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# Outline Airframe – Part 1, Structures, Curriculum

## Instructional Units, Segments and Estimated Instructional Time

### Wood Structures

(Meets the requirements of Part 147, Appendix C-Airframe Structure-A)

1. Service and repair wood structures  
Ref: 147-C-A1 – 7.5 hrs Level 1
  - A. Judge the suitability of substitute materials Level 1
  - B. Describe the kinds of glues and gluing techniques Level 1
  - C. Read drawing pertaining to repair of wood structures Level 1
  - D. Repair of elongated bolt holes Level 1
  - E. Identify protective finishes Level 1
2. Identify wood defects  
Ref: 147-C-A2 - 2.0 hrs Level 1
  - A. Identify defect in wood samples Level 1
3. Inspect wood structures  
Ref: 147-C-A3 - 3.0 hrs Level 1
  - A. Identify kinds of woods Level 1

Estimated Instructional Time: 12.5 hrs

### Aircraft Covering

(Meets the requirements of Part 147, Appendix C-Airframe Structure-B)

4. Select and apply fabric and fiberglass covering materials  
Ref: 147-C-B4 – 3.5 hrs Level 1
  - A. Identify fabrics and seams; and describe methods of applying fabric Level 1

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- 5. Inspect, test, and repair fabric and fiberglass  
Ref: 147-C-B5 – 13.0 hrs Level 1
- A. Inspect, test and repair fabric covering Level 1

Estimated Instructional Time: 16.5 hrs

**Aircraft Finishes**

(Meets the requirements of Part 147, Appendix C-Airframe Structure-C)

- 6. Apply trim, Letters, and touchup paint  
Ref: 147-C-C6 – 2.0 hrs Level 1
- A. Draw registration numbers and describe the application  
of trim designs Level 1
- 7. Identify and select aircraft finishing materials  
Ref: 147-C-C7– 3.0 hrs Level 2
- A. Identify finishing materials and thinners Level 2
- 8. Apply finishing materials  
Ref: 147-C-C8 – 22.0 hrs Level 2
- A. Apply dope Level 2
- B. Spray, primers, dope and paints Level 2
- 9. Inspect finishes and identify defects  
Ref: 147-C-C9 – 3.0 hrs Level 2
- A. Inspect finishes and recognize defects Level 2

Estimated Instructional Time: 30.0 hrs

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## Sheet Metal and Nonmetallic Structures

(Meets the requirements of Part 147, Appendix C-Airframe Structure-D)

10. Select, install, and remove special fasteners for metallic, bonded, and composite structures  
Ref: 147-C-D10 – 15.0 hrs Level 2
- A. Aircraft type of special rivets and fasteners Level 2
  - B. Select acceptable holes and install hi-shear, blind rivets and deicer boot fasteners Level 2
  - C. Remove and replace special rivets and fasteners Level 2
11. Inspect bonded structures  
Ref: 147-C-D11 – 9.0 hrs Level 2
- A. Inspect and repair metal sandwich structures Level 1
  - B. Evaluate damage to bonded structure and determine type of repair needed. Level 2
12. Inspect, test, and repair fiberglass, plastics, honeycomb, composite, and laminated primary and secondary structures  
Ref: 147-C-D12– 11.0 hrs Level 2
- A. Identify and repair plastic, fiber and fiberglass aircraft materials Level 2
  - B. Repair damaged areas in fiberglass aircraft Level 2
13. Inspect, check, service, and repair windows, doors, and interior furnishings  
Ref: 147-C-D13 – 12.0 hrs Level 2
- A. Recognize distinguishing characteristics of transparent plastic and plate glass enclosures Level 2
  - B. Clean, protect, repair and secure transparent plastic aircraft enclosures Level 2
  - C. Inspect and check pressure seals doors and windows, seat recline mechanisms and safety bet installations Level 2

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14. Inspect and repair sheet metal structures  
Ref: 147-C-D14 – 44.0 hrs Level 3
- A. Select and use twist drills and countersinks Level 3
  - B. Select and use hand files for soft metals Level 3
  - C. Repair shallow scratches in sheet metal Level 2
  - D. Repair a slightly oversized hole by reaming for next larger size rivet Level 3
  - E. Prepare dissimilar metals assembly Level 2
  - F. Describe loads in fuselage and wing structures and types of overload failures Level 1
  - G. Make minor repairs to stress-skin wings Level 2
  - H. Determine conditions of stressed skin structures, which has been critically loaded Level 2
  - I. Construct a watertight joint Level 2

15. Install conventional rivets  
Ref: 147-C-D15 – 21.0 hrs Level 3
- A. Identify conventional aircraft rivets Level 3
  - B. Perform riveting to FAA specifications Level 3
  - C. Identify, remove and replace improperly installed rivets Level 3

16. Form, lay out, and bend sheet metal  
Ref: 147-C-D16 – 34.0 hrs Level 3
- A. Make a joggle in aluminum sheet Level 2
  - B. Prepare a layout for a bend in aircraft sheet metals Level 3
  - C. Layout and make bends in sheet metal Level 3
  - D. Form aluminum parts by bumping Level 3

