ÉCOLE NATIONALE D'AÉROTECHNIQUE
UN CAMPUS DU CÉGEP ÉDOUARD-MONTPETIT

280-6A6-EM
WINTER 2018
Pre-Flight department

COURSE OUTLINE

COURSE: **Structural Repairs on Composites, Wood, Fabric and Metal**

PROGRAM: 280.C0 Aircraft Maintenance Technology

DISCIPLINE: 280 Aeronautics

WEIGHTING: Theory: 2 Practical Work: 4 Personal Study: 1

Instructor(s)	Office	☎ extension	✉ email or web site
Éric Jetté	C-182	4615	eric.jette@cegepmontpetit.ca

OFFICE HOURS

	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
Morning					
Afternoon					

Coordinator(s)	Office	☎ extension	✉ email or web site
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CONTEXT OF THIS COURSE IN THE PROGRAM

This course is offered during the sixth session of the Aircraft Maintenance Program.

By the end of this course, students will have developed:

- Dexterity with tools.
- Research skills in technical manuals
- Knowledge of materials and hardware.
- Ability to repair laminated or sandwich-type composites.
- Ability to carry out repairs using moulds.
- Ability to carry out repairs using wood and fabric.
- Ability to install and remove different types of fasteners.
- Ability to provide a preliminary report of a major repair that complies with the applicable manufacturer's standards.

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 ».

COMPETENCIES OF THE EXIT PROFILE (STUDENT SKILL PROFILES)

Maintain aircraft structures.

MINISTERIAL OBJECTIVES AND COMPETENCIES

0261 Maintain the metal structures and structural components of an aircraft.

0262 Maintain aircraft structures and structural components made of composite materials, wood and fabric.

TERMINAL OBJECTIVE OF THE COURSE (FINAL COURSE OBJECTIVE)

At the end of this course, the student will know the nomenclature of a composite structure. He will be able to assess the severity of a damage, make a plan for its repair and finally, with the necessary tools, he will be able to perform the appropriate structural repair.

TEACHING AND LEARNING STRATEGIES

THEORY

The theoretical part of the Structural Repairs on Composites is organized into various themes :

- Composite materials
- Hardware
- Aircraft constraints and structures
- Repair procedures
- Preliminary report
- Techniques for working with wood and fabric

Exercises and class discussions will be used as a strategy to develop the necessary skills for routine aircraft maintenance. Directed research in technical manuals and multimedia elements will complement learning.

PRACTICAL WORK

In the laboratory, the instructor will use hands-on demonstrations to guide students regarding the use of various measuring instruments. The practical assignments will allow students to acquire manual dexterity and the necessary competence for aircraft maintenance technicians. The repair projects carried out during the session are designed to provide students with practical experience using various repair methods on the materials being studied according to aeronautical standards. All of this complies with the health and safety work procedures applicable to the aviation industry.

