

COURSE OUTLINE

COURSE: **Piston Engine Maintenance**

PROGRAM: 280.C0 Aircraft Maintenance Technology

DISCIPLINE: 280 Aeronautics

WEIGHTING: Theory: 1 Practical Work: 3 Personal Study: 1

Instructor(s)	Office	☎ ext	✉ Email or Web Site
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OFFICE HOURS

	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
Morning					
Afternoon					

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CONTEXT OF THIS COURSE IN THE PROGRAM

This course is given during the third semester of the program. By the end of the course, students will have developed their abilities to:

- Apply Transport Canada and manufacturers' laws, standards and regulations associated with overhauling and maintaining piston engines.
- Apply the different types of work and inspection procedures associated with piston engines.
- Use the various manuals and documents associated with piston engines.
- Run the engine and check for snags (defects) on the engine and its systems.
- Distinguish different types of work and inspection methods associated with piston engines.

Students must keep this course outline for the duration of their studies as it will be useful for the comprehensive assessment at the end of the program.

Transport Canada

This course outline meets the requirements of Training Organisation Certification Manual (MCF) of Transport Canada.

The Department applies Transport Canada standard which allows a maximum absence of 5% for the course (theory and laboratory). The department compiles absences of all students enrolled in Aircraft Maintenance (280.C0) and Avionics (280.D0) according to Transport Canada requirements. The application of Transport Canada policies regarding absences is available on the college website and in the student agenda under the heading « Privilèges accordés par Transports Canada ».

MINISTERIAL OBJECTIVE(S) AND COMPETENCIES

025Y To overhaul aircraft piston engines.

025V To inspect the operation of aircraft piston engines.

TEACHING AND LEARNING STRATEGIES

Theory:

A variety of pedagogical methods are used including presentations using a multi-media projector or the blackboard, use of propulsion models and engine parts, and lectures with formative exercises at the end of certain themes.

Practical Work:

Laboratory courses allow students to learn about maintaining piston engines and their peripheral systems. Using a variety of teaching methods, the practical work involves a hands-on approach to the internal inspection of components and maintaining the peripheral systems of piston engines as well as formal lectures on laboratory technologies that are reinforced with demonstrations.

COURSE PLAN – THEORY

The theoretical part of the course is divided into two main phases. The first phase covers documentation and procedures related to aircraft piston engine maintenance; the second phase, performance calculations, covers the calculation methods used to evaluate the performance of piston engines.

PHASE 1: General points about engines

ACTIVITY PERIODS: Weeks 1 to 8

MINISTERIAL OBJECTIVE 025Y: To overhaul aircraft piston engines

LEARNING OBJECTIVES: 1.1 to 2.2, 5.1, 6.1, 7.1, 8.1 and 9.6

Students will gather the necessary information and plan the work that needs to be done in order to carry out the necessary engine maintenance according to the manufacturer's recommendations and Transport Canada regulations.

CONTENT:

1.1 Consult the documentation and the regulations that apply to the piston engines being overhauled.

- Review procedures for hazardous materials and safe handling (WHMIS and the environment).
- Research the laws, regulations and standards specific to overhauling piston engines.
- Locate relevant documents for engine overhauls (MM, OM, IPC, SB, AD, etc.).

1.2 Explain the differences in model numbers of piston engines.

- Classify the models of piston engines used in class.

1.3 Locate and assemble documentation and regulations relevant to overhauling piston engines.

- Read historical overview of the engine being overhauled.
- Locate technical manuals corresponding to the engine being overhauled (MM, OM, IPC, SB).

1.4 Find the latest directives that relate to the engine being overhauled. (A.D.)

2.1 Identify the task that needs to be carried out.

- Determine the type of work according to the engine, the serial number, applicability; research items to be made according to the engine model and use.

2.2 Find and inspect documentation relevant to the task being carried out.

- Identify information, correctly interpret terms and technical information, have a basic knowledge of technical English.

5.1 Establish the type of inspection to be used.

- Determine whether to use visual, dimensional, liquid penetrant, or magnetic particle inspection; prepare parts (special cleaning as needed, product application).
- Take necessary precautions for the type of inspection chosen (gloves, safety glasses, etc.).

