      (1) Supervision; and

      (2) Assistance as required.

   b. Denied: N/A.

   c. Environmental: Suitable classroom facilities or training area large enough to accommodate the entire group.

3. **Standard.** In accordance with specified references, the cadet shall identify types of aircraft engines, to include:

   a. rocket engines;

   b. gas turbine engines; and

   c. piston-powered engines.

4. **Teaching Points**

TP	Description	Method	Time	Ref
TP1	Explain that a powered aircraft needs a means of propulsion to overcome drag and allow the wings to generate lift. Identify common engine types used for propulsion, to include: a. rocket engines; b. gas turbine jet engines; and c. piston-powered engines.	Interactive Lecture	10 min	C3-116 (p. 51) C3-084 C3-086 C3-087 C3-088

5. **Time**

   a. Introduction/Conclusion: 5 min

   b. Interactive Lecture: 10 min

   c. Total: 15 min

6. **Substantiation.** An interactive lecture was chosen for TP1 to introduce types of aircraft engines and give an overview of them.

7. **References**

   a. C3-084 NASA Glenn Research Center. *Engines 101.* Retrieved 21 February 2007, from http://www.ueet.nasa.gov/Engines101.html#Aeronautics.

   b. C3-086 NASA Glenn Research Center. *Engines 101.* Retrieved 21 February 2007, from http://www.grc.nasa.gov/WWW/K-12/airplane/icengine.html.

Unofficial convenience copy of A-CR-CCP-803/PF-001, cached 2026-11-08 from https://app.cadets.gc.ca/cadet-publications/A-CR-CCP-803-PF-001/A-CR-CCP-803-PF-001.pdf.
Verify against the official publication.

c. C3-087 NASA Glenn Research Center. *Propulsion Index.* Retrieved 21 February 2007, from http://www.grc.nasa.gov/WWW/K-12/airplane/shortp.html.

d. C3-088 NASA *Welcome to the Beginner's Guide to Rockets.* Retrieved 21 February 2007, from http://exploration.grc.nasa.gov/education/rocket/bgmr.html.

e. C3-116 A-CR-CCP-263/PT-001/(ISBN 0-9680390-5-7) MacDonald, A. F. and Peppler, I. L. (2000). *From the Ground Up: Millennium Edition.* Ottawa, ON: Aviation Publishers Co. Limited.

8. **Training Aids.** Presentation aids (e.g. whiteboard/flipchart/OHP) appropriate for the classroom/training area.

9. **Learning Aids.** N/A.

10. **Test Details.** N/A.

11. **Remarks.** N/A.

Unofficial convenience copy of A-CR-CCP-803/PF-001, cached 2026-11-08 from https://app.cadets.gc.ca/cadet-publications/A-CR-CCP-803-PF-001/A-CR-CCP-803-PF-001.pdf.
Verify against the official publication.

A-CR-CCP-802/PF-001

ROYAL CANADIAN AIR CADETS

PROFICIENCY LEVEL TWO

INSTRUCTIONAL GUIDE

SECTION 1

EO M232.01 – IDENTIFY TYPES OF AIRCRAFT ENGINES

Total Time: 15 min

PREPARATION

PRE-LESSON INSTRUCTIONS

Resources needed for the delivery of this lesson are listed in the lesson specification located in A-CR-CCP-802/PG-001, Chapter 4. Specific uses for said resources are identified throughout the Instructional Guide within the TP for which they are required.

Review the lesson content and become familiar with the material prior to delivering the lesson.

PRE-LESSON ASSIGNMENT

N/A.

APPROACH

An interactive lecture was chosen for TP1 to introduce types of aircraft engines and give an overview of them.

INTRODUCTION

REVIEW

N/A.

OBJECTIVES

By the end of this lesson the cadet shall be expected to identify types of aircraft engines.

IMPORTANCE

Engines are one of the key systems in a powered aircraft. It is important for cadets to learn about types of aircraft engines so that they can understand subsequent and related aspects of aviation.

Teaching Point 1 **Explain That a Powered Aircraft Needs a Means of Propulsion**

Time: 10 min Method: Interactive Lecture

A powered aircraft needs a means of propulsion to overcome drag and allow the wings to generate sufficient lift to overcome weight.

Unofficial convenience copy of A-CR-CCP-803/PF-001, cached 2026-11-08 from https://app.cadets.gc.ca/cadet-publications/A-CR-CCP-803-PF-001/A-CR-CCP-803-PF-001.pdf.
Verify against the official publication.