COURSE PLAN – THEORETICAL PART

Ministerial objectives	Competence elements	Learning objectives
0261 To maintain the metal structures and structural components of an aircraft.	#1. Become familiar with objectives and requirements.	1. Recognize the stresses that are applied to metal structural members. (different complex cases of the course Structural Repairs 1)
	#3. Plan the work to be carried out	1. Choose the action to take based on the results of the inspection.
		2. Organize the work environment according to the work to be done.
		3. Choose the repair according to the norms and the constraints of operations.
		4. Submit a preliminary report of a structural repair.
	#4. Remove the damaged parts.	1. Clear the damaged area.
	#5. Perform repairs on non-pressurized and pressurized aircraft structures.	1. Perform a repair on a structure of a pressurized aircraft (coating, extruded parts, formed parts, machined parts).
		2. Plan a tubular repair according to AC 43.13-1A.
	#6. Inspect the quality of the work done.	1. Select and use the measurement tools to verify the conformity of an assembly to the technical drawings and aeronautical standards.
		2. Write a work report.
		3. Take into account the requirements of the regulations concerning repairs and modifications to aircraft structures.
	#7. Tidy and clean the work area.	1. Apply health and safety standards for the work performed.
		2. Use hazardous materials standards.
		3. Store tools and equipment.
		4. Clean the work area.
0262 To maintain aircraft structures and structural components made of composite materials, wood and fabric.	#1. Become familiar with objectives and requirements.	1. Distinguish the materials used on wooden and canvas aircraft.
		2. Recognize the stress that are applied by composite structural members.
		3. Recognize the aeronautical uses of composite materials.
		4. Distinguish the materials used on wooden and canvas aircraft.
		5. Explain the repair procedures for composite materials
		6. Explain the structure of the structural repair manuals.
		7. Identify in a structural repair manual and other publications information relevant to wood composite structures, canvas.
		8. Recognize the risks and hazards to health and safety.
	#2. Inspect the damaged parts.	1. Identify the damage.
		2. Identify the cause of the damage
		3. Inspect aircraft structures and components made of wood, canvas and composite materials.
		4. Follow the path of constraints in adjacent structures.
		5. Identify in the structural repair manuals the tolerances of the damaged areas.
		6. Compare the results of the inspection with the specifications of the structural repair manuals.
	#3. Plan the work to be carried out.	1. Choose the action to take based on the results of the inspection.
		2. Choose the repair according to the norms and constraints of operations.
		3. Submit a preliminary report of a structural repair.
		4. Submit a preliminary report of a structural repair.
		5. Choose tools based on selected material characteristics and repair techniques.
	#4. Perform the preliminary work required to repair the damaged parts.	1. Clear the damaged area.
	#5. Install or repair the covering of an aircraft component.	1. Test a fabric section.
		2. Perform a fabric repair according to AC 43.13-1A.
		3. Perform a repair on wood component according to AC 43.13-1A.
	#6. Make a mould out of composite materials.	1. Make a mold according to an existing model.
		2. Make a part using the mold.
	#7. Repair an element made of composite materials.	1. Perform repairs on a laminated and "sandwich" type aircraft component.
		2. Perform a repair on a "sandwich" type construction aircraft component.
		3. Replace a specific fastener to the composite material.
		4. Perform treatment to an authorized damage.
	#8. Tidy and clean the work area.	1. Apply health and safety standards for the work performed.
		2. Use hazardous materials standards.
		3. Store tools, equipment and work area.
		4. Clean the work area.

0261 Maintain the metal structures and structural components of an aircraft.

Block 1: Review of Metal Structural Repairs

Learning Objective	Content	Personal Study Activities
Review of Metal Structural Repairs course (various complex cases from the Structural Repairs 1 course)	• Constraints applied to structural members • Structure of SRM manuals • Applicable regulation requirements	• Consult website for 280-616. • Consult recommended readings • Review personal notes
Schedule a tubular repair as per AC43.13-1A.	• Cutting angle • Typical repairs on internal and external sleeves • Rosette welding	

0262 Maintain aircraft structures and structural components made of composite materials, wood and fabric.

Block 2 : Materials: technical and technological criteria

Learning Objective	Content	Personal Study Activities
Distinguish wood and fabric materials used on aircraft.	• Varieties of wood • Adhesives • Organic fabric • Synthetic fabric • Coatings • Additives	• Consult website for 280-616. • Consult recommended readings • Review personal notes
Distinguish composite materials and related materials used on aircraft.	• Fibres • Resins • Adhesives • Core materials • Mould releasing agent • Film and fabric bagging • Main types of fasteners used	
Recognize the aeronautical use of composite materials.	• Structural use • Non structural use	
Recognize manufacturing techniques for composite parts	• Laminated • NIDA	
Recognize the limitations applied to structural members made of composites	• Tension • Compression • Shearing • Bending • Torsion • Flight area	
Explain repair methods for composite materials.	• Fibre-resin mixture • Vacuuming • Polymerisation - Ambient temperature - Covering • Heat curing	• Consult website for 280-616. • Consult recommended readings • Review personal notes

