

COURSE OUTLINE

COURSE: **Metal Structural Repair**

PROGRAM: 280.C0 Aircraft Maintenance

DISCIPLINE: 280 Aeronautics

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

Instructor(s)	Office	☎ extension	✉ e-mail or website
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OFFICE HOURS

	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
Morning					
Afternoon					

Dep. Coordinator(s)	Office	☎ Extension	✉ Email or Website
Goudreault, Éric	C-160	4691	eric.goudreault@ena.ca
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CONTEXT OF THIS COURSE IN THE PROGRAM

This course is offered during the third session of the program. By the end of the course, students will have developed:

- dexterity with the tools and equipment;
- research skills using technical manuals;
- familiarity with materials and hardware;
- the ability to propose a preliminary report of a major repair;
- the ability to make major repairs to an aircraft frame and skin

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) according to Transport Canada requirements. The application of Transport Canada policies regarding absences is available on the [Ma réussite à l'ÉNA](#) website under the heading « Privilèges accordés par Transports Canada ».

COMPETENCIES OF THE EXIT PROFILE (STUDENT SKILL PROFILES)

The student will perform maintenance on aircraft structural parts.

MINISTERIAL OBJECTIVE(S) AND COMPETENCIES

- 025X** Conduct cleaning, inspection and protect aircraft materials (reinvestment only)
025Z Prepare and assemble sheet metal
0261 Maintain metal structures and structural components of an aircraft

TERMINAL OBJECTIVE OF THE COURSE (FINAL COURSE OBJECTIVE)

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

PEDAGOGICAL ORIENTATIONS

Theory

The theoretical part of the course "Metal Structural Repair" is composed of different themes:

Riveting - Bending of aluminum sheets - Introduction to aluminum structures - Construction of an aluminum structure - Inspection of an aluminum structure - Tools for working aluminum sheet - Repairing an aluminum structure - Special fasteners - Aircraft center of gravity - Control surface balancing - Alignment and structural symmetry

Exercises and discussions in class will be used as a strategy to allow students to develop the necessary skills to perform maintenance on aircraft. Research assignments in technical manuals and the use of multimedia tools will reinforce the learning process.

Practical Work

During the laboratory periods, the instructor will guide students with practical demonstrations of different tools and measuring instruments. Students will acquire manual dexterity and the competence necessary to be aircraft maintenance technicians through a variety of practical exercises that involve evaluating damage, treating corrosion and other observed defects. The different minor repair projects during the session will be assembled by riveting according to aeronautical standards. All activities will comply with the health and safety procedures applicable to the aeronautical industry.

COURSE PLAN – THEORY

Competence 025Z: To prepare and assemble sheet metal

Learning Objective	Content	Personal Study Activities
1- Describe methods of shaping and assembly of sheet metal.	<ul style="list-style-type: none"> ▪ Techniques of shaping sheet metal ▪ Techniques of assembly ▪ Hardware: <ul style="list-style-type: none"> - Solid rivets; - Blind rivets; - High-stress fasteners; - Specialized fasteners. 	<ul style="list-style-type: none"> ▪ Review weekly formative questionnaire ▪ Consult course website (280-376). ▪ Consult recommended readings. ▪ Review personal notes.
2- Describe the characteristics of sheet metal tools and demonstrate their operation.	<ul style="list-style-type: none"> ▪ Rules, characteristics and operation of cutting, measuring, marking, folding and finishing tools 	
3- Recognize the risks to health and safety.	<ul style="list-style-type: none"> ▪ Safe handling ▪ Standards and guidelines that apply to the materials and technique used. 	
4- Interpret technical drawings.	<ul style="list-style-type: none"> ▪ Structural repair manual ▪ Technical drawing 	
5- Prepare and perform bending.	<ul style="list-style-type: none"> ▪ Steps to follow : <ul style="list-style-type: none"> - Establish the dimensions; - Draw a line of sight; - Bend using a press brake - Measure an angle 	

Competence 0261: To maintain the metal structures and structural components of an aircraft