Estimated Instructional Time: 146.0 hrs

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## Welding

(Meets the requirements of Part 147, Appendix C-Airframe Structure-E)

17. Weld magnesium and titanium Ref: 147-C-E17 – 2.0 hrs	Level 1
A. Welding of magnesium and titanium	Level 1
18. Solder stainless steel Ref: 147-C-E18– 1.0 hrs	Level 1
A. Silver solder of stainless steel	Level 1
19. Fabricate tubular structures Ref: 147-C-E19 – 6.0 hrs	Level 1
A. Tubular steel fabrication and repair by welding	Level 1
20. Solder, braze, gas-weld, and arc-weld steel Ref: 147-C-E21 – 32.5 hrs	Level 2
A. Preparation and precautions before soldering, brazing and welding	Level 1
B. Solder electrical connections and make lap joint	Level 2
C. Repair steel parts by welding	Level 2
21. Weld aluminum and stainless steel Ref: 147-C-E21 – 3.5 hrs	Level 1
A. Inspect and weld aluminum and titanium	Level 1
Estimated Instructional Time:	45 hrs

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## Aircraft Finishes

(Meets the requirements of Part 147, Appendix C-Airframe Structure-F)

22. Rig rotary-wing aircraft  
Ref: 147-C-F22 – 8.0 hrs Level 1
- A. Use nomenclature applicable to rotary wing aircraft Level 1
23. Rig fixed-wing aircraft  
Ref: 147-C-F23 – 9.0 hrs Level 2
- A. Use correct aircraft nomenclature Level 1
- B. Interpret theory of flight Level 2
24. Check alignment of structures  
Ref: 147-C-F24 – 10.0 hrs Level 2
- A. Verify alignment of structures Level 2
25. Assemble aircraft components, including flight control surfaces  
Ref: 147-C-F25 – 7.0 hrs Level 3
- A. Assemble components Level 3
26. Balance, rig, and inspect movable and secondary flight control surfaces  
Ref: 147-C-F26 – 24.0 hrs Level 3
- A. Identify aircraft control cable. Level 2
- B. Verify correct control response. Level 3
- C. Install and tension a control cable, inspect a cable control system Level 3
- D. Check static balance of control surface Level 3
- E. Inspect and adjust push-pull control systems Level 3
27. Jack aircraft  
Ref: 147-C-F27 – 3.0 hrs Level 3
- A. Jack aircraft Level 3
- Estimated Instructional Time: 61.0 hrs

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**Airframe Inspection**

(Meets the requirements of Part 147, Appendix C-Airframe Structure-G)

28. Perform airframe conformity and airworthiness inspection

Ref: 147-C-G28 – 20.0 hrs

Level 3

A. Perform 100-hour or annual inspection

Level 3

Estimated Instructional Time:

20.0 hrs

Additional Practice and/or Examinations

5.0 hrs

Grand Total Airframe – Part 1, Structures, Curriculum

339.0 hrs

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# Airframe – Part 1, Structures, Curriculum Detail

## Wood Structures

(Meets the requirements of Part 147, Appendix C-Airframe Structure-A)

1. Service and repair wood structures  
(EIT = 7.5 hrs, T = 7.5 hrs, L/S = 0.0 hrs) Level 1

- A. Judge the suitability of substitute materials Level 1

Student Performance Goal

Given:

A list containing the names of five kinds of wood and AC 43.13-1 other appropriate reference information.

Performance:

Using reference information, the student will select at least two substitute species that exceed the strength properties of aircraft spruce

Standard:

The student will select two substitute species without error.

- B. Describe the kinds of glues and gluing techniques Level 1

Student Performance Goal

Given:

Advisory Circular 43.13-1 or other suitable reference information.

Performance:

The student will describe the preparation of wood surfaces for gluing, the types and characteristics of acceptable glues, spreading of glues, assembly time in gluing, gluing pressures and methods of applying pressures, examined accepted

Standard:

The student will locate information in the reference publications and use correct nomenclature as part of the description and explanation of procedures.

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C. Read drawing pertaining to repair of wood structures Level 1

Student Performance Goal

Given:

AC 43.13-1 or equivalent reference information, and information sheet containing six undimensioned drawings of typical scarf joints.

Performance:

The student will locate information applicable to the scarf splice joints described in AG 43.13-1. He/she will read the diagrams and drawings and apply the dimensions to sketches of typical wood structural repairs.

Standard:

Correctly determine ratio dimensions for five undimensioned drawings or sketches of typical structural repairs.

D. Repair of elongated bolt holes

Level 1

Student Performance Goal

Given:

AC 43.13-1 or equivalent reference information.

Performance:

The student will describe the procedures and methods of repairing elongated bolt holes in wood spars.

Standard:

At least two methods of repair will conform to AC 43.13-1.

E. Identify protective finishes

Level 1

Student Performance Goal

Given:

AC 43.13-1 or equivalent reference information and samples of acceptable and unacceptable finished wood aircraft structures.

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Performance:

The student will use the reference information as an aid in describing the materials and procedures approved to seal wood aircraft structures, and recognize acceptable finishes.

