

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 ».

MINISTRY OBJECTIVES OR 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.

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

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) | <ul style="list-style-type: none"> • Constraints applied to structural members • Structure of SRM manuals • Applicable regulation requirements | <ul style="list-style-type: none"> • Consult website for 280-616. • Consult recommended readings • Review personal notes |
| Schedule a tubular repair as per AC43.13-1A. | <ul style="list-style-type: none"> • 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. | <ul style="list-style-type: none"> • Varieties of wood • Adhesives • Organic fabric • Synthetic fabric • Coatings • Additives | <ul style="list-style-type: none"> • Consult website for 280-616. • Consult recommended readings • Review personal notes |
| Distinguish composite materials and related materials used on aircraft. | <ul style="list-style-type: none"> • Fibres • Resins • Adhesives • Core materials • Mould releasing agent • Film and fabric bagging • Main types of fasteners used | |
| Recognize the aeronautical use of composite materials. | <ul style="list-style-type: none"> • Structural use • Non structural use | |
| Recognize manufacturing techniques for composite parts | <ul style="list-style-type: none"> • Laminated • NIDA | |
| Recognize the limitations applied to structural members made of composites | <ul style="list-style-type: none"> • Tension • Compression • Shearing • Bending • Torsion • Flight area | |
| Explain repair methods for composite materials. | <ul style="list-style-type: none"> • Fibre-resin mixture • Vacuuming • Polymerisation - Ambient temperature - Covering • Heat curing | <ul style="list-style-type: none"> • Consult website for 280-616. • Consult recommended readings • Review personal notes |
| Recognize health and safety risks and hazards. | <ul style="list-style-type: none"> • 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. | <ul style="list-style-type: none"> • Crumpling, cracking, wrinkling, friction, scratch, hollow, notch, break, bulge, buckling, veiling, erosion, delamination, blisters, bulges, nick, void, wear, corrosion, brittleness | <ul style="list-style-type: none"> • Consult website for 280-616. • Consult recommended readings |
| Identify the cause of the damage. | <ul style="list-style-type: none"> • Possible causes: <ul style="list-style-type: none"> - Contamination - Collision - Fatigue - Lightning strike - Heat | <ul style="list-style-type: none"> • Review personal notes |
| Follow the path of constraints in the adjacent structures. | <ul style="list-style-type: none"> • 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. | <ul style="list-style-type: none"> • Structure and content of the structural repair manual <ul style="list-style-type: none"> - 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. | <ul style="list-style-type: none"> • Treatment • Typical repair • Specific repair • Temporary repair • Replacement | <ul style="list-style-type: none"> • Consult website for 280-616. • Consult recommended readings • Review personal notes |
| Choose the repair according to the standards and operation limitations. | <ul style="list-style-type: none"> • Structural repair manual • Airworthiness standards and time constraints related to available time and work area. • Workplace | |
| Submit a preliminary report of structural repairs. | <ul style="list-style-type: none"> • Sketch • Justify choice • Procedures | |

Course Outline 280-6A6-EM: Structural Repairs on Composites, Wood, Fabric and Metal

| 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 | |
| 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 | |

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. | <ul style="list-style-type: none"> • 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. | <ul style="list-style-type: none"> • Structure and content of the structural repair manuals: <ul style="list-style-type: none"> - 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. | <ul style="list-style-type: none"> • Treatment • Typical repair • Specific repair • Temporary repair • Replacement | |
| Organize the actions to take depending on the nature of the work to be done. | <ul style="list-style-type: none"> ▪ Structural repair manual ▪ Airworthiness standards ▪ Available time ▪ Organize the work area <ul style="list-style-type: none"> - Rigor - Communication - Cleanliness - Health and safety | |
| Choose the tools according to the characteristics of the materials and the repair techniques that were chosen. | <ul style="list-style-type: none"> • Characteristics of <ul style="list-style-type: none"> - Fibres - Resins - Adhesives - Core materials - Finishes • Procedures for using tools and equipment: <ul style="list-style-type: none"> - 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 | <ul style="list-style-type: none"> • Ruler • Micrometer • Calliper • Protractor • Compass • Tools for balancing the controls • Structural alignment | |