Learning Objective	Content	Personal Study Activities
1- Identify the structural members	<ul style="list-style-type: none"> ▪ frames ▪ spars ▪ ribs ▪ stringers ▪ skin ▪ struts ▪ reinforcements (stiffeners) ▪ bulkheads 	<ul style="list-style-type: none"> ▪ Review weekly formative questionnaire ▪ Consult course website (280-376). ▪ Consult recommended readings. ▪ Review personal notes.
2- Recognize the stresses applied to the metal structural members.	<ul style="list-style-type: none"> ▪ Tension ▪ Compression ▪ Shearing ▪ Bending ▪ Torsion ▪ Flight control area 	
3- Explain the structure of structural repair manuals.	<ul style="list-style-type: none"> ▪ ATA Classification ▪ Manufacturers' Manuals 	
4- Identify the causes of damage.	<ul style="list-style-type: none"> ▪ Possible causes : <ul style="list-style-type: none"> - corrosion - collision - fatigue - lightning strike - heat 	
5- Follow the path of stresses in the adjacent structures to detect damage.	<ul style="list-style-type: none"> ▪ Tension ▪ Compression ▪ Shearing ▪ Bending ▪ Torsion ▪ Bending moment ▪ Shear force 	

Course outline 280-3A6-EM: Metal Structural Repair

Learning Objective	Content	Personal Study Activities
6- Identify the tolerances of damaged areas in the structural repair manuals.		
7- Determine the action to take following the inspection.	<ul style="list-style-type: none">▪ Treatment▪ Typical repair▪ Specific repair▪ Temporary repair▪ Replacement	
8- Write a work report.	<ul style="list-style-type: none">▪ Preliminary report▪ Work report	

PERIODS OF THEORETICAL ACTIVITIES

- Activity 1** • Course presentation
 • Presentation of the Course Outline
 • Theory: Types of structures, Riveting review, Metal protection

- Activity 2** • Theory: Bending of sheet metal

- Activity 3** • Theory: Doublers (Insertion), Corner and box bends

- Activity 4** • Theory: Structure loads and stresses

- Activity 5** • **Exam # 1**

- Activity 6** • Theory: Special mechanical fasteners

- Activity 7** • Theory: Flowchart of a structural repair

- Activity 8** • Theory: Typical Repair (Part 1)

- Activity 9** • Theory: Typical Repair (Part 2)

- Activity 10** • **Exam # 2**

- Activity 11** • Theory: Rivet calculation

- Activity 12** • Theory: Control surfaces Balancing, Structure symmetry and alignment

- Activity 13** • Theory: Weight and balance

- Activity 14** • **Exam # 3**

SYNTHESIS OF SUMMATIVE EVALUATION METHODS: THEORY

Description of Evaluation Activity	Context of realization and mode of evaluation	Learning Objective(s)	Due Date (approximate date assignment due or exam given)	Weighting (%)
Exam # 1, on the notions activity periods 1 to 4	Individual, written exam, (without notes)	025Z (1) 0261 (1, 2, 3, 5)	5 th Activity period	10
Exam # 2, on the notions activity periods 6 to 9	Individual, written exam, (without notes)	All objectives of the skills 025Z and 0261	10 th Activity period	10
Exam # 3, on the notions activity periods 11 to 13	Individual, written exam, (without notes)	All objectives of the skills 025Z and 0261	15 th Activity period	20

Total: 40 points

COURSE PLAN – PRACTICAL WORK (LABORATORY)

Competence 025X: To clean, inspect and protect aircraft materials (reinvestment only)

Learning Objective	Content	Personal Study Activities
Review of course material Minor repairs	<ul style="list-style-type: none"> ▪ Treat damage that has been authorized ▪ Polish damage ▪ Drill stop holes ▪ Filling compound ▪ Reinforcement and plug ▪ Protection of the materials 	All activities aimed at improving manual dexterity.

Competence 025Z: To prepare and assemble sheet metal

Learning Objective	Content	Personal Study Activities
Recycling of course material Minor repairs	<ul style="list-style-type: none"> ▪ Consult structural repair manual for general tolerances and the type of minor or major repair. ▪ Use appropriate measuring tools. ▪ Assess damage regarding tolerances, standards and specifications. ▪ Treat for authorized damage. ▪ Eliminate and treat for corrosion 	All activities aimed at improving manual dexterity.