Standard:

The student will recognize those sample finishes that are acceptable.

2. Identify wood defect

(EIT = 2.0 hrs T = 1.0 hr L/S = 1.0 hr)

Level 1

A. Identify defect in wood samples

Level 1

Student Performance Goal

Given:

AC 43.13-1 or equivalent publication, random samples of aircraft wood, some of which contain defects described in AC43.13-1.

Performance:

The student will interpret the information contained in AC 43.13-1 and select those samples of wood that would be acceptable for repair of wood aircraft structures.

Standard:

The defects will be identified and the reference specifications interpreted without error.

3. Inspect wood structures

(EIT = 3.0 hrs, T = 1.5 hrs, L/S = 1.5 hrs)

Level 1

A. Identify kinds of woods

Level 1

Student Performance Goal:

Given:

Random samples of aircraft parts made of plywood, laminated and solid wood, and a list of the various kinds of aircraft quality wood.

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**Performance:**

The student will identify each type of wood used in the structure, and describe the strength characteristics which influence the selection of such materials for repair of wood aircraft structures. The student will arrange the list of woods in a descending order of strength.

**Standard:**

The student will identify five species and three forms of aircraft wood, and interpret information from AC 43.13-1 without error.

**Aircraft Covering**

(Meets the requirements of Part 147, Appendix C-Airframe Structure-B)

- 4. Select and apply fabric and fiberglass covering materials (EIT = 3.5 hrs, T = 3.5 hrs, L/S = 0.0 hrs) Level 1
  - A. Identify fabrics and seams; and describe methods of applying fabric Level 1

**Student Performance Goal**

**Given:**

AC 43.13-1 or equivalent reference publications; samples of cotton, linen and synthetic textile materials and samples of doped and sewed seams.

**Performances:**

Using the reference, the student will identify aircraft textiles (both before and after doping) and identify the correct fabric to be used in covering an aircraft when the airspeed and wing loading is specified. He will compare the samples of doped and sewed seams with the specifications appearing in the publications. He will describe the acceptable methods of applying fabric.

**Standard:**

The student will locate reference information. He will identify the kind of fabric without error. He will correctly judge whether the sample seams conform to the specifications, and correctly describe methods of applying fabric.

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5. Inspect, test, and repair fabric and fiberglass  
(EIT – 13.0 hrs, T = 4.0 hrs, L/S = 9.0 hrs) Level 1
- A. Inspect, test and repair fabric covering Level 1

Student Performance Goal

Given:

Maule and/or Seyboth fabric tester, a fabric covered aircraft structure, AC 43.13-1 or equivalent reference information, and the materials and tools necessary to make repairs of fabric.

Performance:

The student will inspect a fabric covered aircraft structure, and identify the areas most susceptible to corrosion. He will perform fabric strength tests, and make both doped and sewed repairs in accordance with AC

43.13-1.

Standards:

The inspection, testing and repairs will be of return-to-service quality.

**Aircraft Finishes**

(Meets the requirements of Part 147, Appendix C-Airframe Structure-C)

6. Apply trim, Letters, and touchup paint  
(EIT - 2.0 hrs, T = 2.0 hrs, L/S = 0.0 hrs) Level 1
- A. Draw registration numbers and describe the application  
of trim designs Level 1

Student Performance Goal

Given:

Appropriate Federal Air Regulations, and graph paper.

Performance:

Using Federal Air Regulations, Part 45 as a reference, the student will locate that information which establishes the location, size and display of aircraft registration markings on Civil Aircraft of United States Registry. On grid or graph paper, the student will draw the letters and numbers used as registration marks, and describe the application of trim and methods of touching up paint.

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Standard:

The student will maintain the correct height, width, stroke and spacing. Description will comply with information provided.

- 7. Identify and select aircraft finishing materials (EIT - 3.0 hrs, T = 2.0 hrs, L/S = 1.0 hrs) Level 2
  - A. Identify finishing materials and thinners Level 2

Student Performance Goal

Given:

Labeled samples of nitrate and butyrate dope, lacquer, zinc chromate primer and enamel, and appropriate thinners,,

Performance:

The student will examine the labeling and physical characteristics of each sample and select the thinner which would be used with each of the sample materials. He will be able to distinguish between lacquer and enamel by physical examination of the material.

Standard:

Select an acceptable thinner for each of five finishing materials. Correctly distinguish between lacquer and enamel.

- 8. Apply finishing materials (EIT = 22.0 hrs, T = 4.0 hrs, L/S = 18.0 hrs) Level 2
  - A. Apply dope Level 2

Student Performance Goal

Given:

A fabric covered structure, covering and finishing materials and a procedure sheet or written instructions.

Performance:

The student will apply dope by brush and spray application. He will apply surface tapes, drain grommets and reinforcing patches as a part of the doping procedure.

Standard:

The resultant fabric doped surface will comply with the requirements of AC 43.13-1.

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B. Spray, primers, dope and paints

Level 2

Student Performance Goal

Given:

Written procedures, assorted primers, dope and paints, spray-painting equipment and facilities, aluminum and fabric covered aircraft structures.