A-CR-CCP-802/PF-001

The propeller and jet engine are very closely related, providing thrust by the same means – the acceleration of a mass of air. The propeller generates thrust by acting on a large mass of air, giving it a relatively small acceleration. The jet engine does exactly the same thing by giving a larger acceleration to a smaller mass of air.

The most common engine types used for aviation propulsion employ internal combustion and they include:

- rocket engines,
- gas turbine jet engines, and
- reciprocating piston-powered engines.



Show the cadets a slide or handout of rocket engine applications in Figures 12A-1 and 12A-2.

The earliest vehicle engines were rocket engines used to power ancient Chinese fire arrows. This method of propulsion proved so effective that, with many improvements, it is still commonly used today for many applications including space exploration. Self-contained with their own oxidizer, rockets have the great advantage of being able to function in a vacuum such as outer space.



All propulsion systems are reactive, meaning that they all employ an equal and opposite reaction predicted by Newton's third law of motion.

Piston-powered internal combustion engines were developed in the late nineteenth century. They were available to Orville and Wilbur Wright, who designed their 1903 flyer with a four-cylinder piston-powered engine.



Show the cadets a slide or handout of a Harvard piston-powered engine application in Figures 12A-3 and 12A-4 located at the end of this document.

Piston-powered engines are the most common vehicle engine of all and the one that Proficiency Level Two cadets will explore in most detail. In many ways, pistons are the most complicated system of converting the chemical energy of fuel into the energy of motion but they are found in many places, including aircraft, automobiles, boats and lawnmowers.



Show the cadets a slide or handout of a gas turbine jet engine application in Figures 12A-5 and 12A-6 located at the end of this document. Point out the airflow path and combustion location in the schematic.

Gas turbine jet engines are improvements upon simple ramjets. The ramjet is a liquid-fuelled rocket-like engine, which uses atmospheric oxygen to burn fuel. One of the most limiting aspects of a ramjet is that it requires high velocity to work. Therefore it cannot start combustion until it is up to speed – it must be launched from a speeding vehicle. Air-launched missiles are one of the few applications of ramjet engines.

Any turbine converts the energy of moving liquid or gases, such as jet exhaust or wind, into rotary motion to turn a shaft. A windmill is a turbine which uses wind energy to turn a shaft. Among other advantages, adding

Unofficial convenience copy of A-CR-CCP-803/PF-001, cached 2026-11-08 from https://app.cadets.gc.ca/cadet-publications/A-CR-CCP-803-PF-001/A-CR-CCP-803-PF-001.pdf.
Verify against the official publication.

a turbine to the simple ramjet allows a compressor to generate high-pressure air so that the gas turbine jet engine can be started from a resting, or static, position. This is the secret of the modern gas turbine jet engine, which still relies on the ejection of hot gases to produce thrust. Until the turbine and compressor are functioning and delivering high-pressure air to the engine, however, the engine cannot start. Even gas turbine jet engines, therefore, must be started with a starting motor.



Show the cadets a slide or handout of the CT-114 Tutor turbojet engine application Figures 12A-7 and 12A-8 located at the end of this document.

A gas turbine jet engine that provides thrust, with no rotating shaft output, is a TURBOJET engine.



Show the cadets a slide or handouts of the C-130 Hercules turboprop engine application Figures 12A-9 and 12A-10 located at the end of this document.

A gas turbine jet engine that provides thrust and also drives a propeller is a TURBOPROP engine.



Show the cadets a slide or handout of the CH-146 Griffon turboshaft engine application Figures 12A-11 and 12A-12 located at the end of this document.

A gas turbine engine that drives a helicopter rotor is usually a TURBOSHAFT engine. In a turboshaft helicopter engine, the output driveshaft is separate from the compressor turbine shaft so that engine speed is not tied to the helicopter's main rotor speed.



Show the cadets a slide or handout of the CC-150 Polaris (A310-300 Airbus) turbofan engine application Figures 12A-5 and 12A-6 located at the end of this document. Point out the fan location.

The most common variation of the gas turbine jet engine is the TURBOFAN, which is a hybrid of a turbojet and a turboprop. The turbofan has a fan that provides thrust with bypass air, in place of a propeller, adding to the reactive thrust of the ejected exhaust gases. This application allows the aircraft to go faster than normal propellers could go, while also reducing engine noise and allowing the aircraft to make efficient use of fuel. The noise reduction and fuel efficiency of turbofans make them very effective for commercial aviation.