Learning Objective	Content	Personal Study Activities
Recognize health and safety risks and hazards.	• WHMIS • Standards and guidelines applicable to the material and the technique used	

Block 3 : Work on Composites

Learning Objective	Content	Personal Study Activities
Identify the damage.	• Crumpling, cracking, wrinkling, friction, scratch, hollow, notch, break, bulge, buckling, veiling, erosion, delamination, blisters, bulges, nick, void, wear, corrosion, brittleness	• Consult website for 280-616. • Consult recommended readings • Review personal notes
Identify the cause of the damage.	• Possible causes: - Contamination - Collision - Fatigue - Lightning strike - Heat	
Follow the path of constraints in the adjacent structures.	• Tension • Compression • Shearing • Bending • Torsion • Bending moment • Shear	
Locate information relevant to composite, wood and fabric structures in a manual of structural repairs and other publications.	• Structure and content of the structural repair manual - Structure categories - Restricted areas - Aerodynamic zones - Material specifications - Information on damage - Classes of damage - Treatment - Repair - Replacement	
Choose the action to take based on the results of the inspection.	• Treatment • Typical repair • Specific repair • Temporary repair • Replacement	• Consult website for 280-616. • Consult recommended readings • Review personal notes
Choose the repair according to the standards and operation limitations.	• Structural repair manual • Airworthiness standards and time constraints related to available time and work area. • Workplace	
Submit a preliminary report of structural repairs.	• Sketch • Justify choice • Procedures	

Week	Duration	Theoretical Content	Block
1	2	Introduction to Composites	**2**
2	2	Characteristics of Composite Materials	**2**
3	2	Characteristics of Composite Materials	**2**
4	2	Pre-impregnated, cores	**2**
5	2	Composite Construction	**2**
6	2	Health and safety, bagging	**2**
7	2	Exam 1	**2**
8	2	Curing and assembly	**2**
9	2	Evaluations of a repairs	**1,3**
10	2	SRM major repairs	**1,3**
11	2	Presentation of the assignment, CTA visit	**3**
12	2	Flight domain constraint, tubular structure	**1, 2, 3**
13	2	Wood and Fabric Materials	**2, 3**
14	2	New Trends	**1, 2, 3**
15	2	Exam 2	**1, 2 ,3**

COURSE PLAN – PRACTICAL PART

FOR ALL ACTIVITIES IN THE LABORATORIES AND IN THE HANGARS, THE FOLLOWING OBJECTIVES APPLY AND WILL BE PART OF THE EVALUATION CRITERIA

Learning Objective	Content	Personal Study Activities
Clear damaged area.	• Procedures for interior removal of the fittings and remove damaged section without attacking the adjacent structure size of the damage according to a regular geometric shape	Any activity that improves manual dexterity
Locate information relevant to composite, wood and fabric structures in a manual of structural repairs and other publications.	• Structure and content of the structural repair manuals: - Structure classes - Restricted areas - Aerodynamic zones - Material specifications - Information on damage - Classes of damage - Treatment - Repair - Replacement	
Choose the actions to take depending on the nature of the work to be done.	• Treatment • Typical repair • Specific repair • Temporary repair • Replacement	
Organize the actions to take depending on the nature of the work to be done.	▪ Structural repair manual ▪ Airworthiness standards ▪ Available time ▪ Organize the work area - Rigor - Communication - Cleanliness - Health and safety	
Choose the tools according to the characteristics of the materials and the repair techniques that were chosen.	• Characteristics of - Fibres - Resins - Adhesives - Core materials - Finishes • Procedures for using tools and equipment: - Cutting tools - Sanding tools - Tools for removing from mould - Finishing tools - Cleaning equipment - Assembly tools	
Select and use measurement tools to check compliance of an assembly with technical drawings and aviation standards	• Ruler • Micrometer • Calliper • Protractor • Compass • Tools for balancing the controls • Structural alignment	