Performance:

The student will prepare the surfaces for painting and apply primers, dopes and paints by spraying.

Standard:

The preparation of the Surface and spray application of finish must be of return-to-flight service quality.

9. Inspect finishes and identify defects  
(EIT = 3.0 hrs, T = 1.0 hrs, L/S = 2.0 hrs)

Level 2

A. Inspect finishes and recognize defects

Level 2

Student Performance Goal

Given:

Written procedures, assorted primers, dope and paints, spray painting equipment and facilities, aluminum and fabric covered aircraft structures.

Performance:

The student will prepare the surfaces for painting and apply primers, dopes and paints by spraying.

Standard:

The preparation of the Surface and spray application of finish must be of return-to-flight service quality.

**Sheet Metal and Nonmetallic Structures**

(Meets the requirements of Part 147, Appendix C-Airframe Structure-D)

10. Select, install, and remove special fasteners for metallic, bonded, and composite structures  
(EIT = 15.0 hrs, T = 5.0 hrs, L/S = 10.0 hrs)

Level 2

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A. Aircraft type of special rivets and fasteners

Level 2

Student Performance Goal

Given:

Written information, AC 43.13-1 or equivalent publication, questions pertaining to special rivets and fasteners used in aircraft and samples of such rivets and fasteners.

Performance:

The student will answer fifteen questions concerning precautions necessary for proper fit when installing special hi-shear and pull-type rivets, the stresses that such rivets are designed to resist, applications and limitations for the use of special rivets and fasteners in aircraft repairs. He will identify and list by type eight different special rivets and fasteners used in aircraft.

Standard:

Correctly answer at least twelve questions and correctly identify at least six types of special rivets.

B. Select acceptable holes and install hi-shear, blind rivets and deicer boot fasteners

Level 2

Student Performance Goal

Given:

Written information; aircraft type structural sections prepared with holes for special rivets and fasteners which include correctly drilled holes, elongated holes, oversized holes, and/or holes which are out of alignment; hi-shear rivets, blind-type rivets and deicer boot fasteners, or Rivnuts; and prescribed tools for installing each type of rivet or fastener provided.

Performance:

The student will inspect the drilled holes and indicate acceptability of each hole, giving reasons for those rejected. He will identify the different types of rivets and fasteners provided and select ten each hi-shear rivets, blind type rivets and deicer-foot fasteners of proper length and diameter for the holes provided. He will install these rivets and fasteners in suitable holes, using appropriate installing tools.

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Standard:

At least 75 percent of the drilled holes properly identified as to acceptability, correct rivets and fasteners selected, correct installing tools used; and 75 percent of each type of rivets and fasteners properly installed in accordance with information provided.

C. Remove and replace special rivets and fasteners Level 2

Student Performance Goal

Given:

Written information, aircraft type structural sections with hi-shear and blind-type rivets, deicer-boot, Dzus, Air-loc and Cam-loc fasteners installed; and appropriate tools for removing and replacing such rivets and fasteners.

Performance:

The student will remove five each of the following types of rivets and fasteners in a manner which permits their replacement similar rivets or fasteners: hi-shear Huck and Cherry rivets, Rivet-nuts or deicer boot fasteners, Dzus, Air-loc, and Cam-loc fasteners. He will then replace each removed rivet or fastener with a similar rivet or fastener using appropriate tools.

Standard:

Removal of at least 75 percent of the special rivets and fasteners correctly accomplished, and 80 percent of the replacement rivets and fasteners correctly selected and installed.

11. Inspect bonded structures (EIT = 9.0 hrs, T = 4.0 hrs, L/S = 5.0 hrs) Level 2

A. Inspect and repair metal sandwich structures Level 1

Student Performance Goal

Given:

Written information and repair procedures, drawings or Photos of aircraft metal sandwich materials, questions with multiple choice answers with reference to bonded aircraft structures.

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Performance:

The student will select answers to ten questions concerning types of bonded metal aircraft material, purposes and reasons for use of metal sandwich panels in high-speed aircraft construction, and the use of metallic “ring” test to inspect for delamination damage of bonded structures.

Standard:

Select correct answers for at least 7 questions.

- B. Evaluate damage to bonded structure and determine type of repair needed.

Level 2

Student Performance Goal

Given:

Written information and repair specifications, and a section of aircraft bonded structure which has a damaged area.

Performance:

The student will inspect the damaged bonded structure evaluate the extent of the damage, and prepare a work description for the type of repair needed.

Standard:

Evaluation and description of repairs conform to specification for at least 75 percent of detectable damage.

- 12. Inspect, test, and repair fiberglass, plastics, honeycomb, composite, and laminated primary and secondary structures (EIT = 11.0 hrs, T = 3.0 hrs, L/S = 8.0 hrs)

Level 2

- A. Identify and repair plastic, fiber and fiberglass aircraft materials

Level 2

Student Performance Goal

Given:

Written information, manufacturer’s reference material and samples of different types of plastic, fiber, and fiberglass aircraft structural and enclosure material.