Learning Objective	Content	Personal Study Activities
1- Describe the characteristics of sheet metal tools and demonstrate their operation.	<ul style="list-style-type: none"> ▪ Rules, characteristics and operation of cutting, measuring, tracing, bending and finishing tools. 	All activities aimed at improving manual dexterity.
2- Choose tools depending on the shaping and assembly technique used in the repair work.	<ul style="list-style-type: none"> ▪ How to use tools and repair equipment. ▪ Planning ▪ Organising 	
3- Interpret technical drawings.	<ul style="list-style-type: none"> ▪ Structural Repair Manual ▪ Technical drawing 	
4- Size and trim materials.	<ul style="list-style-type: none"> ▪ Calculations of developed pieces of sheet metal ▪ Measurements ▪ Portable cutting tool ▪ Fixed cutting tool 	
5- Prepare and perform bending	<ul style="list-style-type: none"> ▪ Steps to follow : <ul style="list-style-type: none"> - Establish the dimensions; - Draw a line of sight; - Bend with a press brake; - Measure an angle 	
6- Prepare and perform riveting.	<ul style="list-style-type: none"> ▪ Steps to follow : <ul style="list-style-type: none"> - Select the rivet - center - drill - deburr - mill - rivet installation using mobile and fixed tools; - install mechanical rivets - remove the rivets 	

Learning Objective	Content	Personal Study Activities
7- Finish the shaped and assembled part	<ul style="list-style-type: none"> ▪ File and polish 	
8- Select and use measurement tools to check assembly compliance with technical drawings and aeronautical standards.	<ul style="list-style-type: none"> ▪ Ruler ▪ Micrometer ▪ Vernier. ▪ Protractor 	
9- Respect the health and safety standards related to the work performed.	<ul style="list-style-type: none"> ▪ Respect standards and instructions. 	
10- Store tools and equipment. Clean the work area.	<ul style="list-style-type: none"> ▪ Follow instructions ▪ Professionalism 	

Competence 0261: To maintain the metal structures and structural components of an aircraft.

Learning Objective	Content	Personal Study Activities
1- Identify damage on parts.	<ul style="list-style-type: none"> ▪ Wrinkling, cracking, folds, rubbing, scratching, hollows, notches, breaks, swelling, buckling, warping, erosion, delamination, blisters, bumps, cuts, vacuum, wear, corrosion, brittleness 	All activities aimed at improving manual dexterity.
2- Inspect structures and metal components on the aircraft to identify damage.	<ul style="list-style-type: none"> ▪ Measuring tools ▪ Structural alignment ▪ NDT methods 	
3- Follow the path of stresses in the adjacent structures to detect damage	<ul style="list-style-type: none"> ▪ Tension ▪ Compression ▪ Shearing ▪ Bending ▪ Torsion ▪ Bending moments ▪ Shear force 	
4- Identify the tolerances of the damaged areas in the structural repair manuals.		
5- Compare the inspection results with the specifications for structural repair manuals.		
6- Determine the action to take based on the inspection results	<ul style="list-style-type: none"> ▪ Treatment ▪ Typical repair ▪ Specific repair ▪ Temporary repair ▪ Replacement 	
7- Organize the work environment based on the work that needs to be done.	<ul style="list-style-type: none"> ▪ Structural repair manual ▪ Airworthiness standards ▪ Temps available ▪ Workplace 	
8- Perform a repair on an unpressurized aircraft structure (skin, extruded parts, molded parts, machined parts).	<ul style="list-style-type: none"> ▪ Following a procedure ▪ Interpreting a drawing ▪ Using marking, cutting, drilling, riveting, assembly, shaping and finishing tools. ▪ Protection of materials ▪ Sealants ▪ Interior set up 	

Learning Objective	Content	Personal Study Activities
9- Perform a repair on a pressurized aircraft structure (skin, extruded parts, molded parts, machined parts).	<ul style="list-style-type: none"> ▪ Following a procedure ▪ Interpreting a drawing ▪ Using marking, cutting, drilling, riveting, assembly, shaping and finishing tools. ▪ Protection of materials ▪ Sealants ▪ Interior set up 	
10- Select and use measurement tools to verify compliance of an assembly with technical drawings and aeronautical standards.	<ul style="list-style-type: none"> ▪ Ruler ▪ Micrometer ▪ Vernier ▪ Protractor ▪ Compass ▪ Flight control balancing tools ▪ Structural alignment 	
11- Write a work report.	<ul style="list-style-type: none"> ▪ Preliminary report ▪ Work report 	
12- Respect the health and safety standards related to the work done.	<ul style="list-style-type: none"> ▪ Respecting standards and instructions 	
13- Use the standards for hazardous materials.	<ul style="list-style-type: none"> ▪ Using the information system on hazardous materials at work (WHMIS) ▪ Using material safety data sheets and following precautions when handling. 	
14- Put away tools and equipment and clean up the work area.	<ul style="list-style-type: none"> ▪ Following instructions ▪ Professionalism 	
15- Demonstrate professional skills.	<ul style="list-style-type: none"> ▪ Dexterity. ▪ Organization. ▪ Planning. ▪ Autonomy. ▪ Quality of work. ▪ Cleanliness at work. ▪ Yield. ▪ Health safety. ▪ Communication. ▪ Ability to understand and execute. 	
16- Demonstrate personal skills.	<ul style="list-style-type: none"> ▪ Interest in work. ▪ Punctuality. ▪ Attendance. ▪ Sense of responsibility. ▪ Relationship with others. ▪ Judgment. 	