Learning Objective	Content	Personal Study Activities
Prepare various reports.	▪ Registration of technical problem ▪ Preliminary report ▪ Work report	
Apply health and safety standards related to the work that was done.	▪ Compliance with standards and guidelines	
Use standards on hazardous materials.	▪ Workplace Hazardous Materials Information System (WHMIS) ▪ Use of product data sheets and precautions for handling	
Store tools and equipment	▪ Following instructions	
Clean the work area	▪ Following instructions	

0261 Maintain the metal structures and structural components of an aircraft.

Block 1: Metal Work

Learning Objective	Content	Personal Study Activities
Perform a repair on a pressurized aircraft structure (coating, extruded parts, formed parts, machined parts).	• Procedure to repair a pressurized structure • Interpretation of a drawing • Use of tracing, cutting, drilling, riveting, assembling, shaping and finishing tools • Protecting materials • Sealants • Interior layout	Any activity that improves manual dexterity
Schedule a tubular repair as per AC 43.13-1A.	• Cutting angle • Typical repairs of internal and external sleeves • Rosette welds	

0262 Maintain aircraft structures and structural components made of composite materials, wood and fabric.

Block 2: Knowledge of Materials

Learning Objective	Content	Personal Study Activities
Distinguish composite materials and related materials used on aircraft.	• Fibres • Resins • Adhesives • Core materials • Mould releasing agents • Film and fabric bagging • Main types of fasteners used	Any activity that improves manual dexterity
Distinguish wood and fabric materials used on aircraft.	• Varieties of wood • Adhesives • Organic fabric • Synthetic fabric • Coatings • Additives	

Block 3 : Inspection composite

Learning Objective	Content	Personal Study Activities
Identify damage and the causes.	• Crumpling, cracking, wrinkling, friction, scratch, hollow, notch, break, bulge, buckling, veiling, erosion, delamination, blisters, bulges, nick, void, wear, corrosion, brittleness	Any activity that improves manual dexterity
Inspect structures and aircraft components in wood, fabric and composite materials.	• Measuring tools • Structural alignment • NDT methods	
Compare inspection results with the specifications in the structural repair manuals.		

Block 4 : Wood and Fabric Work

Learning Objective	Content	Personal Study Activities
Conduct a trial test with a section of fabric covering	• Tensile Test • Maule Test	Any activity that improves manual dexterity
Perform a repair as per AC 43.13-1A.	• AC 43.13-1A specifications • Cleaning material • Part size • Part cut • Heat shrinkage • Fungicide coating • Stiffening piece • Aluminum pigmented coating • Colour coating • Work report	
Perform a repair on a wood composite as per AC 43.13-1A.		

Block 5: Composite Work

5.1 Mould

Learning Objective	Content	Personal Study Activities
Make a mould from an existing model.	• Choose the material • Develop manufacturing steps • Use mould release product • Teat and install the fibres on the model • Polymerize • Install mould supports • Remove the mould from the model	Any activity that improves manual dexterity
Make a part using the mould.	• Choose the material for the part to be made • Develop the manufacturing steps • Use mould release product • Add finishing coat • Treat and install fibres on the model • Put under vacuum • Polymerize • Unmould the part • Size and finish the part • Check quality of the work • Write work report	

Block 5: Composite Work

5.2 Minor Repairs

Learning Objective	Content	Personal Study Activities
Perform treatment to authorized damage	• Patching compound • Resin injection • Surface finish • Material protection	Any activity that improves manual dexterity

Block 5: Composite Work

5.3 Major Repair

Learning Objective	Content	Personal Study Activities
Perform repairs on a laminated and sandwich-type aircraft component	• Follow a procedure • Interpret a drawing • Use tracing, cutting, sanding, assembling and finishing tools. • Prepare mould material • Locate and superimpose reinforcements • Respect the order of the superimposition of the bagging products. • Perform polymerization • Add repair finish • Check work quality • Write work report	Any activity that improves manual dexterity