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Performance:

The student will identify and label ten samples of different plastics, fiber, and fiberglass, including honeycomb and laminated fiberglass structure materials. He/she will answer fifteen questions concerning protection of plastics while being handled or worked, cleaning and polishing of plastics and fiberglass, methods of painting or surface coating plastics and fiberglass, and repair methods for plastic, fiber, and fiberglass aircraft structures

Standard:

Correct labels for seven samples and correct answers for ten questions.

- B. Repair damaged areas in fiberglass aircraft Level 2

Student Performance Goal

Given:

Written information, and procedures for repair of fiberglass structures, sections of molded and laminated fiberglass honeycomb structure with a punctured or crushed area.

Performance:

The student will evaluate repairs needed, prepare each damaged area for repair, and make the repairs specified for one section each of molded fiberglass, laminated fiberglass and fiberglass honeycomb aircraft structure. He/she will finish each repaired area by removing excess material, blending the repair into the surrounding area and smoothing to match the original surface.

Standard:

At least 2 of the 3 repaired areas will conform to return to service standards as specified in the procedures provided.

- 13. Inspect, check, service, and repair windows, doors, and interior furnishings (EIT = 12.0 hrs, T = 3.0 hrs, L/S = 9.0 hrs) Level 2

- A. Recognize distinguishing characteristics of transparent plastic and plate glass enclosures Level 2

Student Performance Goal

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Given:

Written information, samples of transparent plastic and plate glass aircraft enclosures.

Performance:

The student will select samples of transparent aircraft enclosures made of acrylic plastic, acetate plastic, solid tempered plate glass, shatter-proof laminate plate glass, and plate glass with thermal anti-icing plastic layer, list type of material and distinguishing characteristics for each.

Standard:

Correctly (list type for at least four types of material and list distinguishing characteristics for three types.

- B. Clean, protect, repair and secure transparent plastic aircraft enclosures Level 2

Student Performance Goal

Given:

Written information, AC 43.13-1 or equivalent publication, transparent plastic enclosure materials, and plastic windows with surface scratches, cleaning, scratch removing, and installation equipment and materials.

Performance:

The student will clean plastic windows, remove shallow scratches and surface crazing from transparent plastic enclosures, protect plastic enclosure material during handling, repairing and storage, and secure plastic enclosures in aircraft structures.

Standards:

Conformance to procedures given in the manufacturer's manual or in AC 43.13-1 or equivalent publication.

- C. Inspect and check pressure seals doors and windows, seat recline mechanisms and safety bet installations Level 2

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## Student Performance Goal

### Given:

A written check list, manufacturer's manual, FAA Technical Standard Orders, a pressurized aircraft section or mock-up with door and window installations, a seat with recline mechanism and a safety belt installation.

### Performance:

The student will inspect and check the pressure seal and latching mechanism in an externally opening entrance door for a pressurized aircraft, remove, inspect and replace a pressure seal window in a window frame or escape hatch of a pressurized aircraft, inclining mechanism of an aircraft reclining seat with automatic return and inspect and check a safety belt installation for being acceptable to FAA standards.

### Standards:

All items will be correctly judged; doors, windows and seat mechanisms will operate as designed. The safety belt will be correctly installed, identified and the condition of all equipment will be noted on the check sheet.

## 14. Inspect and repair sheet metal structures

(EIT = 44.0 hrs, T = 15.0 hrs., L/S = 29.0 hrs)

Level 3

### A. Select and use twist drills and countersinks

Level 3

## Student Performance Goal

### Given:

Written information concerning drills and drilling, sets of numbered and lettered twist drills, drill cards, countersinks for rivets and screws, suitable drilling equipment and assorted sheet and structural parts of soft aluminum, aluminum alloys, stainless steel, titanium and magnesium.

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Performance:

The student will select as specified, ten different numbered drills, five different lettered drills, and two types of countersinks. He will use suitable drilling equipment to drill five holes with each selected size of drill. At least five holes will be drilled in each of the following kinds of material: soft aluminum castings and sheet, aluminum alloy thin skin and structural parts, stainless steel and titanium sheet and cast magnesium. He will countersink five holes each for flush rivets and for flush screws or bolts.

Standard:

All drilling will be performed in accordance with procedures provided. At least 60 holes will meet specifications and 8 countersunk holes will conform to specified dimensions. 80 percent of holes unmarred around adjacent area.

B. Select and use hand files for soft metals

Level 3

Student Performance Goal

Given:

Metal working information, a variety of metal working files, samples of aluminum and magnesium, a work bench and vise or clamps.

Performance:

The student will select suitable hand files for the metals and use them to file down and finish aluminum and magnesium to specified dimensions.

Standard:

Filing techniques will be in conformance with information provided. Completed jobs will meet dimensions within .010 inch and will have a smooth finish.

C. Repair shallow scratches in sheet metal

Level 2

Student Performance Goal

Given:

Written information on minor repairs of sheet metal, a sample of aluminum or magnesium aircraft skin with one or more shallow scratches, and burnishing tools.

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Performance:

The student will identify scratches repairable by burnishing and burnish one or more scratches in sheet metal of the type used for aircraft skin.

Standards:

Burnishing will be accomplished in accordance with procedures in the information provided.