6.1 Interpret the manufacturer's instructions dealing with the repair being made.

- Identify the proper repair section in the manufacturer's manual.
- Carefully determine the procedure to observe, how to implement it and the degree of repair required.

7.1 Interpret the manufacturer's instructions.

- Use manufacturer's manuals such as *service or maintenance manuals*, tracking sheets and others.

8.1 Interpret documentation.

- Use manufacturer's manuals, technical sheets, drawings or others.

9.6 Complete necessary documentation to have engine certified.

- Label parts, fill out logbook, work cards and other documents as required.
- Certify work in compliance with Transport Canada and the manufacturer.

PHASE 2: Documentation (Weeks 2 and 3)

025V To inspect the operation of aircraft piston engines.

Learning Objectives: 1.8, 1.9, 1.10, 1.11

Content

1.8 Identify Transport Canada laws, standards and regulations associated with piston engines.

- Identify types of necessary documents, certification, definitions of terms, amendments, directives, sections of the CAR, etc.

1.9 Distinguish the different types of work and inspections associated with piston engines.

- Distinguish these inspections: daily, 100-hour, overhaul, rebuild, internal and external repairs, "on top", special.

1.10 Distinguish inspection methods according to manufacturer's standards.

- Distinguish visual, dimensional, liquid penetrant or magnetic particle inspections and others.

1.11 Use the various manuals and documents associated with piston engines.

- Use service or maintenance manuals, parts manuals, service bulletins, AD notes, SL, newsletters, logbooks, computers (ATP navigator) and others.
- Understand technical texts written in English.

Activities for Personal Study

Every week students must do the assigned readings before class. As the course progresses, they must also answer the formative questions in the course notes when applicable.

COURSE PLAN – LABORATORY

The laboratory part of the course is divided into two major themes: INSPECTING PISTON ENGINES AND VERIFYING COMPLIANCE.

In the practical part of the course, students are exposed to laboratory technology through a variety of teaching methods. Short lectures are generally followed by hands-on activities that allow students to develop a detailed understanding of the operation of aircraft piston engines and their systems.

THEME 1: Inspecting Piston Engines

ACTIVITY PERIOD: Weeks 1 to 8

MINISTERIAL OBJECTIVE 025V: Carry out activities related to inspecting the operation of aircraft piston engines.

LEARNING OBJECTIVES 2.1 to 2.3

CONTENT:

2.1 Prepare parts for inspection.

- Steps to follow :
 - Using the manufacturer's manuals, disassemble the engine, label and identify parts, secure parts (put them in the designated places, plug holes).
 - Carry out the work according to the prescribed work standards.
 - Use documents to check the type of inspection to be carried out (see 1.9).
 - Clean and prepare parts for inspection according the required procedure such as cleaning with varsol, alumiprep, sandblasting, etc.

2.2 Carry out the necessary operations for the parts to be inspected.

- Perform visual and dimensional inspections.
- Check limits prescribed by the manufacturer.

2.3 Complete appropriate documentation.

- Using the manufacturer's standards, check the condition of the parts and ensure that they are in compliance.
- Write a report of the inspection.
- Label parts according to their condition, use work cards, logbook and other permanent documentation.
- Certify that the work complies with Transport Canada and the manufacturer.

MINISTERIAL OBJECTIVE 025Y: Carry out activities related to overhauling aircraft piston engines.

LEARNING OBJECTIVES: 1.1 to 6.5

1.1 Consult the documentation and regulations relevant to the piston engines being overhauled.

- Review procedures for hazardous materials and safe handling. (WHMIS and the environment).
- Research the laws, regulations and standards specific to overhauling piston engines.
- Locate relevant documents for engine overhauls (MM, OM, IPC, SB, AD, etc.).

1.2 Explain the differences in model numbers of piston engines.

- Classify the models of piston engines used in class.

1.3 Locate and assemble documentation and regulations relevant to overhauling piston engines.

- Read historical overview of the engine being overhauled.
- Locate technical manuals that correspond to the engine being overhauled (MM, OM, IPC, SB).

1.4 Find the latest directives that relate to the engine being overhauled. (AD)

2.1 Identify the steps that need to be carried out.

- Determine the type of work according to the engine, the serial number, applicability; research items to be made according to the engine model and the use.