Learning Objective	Content	Personal Study Activities
Perform a repair on a sandwich-constructed aircraft component.	• Follow a procedure • Interpret a drawing • Use tracing, cutting, sanding, assembling and finishing tools. • Prepare mould material • Orient and secure core material. • Orient and superimpose reinforcements • Respect the order of the superimposition of bagging products • Perform polymerisation • Finish repair • Check work quality • Write a work report	
Replace a specific fastener to the material.	• Follow a procedure • Prepare a composite section to install fasteners. • Install fastener • Check work quality	

Week	Duration	Practical work content	Block
1	4	Presentation & fiberglass laminated plate	**2**
2	4	Partial penetration & pyrolysis	**2, 3**
3	4	Repair with mould & mini wing project	**5**
4	4	Repair with mould & mini wing project	**5**
5	4	Repair with mould & mini wing project	**5**
6	4	Repair with mould & mini wing project	**5**
7	4	Exam 1	**2**
8	4	Mini-wing project (leading edge mould + trailing edge)	**1**
9	4	Repair of landing gear door & mini wing project	**4,5**
10	4	Repair of honeycomb & mini wing project	**4,5**
11	4	Repair of honeycomb & mini wing project	**4,5**
12	4	Repair with pre-impregnated & mini wing project	**4,5**
13	4	Inspection panel installation & fabric covering	**4, 5**
14	4	Inspection panel installation & fabric covering	**4, 5**
15	4	Exam 2	**5**

SYNTHESIS OF SUMMATIVE EVALUATION METHODS - THEORY

Description of Evaluation Activity	Context	Learning Objective(s)	Évaluation criterias	Due Date (date assignment is due or exam period)	Weighting (%)
Assignment	Individual	Bloc 2	See 3rd week instructions	4th	5
Exam 1	Individual	Bloc 2	See 6th week instructions	6th	10
Research, repair as per SRM	Team	Blocs 1, 2, 3	See 11th week instructions	12th	10
Exam 2	Individual	Blocs 1, 2, 3	See 14th week instructions	15th	15

Sub-total: 40%

SYNTHESIS OF SUMMATIVE EVALUATION METHODS – PRACTICAL PART

Description of Evaluation Activity	Context	Learning Objective(s)	Évaluation criterias	Due Date (date assignment is due or exam period)	Weighting (%)
Inspection report	Individual	Block 2	Relevance of observations	4th	8
Exam 1	Individual / team As per evaluation grid	Blocks 2, 3, 4, 5	terminology mixing repair	7th	15
Different projects	Individual / team As per evaluation grid	Blocks 1, 2, 4, 5	quality dof the repair according to the instructed standards	3th to 14th	12
Exam 2	Individual	Blocks 2, 3, 5	❶	15th	25

Sub-total: 60%

TOTAL: 100%

❶ Relevance of observations, accuracy of dimensions, tolerances, compliance with standards in repair steps, rigorous recording, choice of tools and equipment, proper use of tools, precise calculations, careful removal and laying.

REQUIRED MATERIAL

In the laboratory, safety glasses, safety shoes or boots and coveralls are mandatory.

The following text is required for the course Composite Structural Repair (280-616)

ADVANCED COMPOSITES, Cindy Foreman, Jeppesen, JS312645, Englewood, Colorado, 2002, 200 pages.

MEDIAGRAPHY

Internet site for this course: **http://www.collegeem.qc.ca/ena/preenvol/pmenard/**

ACCEPTABLE METHODS, TECHNIQUES AND PRACTICES; V. 1: AIRCRAFT INSPECTION AND REPAIR, AC 4313-1A, V. 2: AIRCRAFT ALTERATIONS, AC 4313-2A, , Department of Transportation. Federal Aviation Administration. Washington D.C., U.S. Government Printing Office, 1977, 2 volumes.