- D. Repair a slightly oversized hole by reaming for next larger size rivet

Level 3

Student Performance Goal

Given:

Written information, rivet hole size tables, an aircraft part with a hole that is slightly oversized after rivet removal, reaming and hole measuring tools.

Performance:

The student will determine the next larger size rivet and what diameter hole it requires, ream the hole, and obtain, by measurement, a hole of correct size for the rivet selected.

Standard:

The hole will be true, round and vertical, and meet specified diameter within 10 percent.

- E. Prepare dissimilar metals assembly

Level 2

Student Performance Goal

Given:

Written information, AC 43.13-1 or equivalent publication, samples of several dissimilar metals used in aircraft assemblies, materials and equipment for applying corrosion protection coatings on the metal samples provided.

Performance:

The student will determine the type of corrosion protection required for assembly of five different dissimilar pairs of aircraft type metals and list the type of coating to be applied to each pair selected. He will apply coatings as specified on two pairs of the selected metals which require corrosion treatment.

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Standard:

Determine correct corrosion protection, listing coatings to be used for at least four pairs and apply corrosion protection on two pairs of dissimilar metals in accordance with specifications.

- F. Describe loads in fuselage and wing structures and types of overload failures Level 1

Student Performance Goal

Given:

Written information, drawings of aircraft, showing structure of monocoque and semimonocoque fuselages, drawings showing construction of a cantilever wing, and descriptions of bearing and shear failures as related to sheet metal structure.

Performance:

The student will show by arrows and labels, which members, in normal flight, carry primary bending and torsional loads in a monocoque and a semimonocoque fuselage, and the tension and compression loads imposed upon the spars in a cantilever wing structure. From a written description of a bearing failure and a shear failure, each at a riveted area in a sheet metal structure, the student will draw a sketch showing by arrows the applied loads and by breakage lines, the type of breakage which occurs in each type of failure.

Standard:

At least 70 percent of the loads will be correctly indicated and breakage lines will be drawn correctly.

- G. Make minor repairs to stress-skin wings Level 2

Student Performance Goal:

Given:

Written information, AC 43.13-1 or equivalent publication, a section or a mock-up of a stressed-skin airplane wing, tools and materials for making stressed-sink repairs.

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Performance:

The student will perform repairs for the following real or introduced damage: a hole in a stressed-skin metal wing, a section of damaged skin (using a single-lap sheet splice), damaged stringers on the lower surface of a stressed-skin metal wing. He/she will determine the correct rivet layout and spacing for each repair and perform the dimpling process in a least one of the repairs.

Standard:

All repairs will be of correct type and gauge metal and will be laid out in accordance with specifications in the publication proved, and at least 75 percent of the rivets will conform to spacing and riveting techniques.

- H. Determine conditions of stressed skin structures, which has been critically loaded

Level 2

Student Performance Goal

Given:

Written information, AC 43.13-1 or equivalent publication, aircraft sheet metal structural members with failed sections (such as spars or engine mounts), tools, rivets and materials for sheet metal repair.

Performance:

The student will repair two damaged sections in aircraft sheet metal structural units. He/she will determine the type and size of repair splice or patch for each damaged section, plan and layout the rivet patterns, select proper number and types of rivets required and use proper riveting techniques in making the repairs.

Standard

Both repairs will conform to the specifications as to size of patch, type and gauge of metal used and rivet layout. At least 75 percent of the rivets installed will meet specifications.

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I. Construct a watertight joint

Level 2

Student Performance Goal

Given:

Written information and a section of a stressed skin metal aircraft structure which is known to have been critically loaded and which has several overload indications.

Performance:

The student will inspect the skin, rivets, and structural members for evidence of damage. He/she will list any popped or sheared rivets, wrinkled or distorted skin areas. Misaligned or cracked structural members and any other evidences of overload.

Standard:

At least 75 percent of all visible indications of damage will be listed correctly.

15. Install conventional rivets

(EIT = 21.0 hrs, T = 5.0 hrs, L/S = 16.0 hrs)

Level 3

A. Identify conventional aircraft rivets

Level 3

Student Performance Goal

Given:

Written information, charts, AC 14.3.13-I or equivalent publication, a supply of aircraft rivets including rivets of various diameters, lengths, head styles, and alloys, and ten questions concerning the properties and uses of aircraft rivets.

Performance:

The student will select thirty different aircraft rivets and identify 1 each rivet by head style, alloy, diameter and length of shank. He will answer ten questions concerning rivet identification, properties of heat-treated rivets, and factors that determine the use of specific types of rivets in aircraft.

Standard:

Correctly list at least twenty-four different rivets, and correctly answer eight test questions.

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B. Perform riveting to FAA specifications

Level 3

Student Performance Goal:

Given:

Written instructions or drawing, AC 43.13-1 or equivalent publication, samples of aluminum alloy sheet material of various thicknesses and alloys, AN 470 rivets of various alloys, tools for drilling and riveting, rivet heat- treating equipment.