All three of these engine types, rocket, gas turbine jet and piston-powered engines, use internal combustion to capture the energy of expanding hot gases in a closed container.

END OF LESSON CONFIRMATION

QUESTIONS

Q1. Which engine type was the first to be used for propulsion?

Unofficial convenience copy of A-CR-CCP-803/PF-001, cached 2026-11-08 from https://app.cadets.gc.ca/cadet-publications/A-CR-CCP-803-PF-001/A-CR-CCP-803-PF-001.pdf.
Verify against the official publication.

A-CR-CCP-802/PF-001

Q2. Why are the rocket, gas-turbine and piston-powered engines all internal combustion engines?

Q3. Why does a gas turbine jet engine need to have a starting motor?

ANTICIPATED ANSWERS

A1. The rocket was the first to be used for propulsion.

A2. The rocket, gas-turbine and piston-powered engines all use internal combustion to capture the energy of hot expanding gases in a closed container.

A3. A gas turbine jet engine needs to have a starting motor because, until the turbine and compressor are running, there is no high-pressure air to operate the engine.

CONCLUSION

HOMEWORK/READING/PRACTICE

N/A.

METHOD OF EVALUATION

N/A.

CLOSING STATEMENT

The topic of aircraft engines is very broad and ever-changing as new solutions are found and new products developed to push the performance envelope.

INSTRUCTOR NOTES/REMARKS

N/A.

REFERENCES

C3-084 NASA Glenn Research Center. *Engines 101*. Retrieved 21 February 2007, from http://www.ueet.nasa.gov/Engines101.html#Aeronautics.

C3-086 NASA Glenn Research Center. *Engines 101*. Retrieved 21 February 2007, from http://www.grc.nasa.gov/WWW/K-12/airplane/icengine.html.

C3-087 NASA Glenn Research Center. *Propulsion Index.* Retrieved 21 February 2007, from http://www.grc.nasa.gov/WWW/K-12/airplane/shortp.html.

C3-088 NASA. *Welcome to the Beginner's Guide to Rockets.* Retrieved 21 February 2007, from http://exploration.grc.nasa.gov/education/rocket/bgmr.html.

C3-116 A-CR-CCP-263/PT-001/(ISBN 0-9680390-5-7) MacDonald, A. F. and Peppler, I. L. (2000). *From the Ground Up: Millennium Edition.* Ottawa, ON: Aviation Publishers Co. Limited.

Unofficial convenience copy of A-CR-CCP-803/PF-001, cached 2026-11-08 from https://app.cadets.gc.ca/cadet-publications/A-CR-CCP-803-PF-001/A-CR-CCP-803-PF-001.pdf.
Verify against the official publication.

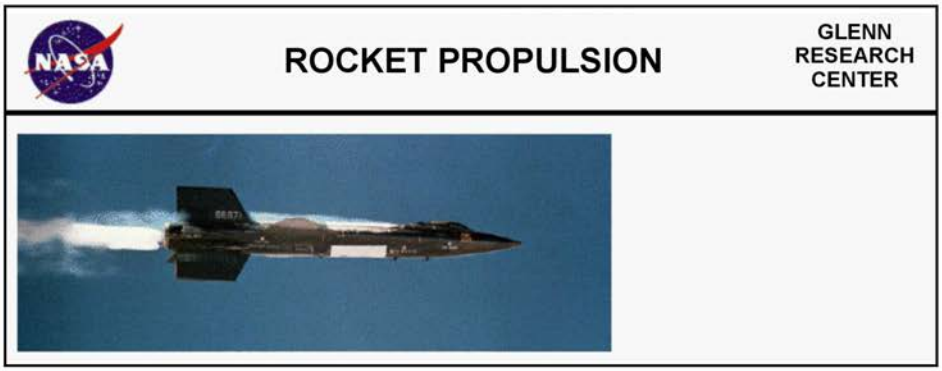
IDENTIFYING TYPES OF AIRCRAFT ENGINES

Rocket Engines



National Aeronautics and Space Administration (NASA), "Missions" Space Shuttle System (2006). Retrieved 17 March 2007, from http://www.nasa.gov/returntoflight/system/system_SSME.html

Figure 12A-1 Rocket Engine Application



NASA Glenn Research Center. "Propulsion Index". Rocket Propulsion (2006). Retrieved 21 February 2007, from http://www.grc.nasa.gov/WWW/K-12/airplane/shortp.html

Figure 12A-2 X-15 in Flight

Unofficial convenience copy of A-CR-CCP-803/PF-001, cached 2026-11-08 from https://app.cadets.gc.ca/cadet-publications/A-CR-CCP-803-PF-001/A-CR-CCP-803-PF-001.pdf.
Verify against the official publication.