PERIODS OF LABORATORY ACTIVITIES

- Week # 1
- Sheet metal paper plane
 - Formative evaluation: Tin paper plane
- Week # 2
- Fuselage round reinforcement
- Week # 3
- Formative evaluation: Round fuselage reinforcement
 - Homework: Wings bending presses
- Week # 4
- Homework verification: Wing bending presses
 - Bending practice
 - Precision bending of the wings of the biplane
- Week # 5
- Work on the biplane
 - Presentation Exam # 1
- Week # 6
- **Exam # 1: Manufacture and installation of an L-shaped stringer (10/60)**
- Week # 7-8-9
- Repair of the L-shaped stringer
 - **Summative evaluation: Repair of the L-shaped stringer (10/60)**
 - **Summative evaluation: The biplane (5/60)**
- Week # 10
- Manufacture and installation of a Z-rail
 - Formative Evaluation: Manufacture and installation of a Z-shaped stringer
- Week # 11-12-13-14
- Repair of skin near a Z-shaped stringer
- Week # 14
- **Summative evaluation: Repair of skin near a Z-shaped stringer (10/60)**
 - (Homework) Drafting of the repair document
- Week # 15
- **Exam # 2: Repair of the free flange of a Z-shaped stringer (25/60)**

SYNTHESIS OF SUMMATIVE EVALUATION METHOD: PRACTICAL WORK

Description of the evaluation activity	Context of realization and method of evaluation	Learning objective(s)	Due Date (approximate date assignment due or exam given)	Weighting (%)
Manufacture and installation of a Z-Stringer	Individually, practical work	025Z (1 to10) 025X	6 th Activity period	10
Evaluation criteria: Accuracy of calculations, accuracy of drawing, dimensional accuracy of the manufactured part, precision and cleanliness of rivets executed, assembly corresponding to the drawing, cleanliness of the assembly.				
Repair of Skin near L-Stringer.	Individually, practical work	025Z (2, 3, 4, 5, 6, 7, 8) 0261 (1, 2, 6, 7, 8, 10, 11, 12, 13, 14)	8 th Activity period	10
Evaluation criteria: Dimensional accuracy of the repair, precision and cleanliness of the rivets executed, assembly corresponding to the drawing, cleanliness of the assembly.				
Building a biplane	Individually, practical work	025Z (2, 3, 4, 5, 6, 7, 8) 0261 (1, 2, 6, 7, 8, 10, 11, 12, 13, 14)	9 th Activity period	5
Evaluation criteria: Dimensional accuracy of the repair, precision and cleanliness of the rivets executed, assembly corresponding to the drawing, cleanliness of the assembly.				
Repair of skin near a Z-shaped stringer	Individually, practical work	025Z (2, 3, 4, 5, 6, 7, 8) 0261 (1, 2, 6, 7, 8, 10, 11, 12, 13, 14)	14 th Activity period	10
Evaluation criteria: Dimensional precision of the assembly, precision and cleanliness of the rivets executed, assembly corresponding to the drawing, cleanliness of the assembly.				
Repair of the free flange of a Z-shaped stringer	Individually, practical work	025X and 025Z (2, 3, 4, 5, 6, 7, 8, 9, 10) 0261 (7, 8, 10, 11)	7 th Activity period	25
Evaluation criteria: Dimensional precision of the assembly, precision and cleanliness of the rivets executed, assembly corresponding to the drawing, cleanliness of the assembly.				

Total 60 points

REQUIRED MATERIAL

In the laboratory, safety glasses, safety boots/shoes are mandatory. Authorized clothing for students are ÉNA overalls OR ÉNA polo and black work pants only.

MEDIAGRAPHY

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.

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

STANDARD AIRCRAFT HANDBOOK, Leavell, Stuart et Stanley BUNGAY, 3^e éd., Fallbrook, Calif., Aero, 1980, 159 pages.

AIRCRAFT SHEET METAL, Nick Bonaci, International Aviation Publisher, EA-SM, Casper (Wyoming), 1987, 134 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, pages 1 à 69.