Performance:

The student will cut 3.5" by 5" sections each, of the following aluminum alloys: 7075-T, 2024-T3, 2017 Alclad, in gauges .032 to .064. The student will layout each hole plan, drill holes, install proper type and length rivets for a four row lap splice of 2024-T3 sections, using 3/32" protruded head rivets; and a single row lap splice of 2017Alclad sections, using 3/16" protruded head rivets. He/she will use an air powered riveting gun. Select rivet sets and bucking bars suitable for each type of rivet used, and install heat treat rivets when necessary.

Standard:

Work procedures will comply with the information provided. The riveted sections will have 75 percent of strikes, rivets properly spaced and 75 percent of the rivets installed to meet the specifications in AC 43.13-1 or equivalent publication.

C. Identify, remove and replace improperly installed rivets

Level 3

Student Performance Goal

Given:

Aircraft type riveted splices and joints; four row, double row and single row lap splices previously made by the student; AC 43.13-1 or equivalent publication, and written information concerning aircraft rivet installation and removal.

Performance:

The student will inspect riveted splices and joints, of the type used in aircraft skin and structure, to identify rivets which are faulty. He will inspect the four rows and single row lap splices he previously made and remove all rivets which fail to meet specifications. He will replace all removed rivets with equivalent rivets. He will remove all rivets in the double row splice and replace one half with same type and size rivets.

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Standards:

Locate at least 75 percent of all faulty rivets in accordance with specifications provided. At least 75 percent of removed rivets will have holes drilled to meet specifications and 80 percent of replaced rivets will meet FAA specifications.

16. Form, lay out, and bend sheet metal  
(EIT = 34.0 hrs, T = 7.0 hrs, L/S = 27.0 hrs)

Level 3

A. Make a joggle in aluminum sheet

Level 2

Student Performance Goal

Given:

Written information including specifications for a joggle, two sections of .025 gauge 2024-T3 aluminum alloy, rivets and tools appropriate for making a joggle.

Performance:

The student will make a joggle in aluminum alloy sheet, using joggle plates and hydraulic press or hammer and joggle block and rivet the joggled sheet to a section of similar sheet material.

Standard:

Finished joggle will have a flush assembly fit and will meet specifications provided within .010 inch.

B. Prepare a layout for a bend in aircraft sheet metals Level 3

Student Performance Goal

Given:

Written information, reference material on sheet metal bending, a drawing of a sheet metal bend in cross section, a blueprint of an aircraft sheet metal component requiring bending and a section of the sheet metal called for in the blueprint.

Performance:

The student will write a brief definition of bend radius, determine and draw in the neutral (axis) line in a cross section drawing of a bend, use a blueprint of an aircraft sheet metal component which requires a bend, to determine the dimensions and prepare a layout on the metal for the bend, taking into consideration the type of metal and the relationship of the metal "grain" to the bend to minimize the possibility of cracking.

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Standard:

Written definition and marked neutral axis will be correct.  
Calculated dimensions and layout drawings not more than .030 inch deviation from specifications provided. Relationship of bend to metal "grain" will be correct.

C. Layout and make bends in sheet metal Level 3

Student Performance Goal

Given:

Written procedures and reference tables for bending sheet metal, sections of various types and thicknesses of sheet metal in various temper conditions, layout and bending tools and equipment.

Performance:

The student will determine and select type of sheet metal which requires radius for bending. He will calculate and layout dimensions and bend lines for a specified angle of bend and make the bend, using recommended bending techniques. He will select a different type of material which requires a small radius for bending, calculate and layout bend lines for a 130 degree bend and bend the material to the specified bend, using the minimum bend radius permissible in the tables for the type and thickness of the material used.

Standard:

All calculations, layouts, and bends will be accurate within .030 inch of the dimensions specified.

D. Form aluminum parts by bumping Level 3

Student Performance Goal

Given:

Written information, blueprints or drawings flat sheet stock of aluminum in "soft-temper" condition, tools and equipment for forming aluminum by bumping.

Performance:

The student will interpret blueprints or drawings and form the following parts by bumping: A curved flange, a "U" channel, and a compound curved part, using "V" blocks, crimp and shrink blocks, crimping tool, form blocks, and planishing hammer.

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Standard:

Each part made by bumping will conform to the specification in the blueprint or drawing within 0.030 inch to all dimensions.

## Welding

(Meets the requirements of Part 147, Appendix C-Airframe Structure-E)

### 17. Weld magnesium and titanium

(EIT = 2.0 hrs, T = 2.0 hrs, L/S = 0.0 hrs)

Level 1

#### A. Welding of magnesium and titanium

Level 1

Student Performance Goal

Given:

Written information and questions with multiple choice answers regarding welding of magnesium and titanium.

Performance:

The student will select answers to ten questions covering the method of cleaning magnesium for welding, the function of flux, the types of gasses to use, the use of butt joints when welding magnesium, and the methods of welding titanium.

Standard:

Select correct answers for at least seven questions.

### 18. Solder stainless steel

(EIT = 1.0 hr, T = 1.0 hr, L/S = 0.0 hr)

Level 1

#### A. Silver solder of stainless steel

Level 1

Student Performance Goal

Given:

Written information and questions concerning welding of aluminum and stainless steel, welding equipment, samples of acceptable and unacceptable inert gas welds, and samples of aluminum alloy sheet and stainless steel sheet.