2.2 Find and inspect the documentation relevant to the tasks being carried out.

- Identify information, correctly interpret terms and technical information, have a basic knowledge of technical English.

2.3 Check the equipment needed to carry out the work.

- Know which tools and equipment are required and their proper use.
- Check equipment for condition and compliance.
- Check and be familiar with parts, model and serial numbers, applicability; know how to read labels on parts; check compliance and applicable laws.

2.4 Using the relevant documentation, plan operations in a logical order such as reading the documentation and determining the work to be carried out, removing and installing parts, inspecting, cleaning and reassembling, quarantine and completing relevant paperwork.

- Ensure compliance with health and safety regulations at work as well as the WHMIS system.

3.1 Implement directives appropriately.

- Read and understand documents related to the work being carried out.

3.2 Implement the method to be used.

- Choose the method, tools and equipment to be used.
- Know how to use equipment and which tools to use.
- Take precautions regarding parts and equipment.
- Visually inspect parts when removing them, identify defects and check manufacturer's limits.
- Monitor health and safety guidelines at work.

4.1 Use protective equipment and establish a safety zone around the work area.

- Implement safety rules for dismantling piston engines.
- Respect safety precautions when handling equipment.

4.2 Properly use special tools to disassemble piston engines.

- Use special tools (depending on the procedure).

4.3 Follow the procedure described in the manufacturer's manual for dismantling piston engines.

- Follow current practices for dismantling piston engines (labeling, filling holes, wrapping, putting on the shelf, storing, etc.).

4.4 Wipe clean, visually inspect, identify and store engine parts.

4.5 Prepare for the storage of engine parts (labeling, filling holes, wrapping, etc.).

4.6 Record information in relevant documents.

- Complete forms or use electronic media.
- Record observations and operations carried out.

5.1 Establish the type of inspection to be used.

- Determine whether to use visual, dimensional, liquid penetrant, or magnetic particle inspection; prepare parts (special cleaning as required, product application).
- Take necessary precautions according to the type of inspection chosen (gloves, safety glasses, etc.).

5.2 Perform required inspection using appropriate metrology instruments.

- Review how to use micrometer, table dial indicator, feeler gauge, depth gauge, etc.

5.3 Write an inspection report.

- Check manufacturer's limits; establish out-of-date components and actions to be taken to put the part back in service or quarantine it.
- Complete purchase orders for parts and verify applicability depending on the model.

6.1 Interpret manufacturer's instructions regarding the repair being carried out.

- Identify the proper repair section in the manufacturer's manual.
- Carefully determine the procedure to observe, how to implement it and the degree of repair required.

6.2 Analyse the snag (defect) to be repaired.

- Work from work document or other method.
- Determine the severity and extent of repairs needed using the manufacturer's documents.

6.3 Make necessary repairs.

- Respect safety standards.
- Choose the method and equipment required to make the repair.
- Follow the manufacturer's instructions in performing the repair.

6.4 Check the part and ensure compliance after the repair.

- Determine the condition of the part according to the manufacturer's standards.
- Determine the dimensions and appropriate coating of the part.

6.5 Complete necessary documentation for certification of the part to be returned to service.

- Make labels, complete work documents, etc.

THEME 2: Assembling engine, installing components and verifying compliance

ACTIVITY PERIODS: Weeks 9 to 15

MINISTERIAL OBJECTIVE 025Y: Carry out activities related to overhauling aircraft piston engines.

LEARNING OBJECTIVES: 7.1 to 10.3

CONTENT:

7.1 Interpret the manufacturer's instructions.

- Interpret manufacturer's manuals such as service or maintenance manuals, tracking sheets and others.

7.1 Assemble engine sub-assemblies.

- Using appropriate tools, assemble pistons, connecting rods, crankshaft, camshaft, crankcase, etc. according to the manufacturer's standards.
- Make necessary adjustments, review the use of required tightening torques, locking members such as safety wire, self-locking washers, pins and other recommended operations.

7.2 Respect safety standards.

- Properly use safety equipment such as safety glasses, boots, visors, gloves, as needed.
- Review the implementation of the WHMIS system.
- Take precautions with hazardous liquids, handle materials properly.