A & P TECHNICAL AIRFRAME TEXTBOOK, Jeppesen, EA-ITP-A², Englewood, Colorado, 1992, 794 pages, chapitres 3, 5 et 6.

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 at summative assessment activities is mandatory (PIEA article 5.2.5.1)

(3) Submitting Assignments

Homeworks required by a teacher must be submitted to the date, the place and time set. The penalties associated with delays are established according to departmental rules (PIEA, section 5.2.5.2).

In case of delay penalties are:

- See section « Règles des départements » at the following link:
<http://guideena-en.cegepmontpetit.ca/departement-rules/>
<https://mareussite.cegepmontpetit.ca/ena/mon-parcours/mon-programme/regles-departementales>

(4) Presentation of Written Work

The instructor(s) will provide students with information and guidelines regarding the presentation of written work. When the presentation of an assignment is unacceptable, the work will be penalized as a late assignment until an acceptable version is submitted. In this case, the penalties for late work will be applied.

Students must follow the standards adopted by the Cégep for written work (« *Normes de présentation matérielle des travaux écrits* »). These can be found at: <http://rmsh.cegepmontpetit.ca/normes-de-presentation-materielle-des-travaux-ecrits-du-cegep/>.

The **departmental penalties** for non-compliance with Written Work Standard Presentation (PIEA, article 5.3.2) are:

<http://guideena-en.cegepmontpetit.ca/departement-rules/>
<https://mareussite.cegepmontpetit.ca/ena/mon-parcours/mon-programme/regles-departementales>

METHODS OF COURSE PARTICIPATION

Safety Regulations for Workshop Personal

1. Running is prohibited.
2. Loose clothing and hair must be pulled back, tightened or tucked in when using rotational equipment (e.g. ties, sleeves, long hair).
3. Hand tools and workshop equipment are to be used only after a demonstration.
4. No work may be done in the workshop without the supervision of an instructor.
5. Small metal parts to be drilled (manually or with a drill press) must be held in place with clamps.
6. All dangerous products should be used in a ventilated area (paint shop).
7. Sitting on the workbenches or machines is prohibited.
8. Visual and auditory instructions in case of a fire must be followed by everyone.
9. Any accident must be reported to authorized staff; the guard must be notified if first aid is not sufficient.

Safety Regulations for Workshop Equipment

1. Clean the workshop after each course (tables, workbenches, floor, etc.)
2. Clean workshop equipment after each use (drill press, sandblaster, grinder, etc.)
3. No aluminum material or non-ferrous material may be used on the grinders.
4. Respect directives regarding materials when using the bandsaw.
5. Return all workshop equipment to its appropriate place after use.
6. Report any defective or damaged equipment or tools.
7. Correctly maintain the classification of rivets or bolts.

OTHER DEPARTEMENTAL REGULATIONS

Students are encouraged to consult the website for the specific regulations for this course:

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

<https://mareussite.cegepmontpetit.ca/ena/mon-parcours/mon-programme/regles-departementales>

INSTITUTIONAL POLICIES AND REGULATIONS

All students enrolled in the École Nationale d'aérotechnique of Édouard-Montpetit CEGEP must be aware of and comply with the contents of institutional policies and regulations. In particular, the *Politique institutionnelle de la langue française (PILF)*, the *Politique pour un milieu d'études et de travail exempt de harcèlement et de violence (PPMÉTEHV)*, the *conditions of admission and academic progress*, the *procedure dealing with student complaints within educational relations*.

The complete version of these policies and regulations is available on the CEGEP website at the following address: <http://www.cegepmontpetit.ca/ena/a-propos-de-l-ecole/reglements-et-politiques>. In case of discrepancy between the version appearing elsewhere and the complete version, the complete version will be applied and will be considered the official version for legal purposes.

THE ADAPTED SERVICE CENTER (CSA) - FOR STUDENTS WITH DISABILITIES

Students having received a professional diagnosis of impairment (motor skills, neurological, organic, sensory, learning difficulties, mental health, autism spectrum disorder or other) or suffering from a temporary medical condition may request special accommodations.

Students seeking these accommodations must forward their diagnosis to the CSA by either MIO to "Service, CSA-ENA" or email to "servicesadaptesena@cegepmontpetit.ca".

<https://mareussite.cegepmontpetit.ca/ena/mes-ressources/soutien-aux-apprentissages/centre-de-services-adaptes/>.

APPENDIX

None.