Course Outline 280-6A6-EM: Structural Repairs on Composites, Wood, Fabric and Metal

| Learning Objective | Content | Personal Study Activities |
|--|--|----------------------------------|
| Prepare various reports. | <ul style="list-style-type: none"> ▪ Registration of technical problem ▪ Preliminary report ▪ Work report | |
| Apply health and safety standards related to the work that was done. | <ul style="list-style-type: none"> ▪ Compliance with standards and guidelines | |
| Use standards on hazardous materials. | <ul style="list-style-type: none"> ▪ Workplace Hazardous Materials Information System (WHMIS) ▪ Use of product data sheets and precautions for handling | |
| Store tools and equipment | <ul style="list-style-type: none"> ▪ Following instructions | |
| Clean the work area | <ul style="list-style-type: none"> ▪ Following instructions | |
| Demonstrate professional skills. | <ul style="list-style-type: none"> • Dexterity • Quality of work • Performance • Communication • Ability to understand and follow through | |
| Demonstrate personal skills | <ul style="list-style-type: none"> • Interest at work • Sense of responsibility • Relationship with others | |

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). | <ul style="list-style-type: none"> • 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. | <ul style="list-style-type: none"> • 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. | <ul style="list-style-type: none"> • 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. | <ul style="list-style-type: none"> • 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. | <ul style="list-style-type: none"> • 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. | <ul style="list-style-type: none"> • 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 | <ul style="list-style-type: none"> • Tensile Test • Maule Test | Any activity that improves manual dexterity |
| Perform a repair as per AC 43.13-1A. | <ul style="list-style-type: none"> • 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. | <ul style="list-style-type: none"> • 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. | <ul style="list-style-type: none"> • 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 | <ul style="list-style-type: none"> • 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 | <ul style="list-style-type: none"> • 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 |
| Perform a repair on a sandwich-constructed aircraft component. | <ul style="list-style-type: none"> • 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. | <ul style="list-style-type: none"> • Follow a procedure • Prepare a composite section to install fasteners. • Install fastener • Check work quality | |

Course Outline 280-6A6-EM: Structural Repairs on Composites, Wood, Fabric and Metal

| 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 | |
| 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 | |

SYNTHESIS OF SUMMATIVE EVALUATION METHODS - THEORY

| Description of Evaluation Activity | Context | Learning Objective(s) | Due Date (date assignment is due or exam period) | Weighting (%) |
|------------------------------------|------------|-----------------------|---|---------------|
| Assignment | Individual | Bloc 2 | 4 th | 5 |
| Exam 1 | Individual | Bloc 2 | 6 th | 10 |
| Work and research | Team | Blocs 1, 2, 3 | 12 th | 10 |
| Exam 2 | Individual | Blocs 1, 2, 3 | 15 th | 15 |

Sub-total: 40%

SYNTHESIS OF SUMMATIVE EVALUATION METHODS – PRACTICAL PART

| Description of Evaluation Activity | Context | Learning Objective(s) | Due Date (date assignment is due or exam period) | Weighting (%) |
|------------------------------------|---|-----------------------|---|---------------|
| Inspection report | Individual | Block 2 | 4 th | 8 |
| Exam 1 | Individual / team As per evaluation grid | Blocks 2, 3, 4, 5 | 7 th | 15 |
| Different projects | Individual / team As per evaluation grid | Blocks 1, 2, 4, 5 | 3 th to 14 th | 12 |
| Exam 2 | Individual | Blocks 2, 3, 5 | 15 th | 25 |

Sub-total: 60%

TOTAL: 100%

REQUIREMENTS TO PASS THE COURSE

(1) Passing Mark

The passing mark for this course is 60%.

(2) Attendance for Summative Evaluations

Attendance is mandatory for summative evaluations.

(3) Submitting Assignments

All assignments must be submitted by the date, time and place designated by the instructor. Any class or homework assignment handed in late will be penalized 10% per day that it is late and will receive a mark of zero (0) after one week.

<http://guideena-en.cegepmontpetit.ca/department-rules/>

(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 center on the Cégep web site www.cegepmontpetit.ca/normes under the heading **Liens éclair, Bibliothèques, « Méthodologie »**.

CONDITIONS FOR CLASS 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 the security guards if first aid measures are not sufficient.

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.

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.

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* (PIEA), *la Politique institutionnelle de la langue française* (PILF), *la Politique pour un milieu d'études et de travail exempt de harcèlement et de violence* (PPMÉTEHV), *les Conditions d'admission et cheminement scolaire*, *la Procédure concernant le traitement des plaintes étudiantes dans le cadre des relations pédagogiques*.

The full text of these policies and regulations is accessible on the Cégep web site at the following address: <http://www.cegepmontpetit.ca/ena/a-propos-de-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 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.