7.3 Properly use necessary materials, equipment and tools.

- Engine mounts, cable support, bridge or gin support and specialized tools properly.
- Work table, documentation, security zone, warning labels, equipment, parts, tools.

7.4 Complete appropriate documentation.

- Verify that the assembly is in compliance.
- Label parts, fill out logbook, work cards and other documents as required.
- Certify that work is in compliance with Transport Canada and the manufacturer.

8.1 Interpret documentation.

Manufacturer's manuals, sheets, drawings and others.

8.2 Observe occupational health and safety policies.

- Review use of protective equipment (safety glasses, gloves, boots, etc.) to work safely.

8.3 Check the condition and compliance of components to be installed.

- Check integrity of components, to ensure they are without any apparent defects and have certification labels.

8.4 Install required components.

- Check components, model and serial numbers, applicability.
- Associate the components with the task to be performed.
- Install components according to standards; use proper mounting procedures such as thermal processes, locking, torquing, etc.

8.5 Complete necessary documentation.

- Label parts, fill out logbook, workcards and other documents as required.
- Certify work complies with Transport Canada and the manufacturer.

9.1 Interpret engine-check tests.

9.2 Perform compliance tests on the engine.

- Perform cylinder differential pressure test.
- Start the engine according to the list of procedures; check operation.
- Perform tests for system leaks (oil, fuel, air).

9.3 Check the performance and limits prescribed by the manufacturer.

- Check performance calculations, make comparisons with manufacturer's graphics.
- Check torque and power.

9.4 Perform diagnostics and necessary repairs.

- Identify defects, verify the severity/cause, isolate the problem and make repairs as specified by the manufacturer and conduct necessary tests.
- Check pressure (oil, manifold intake, fuel), temperature (EGT, CHT), oil carburetion, ignition and other systems.

9.5 Make adjustments and final adjustments of the systems.

9.6 Complete necessary documentation to certify the engine.

- Label parts, fill out logbook, work cards and other documentation as required.
- Certify work in compliance with Transport Canada and the manufacturer.

10.1 Tidy and clean the work area.

- Put away equipment used such as buckets, ladders, lights, etc.
- Sweep the premises and ensure that the floor and work area are clean and safe.

10.2 Store in appropriate places the components, equipment and tools used such as scaffolding, jacks, adapters, cables, wrenches and others.

10.3 Implement health and safety rules at work.

- Dispose of liquids in the appropriate places.
- Dispose of rags and other toxic products used in the containers provided for this purpose.
- Ensure the cleanliness and safety of the premises.

PERSONAL STUDY ACTIVITIES: Every week students must do the assigned readings before the course. As the course advances, they are also expected to answer the formative questions in the course notes.

SYNTHESIS OF EVALUATION METHODS

Traditional and/or multiple choice evaluations are used.

Theory

Description of the evaluation activity	Context	Learning Objective(s)	Due Date (date assignment is due or exam date)	Weighting (%)
Exam 1	Individual; duration up to one and a half hour	1.1 to 2.2 – 5.1 – 6.1	Week 4	20%
Exam 2	Individual; duration up to one and a half hour	1.1 to 2.2 – 5.1 – 7.1 – 8.1 – 9.6	Week 8	20%

Sub-total : 40%

Practical Work

Description of the evaluation activity	Context	Learning Objective(s)	Due Date (date assignment is due or exam date)	Weighting (%)
Written and practical exam	Individual; duration up to 3 hours	<u>025 V</u> : 2.1 to 2.3 <u>025 Y</u> : 1.1 to 5.2	Week 6	20
Lab Report	In teams	<u>ALL</u>	Week 11	10
Practical Exam on the test bench.	In teams of 2 or 3	<u>025 Y</u> : 9.2 and 9.3 10.1 to 10.3	Weeks 13 or 14	10
Written Exam	Individual; duration up to 3 hours	<u>025 Y</u> : 6.1 to 10.3	Week 15	20

