ROYAL CANADIAN AIR CADETS

PROFICIENCY LEVEL TWO

INSTRUCTIONAL GUIDE

SECTION 4

EO M232.04 – RECOGNIZE THE FUNCTIONS OF OIL IN A FOUR-STROKE PISTON-POWERED ENGINE

Total Time: 30 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.

Create a slide or handout of Figure A-1.

Copy handouts of Figure B-1 for each cadet.

PRE-LESSON ASSIGNMENT

N/A.

APPROACH

An interactive lecture was chosen for TP1 and TP3 to TP5 to introduce the functions of oil in a four-stroke piston-powered engine and to give an overview of them.

An in-class activity was chosen for TP2 as it is an interactive way to provoke thought and stimulate an interest among cadets.

INTRODUCTION

REVIEW

N/A.

OBJECTIVES

By the end of this lesson the cadet shall be expected to recognize the functions of oil in a four-stroke piston-powered engine.

IMPORTANCE

It is important for cadets to learn about the four functions of oil because specific oil is required for the efficient operation and maintenance of engines that are so critical to aviation.

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Teaching point 1 **Explain That Oil Lubricates the Engine**

Time: 5 min Method: Interactive Lecture



Show the cadets a slide or handout of the functions of oil located at Annex A.

Oil plays an important role in the functioning of an aircraft engine. Oil fulfills four important functions:

- Lubricating,
- Sealing,
- Cooling, and
- Flushing.

LUBRICATING

Oil lubricates the engine by creating a smooth surface between parts that rub together, such as the piston when it moves up and down in the cylinder.

Oil is manufactured in different grades and viscosities. The grade of a particular sample of oil is a measure of its ability to maintain its viscosity, or resistance to flow, under extreme temperatures.

The viscosity, or resistance to flow, affects the oil's stickiness. Low-viscosity oil flows more easily than high-viscosity oil. Oil thins as its temperature is raised so the correct grade of oil must be selected for the intended condition when the engine is at operating temperature. Oil that is too thin (too low a viscosity number) at operating temperature will result in low oil pressure and will not protect the engine component surfaces adequately. Oil that is too thick will result in too high an oil pressure and will not be delivered in sufficient quantity when the engine is cold.

A good grade of oil is one in which the changes in viscosity, due to widely varying operating temperatures, are small.



The engine manufacturer specifies what oil to use and this direction must be followed to avoid engine wear.

Cold oil is often too thick to be delivered to the engine component's metal surfaces in sufficient quantity so when an engine is cold it should not be run fast or given a load. An aircraft will often be seen sitting still with the engine and propeller running while the engine oil comes up to temperature, just like a car in the winter.

CONFIRMATION OF TEACHING POINT 1

QUESTIONS

Q1. How does oil lubricate an engine?

Q2. Who specifies the correct oil for an engine?

Q3. What does the viscosity number of oil mean?

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ANTICIPATED ANSWERS

A1. Oil lubricates the engine by creating a smooth surface between parts that rub together.

A2. The manufacturer of the engine specifies the correct oil to use.

A3. The viscosity number indicates the oil's resistance to flow; the higher the number the greater the resistance.

Teaching point 2 **Compare Friction and Heat**

Time: 5 min Method: In-Class Activity

ACTIVITY

OBJECTIVE

The objective of this activity is to have the cadets experience the effects of lubrication.

RESOURCES

Hand cream.

ACTIVITY LAYOUT

N/A.

ACTIVITY INSTRUCTIONS

1. Have the cadets rub their hands together firmly to generate heat and friction.

2. Place a drop of hand cream on the palm of one of the cadets' hands and have them repeat the rubbing exercise.

3. Discuss the experience.

4. Ask cadets if their hands slid easier and felt cooler with hand cream.



Conduct a brief discussion to allow the cadets to share their experience with the class and to reflect on it:

- Did hands slide easier with hand cream? The answer should be yes.
- Did hands feel cooler with hand cream? The answer should be yes.

If a cadet does not agree that hands slide easier and that hot spots disappear when hand cream is applied, have them repeat the experiment. Ensure that hands are rubbed vigorously before hand cream is applied and apply hand cream generously.

SAFETY

N/A.

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CONFIRMATION OF TEACHING POINT 2

The cadets' participation in the activity will serve as the confirmation of this TP.

Teaching point 3 **Explain That Oil Seals the Combustion Chamber**

Time: 5 min Method: Interactive Lecture

SEALING

Oil seals the combustion chamber by preventing the expanding gases from leaking out during the power stroke. It does this by creating a barrier between the engine components so that air and other gases cannot get through. This is especially important in the cylinder, so that the exploding gasoline and air mixture does not escape.

Oil has conflicting demands to meet. A high viscosity (resistance to flow) provides the best seal for the combustion chamber but a low viscosity enables the oil to be delivered in greater quantity to bearing surfaces. The same oil must do both jobs and so the engine manufacturer must consider both of these competing requirements when specifying the viscosity and grade of oil to be used.

CONFIRMATION OF TEACHING POINT 3

QUESTIONS

Q1. What part of the engine does oil help seal and why?

Q2. How does oil provide a seal?

Q3. What conflicting demands must oil meet?

ANTICIPATED ANSWERS

A1. Oil seals the combustion chamber to prevent the expanding gases from leaking out.