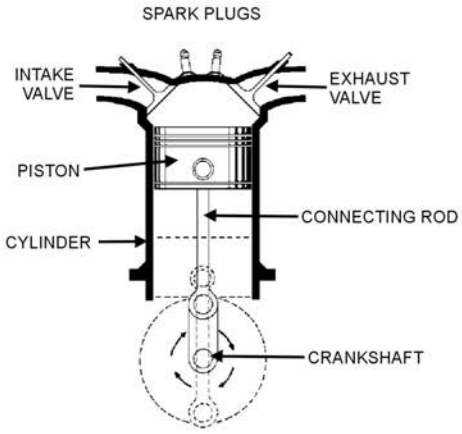
A-CR-CCP-802/PF-001
Chapter 12, Annex A

Piston-powered Engines



Canadian Forces. Aircraft. (2005). Retrieved 17 March 2007, from http://www.airforce.gc.ca/equip/equip1_e.asp

Figure 12A-3 Piston-powered Engine Application



A-CR-CCP-263/PT-001 (p. 53)

Figure 12A-4 Piston-powered Engine Schematic

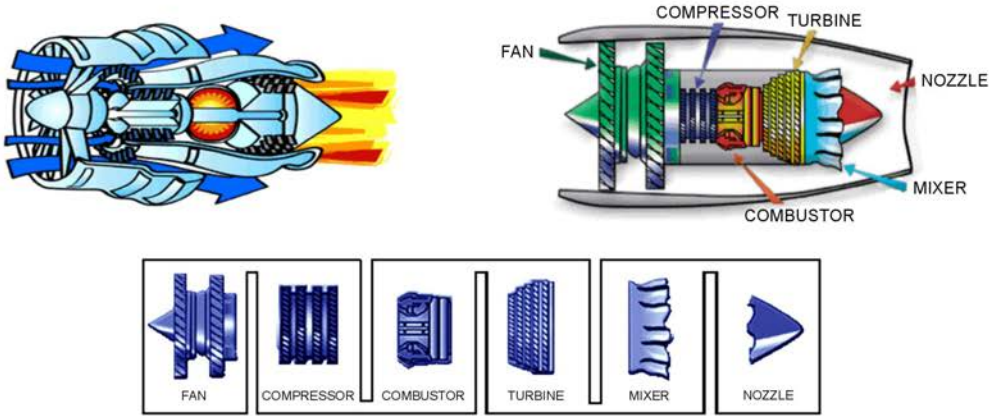
Unofficial convenience copy of A-CR-CCP-803/PF-001, cached 2026-11-08 from https://app.cadets.gc.ca/cadet-publications/A-CR-CCP-803-PF-001/A-CR-CCP-803-PF-001.pdf.
Verify against the official publication.

Jet Engine



Canadian Forces. Aircraft. (2005). Retrieved 17 March 2007, from http://www.airforce.gc.ca/equip/equip1_e.asp

Figure 12A-5 Gas Turbine Engine Application



NASA "Engines 101". Ultra Efficient Engine Technology (UEET). (2001). Retrieved 17 March 2007, from http://www.ueet.nasa.gov/Engines101.html

Figure 12A-6 Turbofan Parts

Unofficial convenience copy of A-CR-CCP-803/PF-001, cached 2026-11-08 from https://app.cadets.gc.ca/cadet-publications/A-CR-CCP-803-PF-001/A-CR-CCP-803-PF-001.pdf.
Verify against the official publication.

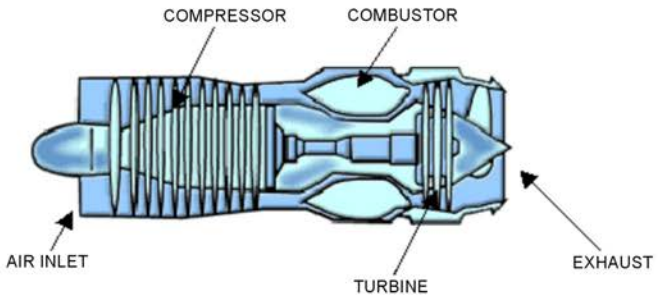
A-CR-CCP-802/PF-001
Chapter 12, Annex A

Turbojet Engines



Canadian Forces. Aircraft. (2005). Retrieved 17 March 2007, from http://www.airforce.gc.ca/equip/equip1_e.asp