Sub-total: 60%

TOTAL: 100%

SCHEDULE OF THEORY AND PRACTICE COURSES

THEORY (Intensive) (2 X 1 period)		LABORATORY (3 periods)	
Practical maintenance	1.	<ul style="list-style-type: none"> Course outline. The AME. Technical documents. 	1. <ul style="list-style-type: none"> Course outline. <ul style="list-style-type: none"> Two students per team and engine distribution. Becoming familiar with computer and work tools. <ul style="list-style-type: none"> Tool box inventory. Find 0-320-E, 0-200-A manufacturer manuals. Security and aeronautical work methods. <ul style="list-style-type: none"> Torque, lockwire and WHMIS. Type certificate and S.T.C. <ul style="list-style-type: none"> Find TC 0-320-E and 0-200-A. Identify accessories and options.
	2.	<ul style="list-style-type: none"> Identifying different engines. Sequence of an aeronautical job. Work Labels. + Theme : differential pressure testing. 	2. <ul style="list-style-type: none"> Applying Airworthiness Directives (A.D.). <ul style="list-style-type: none"> Service Bulletin (S.B.) Service Instructions (S.I.). Lycoming 0-320-E. <ul style="list-style-type: none"> Oil pump (S.B.524) (S.I. 1341, 1164B, 1230B). or other application.
	3.	<ul style="list-style-type: none"> Top Overhaul. Concepts of piston engine maintenance. Engine snags. + Theme : ignition, magnetos. 	3. <ul style="list-style-type: none"> (continuation) A.D., S.B., S.I. Lycoming 0-320-E. <ul style="list-style-type: none"> Exhaust valve guide. (S.B. 388C) (S.I. 1425A). or other application.
Engine maintenance	4.	Evaluation 1.5 hour (20%)	4. <ul style="list-style-type: none"> (continuation) A.D., S.B., S.I. Continental 0-200-A. <ul style="list-style-type: none"> Differential pressure and borescope inspection (SB03-3). or other application.
	5.	<ul style="list-style-type: none"> Exam revision. Inspection modules, measuring instruments, N.D.T. Inspections according to the maintenance schedule. + Theme : propeller strike, immersion, lighting. 	5. <ul style="list-style-type: none"> (continuation) A.D., S.B., S.I. Continental 0-200-A. <ul style="list-style-type: none"> Magneto synchronization Bendix and Slick. (MSB94-8D). or other application.
	6.	<ul style="list-style-type: none"> Test Bench, engine instruments, snags and troubleshooting. + Theme : screening of technical problems. 	6. Evaluation (20%) <ul style="list-style-type: none"> Theoretical (open book). Practical. <ul style="list-style-type: none"> «TIMING MAG» / Differential pressure on engine. or other.

C.A.R.	7.	<ul style="list-style-type: none"> Regulations for piston engines maintenance. A.M.O. specialized maintenance. Maintenance release. 	Cylinder overhaul	7.	<ul style="list-style-type: none"> Exam revision. Top overhaul. Lycoming 0-320-E (½ engine per team). <ul style="list-style-type: none"> Theory reminder/Engine distribution. - Removal of one cylinder per student. 			
	8.	Final evaluation 1.5 hour (20%)		8.	<ul style="list-style-type: none"> (continuation) Top overhaul. <ul style="list-style-type: none"> Disassembly of cylinder and visual inspection. 			
<p>WEB sites and You tube references :</p> <ul style="list-style-type: none"> Lycoming engine oil pump replacement Photos S.I. Valve/Guide Lycoming 0-320: Photos Cylinder default Magneto theory Aircraft magneto operation and component description Magneto to engine timing Check the timing on aircraft magnetos Annual condition inspection power plant Compression test How to do a compression test on an engine DVD : Engine overhaul 0-320 SkyWard Tech. Inc. www.actechbooks.com/products/Act 405 			Cylinder overhaul	9.	<ul style="list-style-type: none"> (continuation) Top overhaul. <ul style="list-style-type: none"> Dimensional inspection. 			
			10.	<ul style="list-style-type: none"> (continuation) Top overhaul. <ul style="list-style-type: none"> End of inspection and cylinder assembly. 				
			11.	<ul style="list-style-type: none"> (continuation) Top overhaul. <ul style="list-style-type: none"> Assembly and cost analysis report (10%) on maintenance overhaul. <div style="background-color: #cccccc; padding: 5px;"> <p>Note : If progress on the program, possibility : - opening and closing of crankcase/crankshaft Inspection : Propeller strike - immersion - lightning Or participation on another project.</p> </div>				
						Test Bench	12.	<ul style="list-style-type: none"> Test bench engine troubleshooting Lycoming IO-540 with 3 blades variable pitch propeller OR Radial R-985 Demonstrations: <ul style="list-style-type: none"> Starting, fix point, cruise.... Snag interpretation (bench, engine). Engine performance evaluation.
						13.	<p>Practical test bench evaluation (10%) Teams of 2 in rotation during weeks 13 and 14. The team is able to:</p> <ul style="list-style-type: none"> Start, warm-up, fix point... Cruise, take data and evaluate HP, S.F.C... 	
14.	<p>Practical test bench evaluation (continuation) Note : If needed, students can use course 13 and 14 to complete the assembly of their engine.</p>							
			Test Bench	15.	<p>Final evaluation (20%)</p>			