A2. Oil seals engine parts by creating a barrier between them.

A3. Oil must be thin enough to flow to bearing surfaces but it must also be thick enough to seal the combustion chamber.

Teaching point 4 **Explain That Oil Cools Hot Spots in the Engine**

Time: 5 min Method: Interactive Lecture

COOLING

Some parts of the engine get hotter than other parts. Areas near the combustion chamber get particularly hot and need to be cooled. Oil cools hot spots in the engine by carrying heat away and equalizing temperature within the engine. This equalization of temperature also helps to bring a cold engine up to operating temperature quickly.

Oil must maintain its viscosity while near the heat of the combustion chamber and so manufacturers of oil have developed viscosity modifiers that lessen the change of viscosity that results from temperature change. Engine manufacturers take this into consideration when specifying what oil to use.

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CONFIRMATION OF TEACHING POINT 4

QUESTIONS

Q1. What engine parts get particularly hot?

Q2. How does oil cool hot spots in the engine?

Q3. What must oil be able to do near the combustion chamber?

ANTICIPATED ANSWERS

A1. Engine parts near the combustion chamber get particularly hot.

A2. Oil cools hot spots in the engine by carrying heat away and equalizing temperature.

A3. Oil must maintain its viscosity while near the heat of the combustion chamber.

Teaching point 5 **Explain That Oil Removes and Holds Particles Harmful to the Engine**

Time: 5 min Method: Interactive Lecture

FLUSHING

Oil flushes the engine. It removes and holds tiny particles and grit, which are harmful to the engine. This means the oil carries away dirt and debris from the engine as it flows through. This is why it is important to change oil at frequent intervals as specified by the engine manufacturer.

As the oil is continuously circulated around the engine it passes through an oil filter. This filter fills with debris and must also be changed at regular intervals to remain effective, just as in a car.



Distribute handouts of Figure B-1 and have the cadets fill in the four functions of oil.

CONFIRMATION OF TEACHING POINT 5

QUESTIONS

Q1. How does oil clean the engine?

Q2. Who specifies oil change intervals?

Q3. What component must be changed regularly, as well as the oil, to remain effective?

ANTICIPATED ANSWERS

A1. Oil removes and holds tiny particles and grit, which are harmful to the engine.

A2. The engine manufacturer specifies oil change intervals.

A3. The oil filter must be changed regularly to remain effective.

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END OF LESSON CONFIRMATION

QUESTIONS

Q1. What are the functions of oil in an engine?

Q2. Why must oil be changed according to the engine manufacturer's instruction?

Q3. What conflicting demands must oil meet?

ANTICIPATED ANSWERS

A1. The functions of oil in an engine are lubricating, sealing, cooling and flushing.

A2. Oil must be changed according to the engine manufacturer's instruction to extend engine life.

A3. Oil must be thin enough to flow to bearing surfaces but it must also be thick enough to seal the combustion chamber.

CONCLUSION

HOMEWORK/READING/PRACTICE

N/A.

METHOD OF EVALUATION

N/A.

CLOSING STATEMENT

Oil is of first importance to engine operation and maintenance and, if the manufacturer's directions are followed, it will prolong engine life.

INSTRUCTOR NOTES/REMARKS

N/A.

REFERENCES

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.

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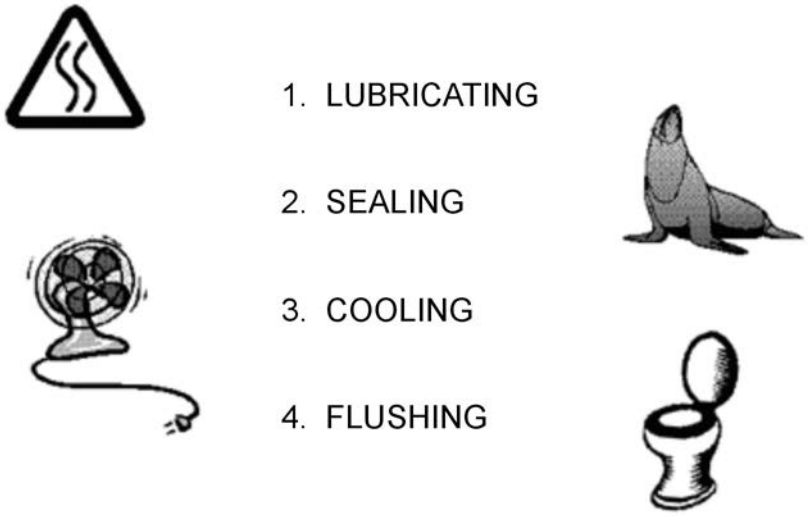
THE FUNCTIONS OF OIL



Cadets Canada: RCSU Pacific, 2007, Air Cadet Master Lesson Plans. Retrieved 7 March 2007, from http://www.regions.cadets.ca/pac/aircad/resources/mlp_air_e.asp

Figure A-1 Oil's Functions

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NAME OIL'S FUNCTIONS

NAME THE FOUR FUNCTIONS OF OIL.

NAME:_____

1.

2.

3.

4.



Cadets Canada: RCSU Pacific, 2007, Air Cadet Master Lesson Plans. Retrieved 7 March 2007, from http://www.regions.cadets.ca/pac/aircad/resources/mlp_air_e.asp

Figure B-1 Name Oil's Functions

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