CARE AND REPAIR OF ADVANCED COMPOSITES, Keith B. Armstrong ,SAE International, 2005, 664 pages.

AIRCRAFT STRUCTURAL TECHNICIAN, Dale Hurst , Avotek Publishing, Harrisonburg, Virginia, 2001, 272 pages.

STANDARD AIRCRAFT HANDBOOK, Leavell, Stuart et Stanley BUNGAY., 3d ed., Fallbrook, Calif., Aero, 1980, 159 pages.

UNDERSTANDING AIRCRAFT STRUCTURE, John Cutler, Granada publishing Ltd, Frogmore (England), 1981, 170 pages.

CELLULES ET SYSTÈMES D`AÉRONEFS, Didier Féminier, Modulo Éditeur, Mont-Royal, 1982, 315 pages. Chapitres 1 à 4, page 1 à 69.

ADVANCED COMPOSITE MATERIAL CHAPTER 7 AMT AIRFRAME HANDBOOK VOLUME 1 FAA-H8083-31
HTTP://WWW.FAA.GOV/REGULATIONS_POLICIES/HANDBOOKS_MANUALS/AIRCRAFT/AMT_AIRFRAME_HANDBOOK/MEDIA/AMA_CH07.PDF

REQUIREMENTS TO PASS THE COURSE

(1) Passing Mark

The passing mark for this course is 60% (PIEA, article 5.1m).

(2) Attendance for Summative Evaluations

Attendance is mandatory for summative evaluations (PIEA, article 5.2.5.1)..

(3) Submitting Assignments

All assignments must be submitted by the date, time and place designated by the teacher. Any class or homework assignment handed in late will be penalized. The **penalties** associated with delays are set **according to the departemental rules** (PIEA, article 5.2.5.2).

(4) Presentation of Written Work

Students must follow the standards adopted by the Cégep for written work (« *Normes de présentation matérielle des travaux écrits* »). These can be found in the documentation centre on the Cégep web site www.cegepmontpetit.ca/normes. under the heading ***Liens éclair*****, Bibliothèques, « Méthodologie » (**des centres de documentation du Cégep)**.**

The **departemental penalities** concerning non-compliance with the standards for assignement presentation (PIEA, article 5.3.2) are : http://guideena.cegepmontpetit.ca/regles-des-departements/.

METHOD OF COURSE PARTICIPATION

SAFETY RULES IN THE HANGAR

1. No running
2. Take precautions with loose clothing when using rotary tools. (For example: tie, sleeves, long hair must be tied back).
3. Workshop and hand tools may be used only after demonstration.
4. No work in workshops without the supervision of a teacher.
5. Small pieces of metal to drill (manual or column) must be held in place with a clamp
6. All hazardous products (e.g. M.E.K.) must be used in a room with adequate ventilation (painting room).
7. Do not sit on the equipment tables in the workshop.
8. Everyone must follow instructions according to the visual and aural signals in case of fire.
9. All accidents must be reported to authorized personnel; notify security if first aid measures do not suffice.

SAFETY RULES FOR WORKSHOP EQUIPMENT

1. Clean the workshop after each course (tables, workbenches, floor, etc.).
2. Clean workshop tools after each use (drill, sander, grinder, etc.).
3. No aluminum or non-ferrous material on the grinding wheels.
4. Respect material indications on the band saws.
5. Return workshop equipment to the appropriate place after use.
6. Report any defective equipment or tools.
7. Correctly maintain the classification of rivets and bolts.

OTHER DEPARTMENTAL REGULATIONS

Students are encouraged to consult the website for healt and safety regulations :
http://guideena.cegepmontpetit.ca/sante-et-securite/

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

NOTE: This Course Outline is a translation of the *Plan de cours* for 280-616-EM: *Réparation de structures en composite, bois, toile et métal*. If there is a discrepancy, then the original French version will be considered the official version for legal purposes.

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 d'admission et cheminement scolaire, la Politique relative à l'usage, à la qualité et à la 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 College 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.