The periods of the activities in the course outline of the propulsion department are for illustrative purposes only. Changes could be made to these periods to fit logistical problems

REQUIREMENTS TO PASS THE COURSE

(1) Passing Mark

The passing mark for this course is 60%, this is calculated based on combined marks of theoretical and practices (Labs).

(2) Presence at Summative Evaluations

Presence is required at summative evaluations.

(3) Submitting Assignments

Assignments must be submitted by the date, place and time determined by the instructor. Any assignment submitted after the due date will be penalized 10% per day for each day it is late up to a week. After one week, the assignment will receive a zero (0) unless other arrangements have been made with the instructor.

(4) Presentation of Written Work

The full text of these policies and regulations is accessible on the Cégep web site at the following address: <http://ena.cegepmontpetit.ca/l-ecole/reglements-et-politiques>. If there is a disparity between shortened versions of the text and the full text, the full text will be applied and will be considered the official version for legal purposes.

REQUIRED MATERIAL

- Course notes and appropriate manual as specified by the instructor at the beginning of the session.
- Calculator (ENA).
- Overalls (ENA).
- Rag (ENA).
- Safety glasses (clear lens).
- Safety shoes or boots.
- Mechanic's gloves.
- Ear plugs (available in class).

MEDIAGRAPHY:

Books in English:

<u>Aircraft Fuel Metering Systems</u> , International Aviation Publishers	629.134351C891a
<u>Aircraft Powerplants</u> , Kroes & Wild	629.13435M158a
<u>Airframe and Powerplant Mechanics</u> , AC65-12A, FA A	629.1343E83a-4
<u>Illustrated Parts Catalog for C-75, C-85, C-90 and 0-200 Aircraft Engines</u> , X30011A1985 Teledyne Continental Motors	
<u>Sky Ranch Engineering Manual</u> , John Schwaner	629.134353S398s

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INSTITUTIONAL POLICIES AND REGULATIONS

All students enrolled at cégep Édouard-Montpetit must become familiar with and comply with the institutional policies and regulations. In particular, these policies address learning evaluations, maintaining admission status, French language policies, maintaining a violence-free and harassment-free environment, and procedures regarding student complaints. The French titles for the policies are: *Politique institutionnelle d'évaluation des apprentissages, les conditions particulières concernant le maintien de l'admission d'un étudiant, la Politique de valorisation de la langue française, la Politique pour un milieu d'études et de travail exempt de harcèlement et de violence, les procédures et règles concernant le traitement des plaintes étudiantes.*

The full text of these policies and regulations is accessible on the Cégep web site at the following address: <http://ena.cegepmontpetit.ca/l-ecole/reglements-et-politiques>. If there is a disparity between shortened versions of the text and the full text, the full text will be applied and will be considered the official version for legal purposes.

OTHER DEPARTMENTAL REGULATIONS

Students are encouraged to consult the website for the specific regulations for this course:
<http://guideena-en.cegepmontpetit.ca/department-rules/>

APPENDIX

Activity periods written in the course outline for the Propulsion Department serve as a general guideline. Modifications may be made to accommodate any logistical problems that may arise.