Figure 12A-7 Turbojet Application



NASA Engines 101. Ultra Efficient Engine Technology (UEET). (2001). Retrieved 17 March 2007, from http://www.ueet.nasa.gov/Engines101.html

Figure 12A-8 Turbojet Schematic

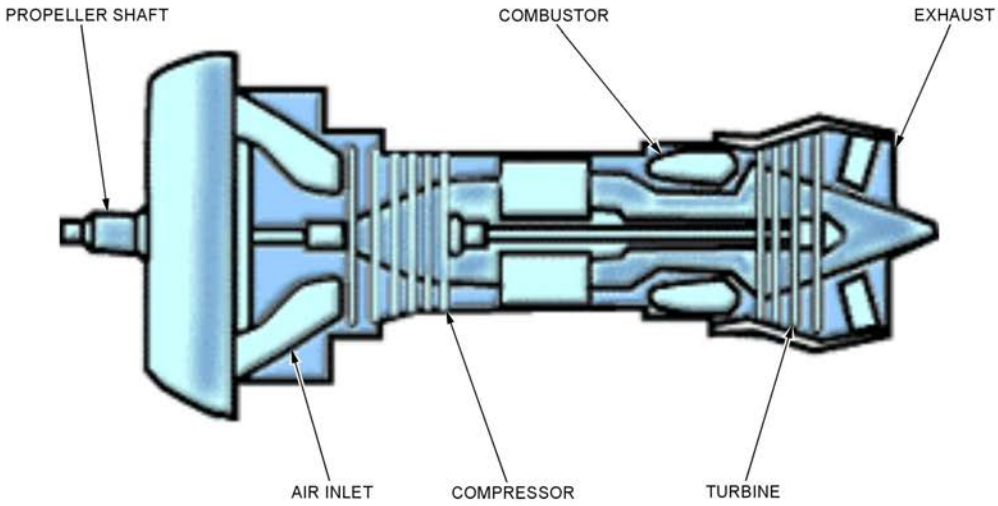
Unofficial convenience copy of A-CR-CCP-803/PF-001, cached 2026-11-08 from https://app.cadets.gc.ca/cadet-publications/A-CR-CCP-803-PF-001/A-CR-CCP-803-PF-001.pdf.
Verify against the official publication.

Turboprop Engines



Canadian Forces. Aircraft. (2005). Retrieved 17 March 2007, from http://www.airforce.gc.ca/equip/equip1_e.asp

Figure 12A-9 Turboprop Application



NASA Engines 101. Ultra Efficient Engine Technology (UEET). (2001). Retrieved 17 March 2007, from http://www.ueet.nasa.gov/Engines101.html

Figure 12A-10 Turboprop Engine Schematic

Unofficial convenience copy of A-CR-CCP-803/PF-001, cached 2026-11-08 from https://app.cadets.gc.ca/cadet-publications/A-CR-CCP-803-PF-001/A-CR-CCP-803-PF-001.pdf.
Verify against the official publication.

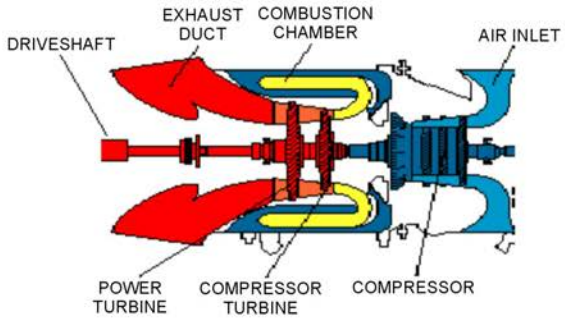
A-CR-CCP-802/PF-001
Chapter 12, Annex A

Turboshaft Engines



Canadian Forces. Aircraft. (2005). Retrieved 17 March 2007, from http://www.airforce.gc.ca/equip/equip1_e.asp

Figure 12A-11 Turboshaft Engine Application



Imagine the Power, Pratt & Whitney Canada. Retrieved 16 March 2007, from http://www.pwc.ca/en/3_0/3_0_3/3_0_3_3_1.asp

Figure 12A-12 Turboshaft Engine Schematic

Unofficial convenience copy of A-CR-CCP-803/PF-001, cached 2026-11-08 from https://app.cadets.gc.ca/cadet-publications/A-CR-CCP-803-PF-001/A-CR-CCP-803-PF-001.pdf.
Verify against the official publication.