Performance:

The student will select answers to ten questions covering the method of cleaning magnesium for welding, the function of flux, the types of gasses to use, the use of butt joints magnesium, and the methods of welding titanium.

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Standard:

Correctly answer at least four questions, correctly record acceptability of at least three sample welds, complete at least one welded bead each on sample aluminum alloy and stainless steel and identify flaws in the welds when completed.

19. Fabricate tubular structures

(EIT = 6.0 hrs, T = 6.0 hrs, L/S = 0.0 hrs)

Level 1

A. Tubular steel fabrication and repair by welding

Level 1

Student Performance Goal

Given:

Written welding information, AC 43.13-1 or equivalent publication, samples of aircraft tubular structure which include tubular steel welding splices, joints, and clusters, with do not meet return-to-flight standards.

Performance:

The student will identify ten welded splices, joints, and sleeve repairs in tubing and tubular welded clusters. He will inspect ten samples of aircraft welded tubular structures and list whether each selected weld meets return-to-flight standards as specified in FAA publications.

Standard:

Correctly identify at least seven welded samples, and correctly judge return-to-flight acceptability for at least seven welds.

20. Solder, braze, gas-weld, and arc-weld steel

(EIT = 32.5 hrs, T = 7.0 hrs, L/S = 25.5 hrs)

Level 2

A. Preparation and precautions before soldering, brazing and welding

Level 1

Student Performance Goal

Given:

Written technical information, AC 43.13-1 or equivalent publication, and multiple-choice questions concerning preparations and precautions before soldering, brazing and welding.

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Performance:

The student will select answers for ten questions concerning the preparation of metal for soldering, brazing and welding; preheating prior to welding and the precautions regarding welding over previously brazed or soldered joints.

Standard:

Select correct answers for at least eight questions.

- B. Solder electrical connections and make lap joint

Level 2

Student Performance Goal

Given:

Written information pertaining to soldering, samples of aircraft electrical wire, cable and solder type connectors; scraps of brass and shim material, tinned steel, stainless steel, and soldering equipment.

Performance:

The student will solder electrical wires or cables to solder type connectors, sweat solder lap joints of brass, tinned steel and stainless steel.

Standard:

Wires and cables will be soldered to connectors in compliance with connectors manufacturer's specifications and lap-joints will each have at least 70 percent indicated surface adhesion when torn apart.

- C. Repair steel parts by welding

Level 2

Student Performance Goal

Given:

Written welding information, AC 43.13-1 or equivalent publication, welding equipment, a portable welding set, samples of damaged or defective aircraft parts, some of which are repairable by welding.

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**Performance:**

The student will identify and select parts which he considers repairable by welding. He will set up a portable gas welding set, clean and prepare steel parts for welding, and use the portable welding set to repair the steel parts by welding. He/she will preheat the parts, select correct size tip and adjust an oxy-acetylene torch for correct type flame, select and use filler rod; perform welding of the steel parts and normalize them.

**Standard:**

All steps will be performed in accordance with procedures provided and completed welds will comply with the requirements of AC 43.13-1 or equivalent publication.

**21. Weld aluminum and stainless steel**

(EIT = 3.5 hrs, T = 0.5 hrs, L/S = 3.0 hrs)

Level 1

**A. Inspect and weld aluminum and titanium**

Level 1

**Student Performance Goal**

**Given:**

Written information and questions concerning welding of aluminum and stainless steel, welding equipment, samples of acceptable and unacceptable inert-gas welds, and samples of aluminum alloy sheet and stainless steel sheet.

**Performance:**

The student will select answers to ten questions covering the method of cleaning magnesium for welding, the function of flux, the types of gasses to use, the use of butt joints when welding magnesium, and the methods of welding titanium.

**Standard:**

Correctly answer at least four questions, correctly record acceptability of at least three sample welds, complete at least one welded bead each on sample aluminum alloy and stainless steel and identify flaws in the welds when completed.

**Aircraft Finishes**

(Meets the requirements of Part 147, Appendix C-Airframe Structure-F)

**22. Rig rotary-wing aircraft**

(EIT = 8.0 hrs, T = 8.0 hrs, L/S = 0.0 hrs)

Level 1

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III-34	0	08/01/2016	08/01/2016

A. Use nomenclature applicable to rotary wing aircraft Level 1

Student Performance Goal

Given:

Information sheets containing unlabeled drawings of rotary wing aircraft and appropriate rotary wing reference manuals.

Performance:

The student will label the drawings, identifying the three axes of a rotorcraft and the movement about each of the axes induced by operation of the flight controls. He/she will enable him to recognize and explain:

- a. The cause and effect of blade stall when helicopters are operating at high speed.
- b. The cause of vertical vibrations.
- c. The methods of tracking main rotor blades.
- d. The preparation required prior to rigging a rotorcraft.

Standard:

The drawings will be correctly labeled. Correct nomenclature will be used throughout the explanations.

23. Rig fixed-wing aircraft

(EIT = 9.0 hrs, T = 4.0 hrs, L/S = 5.0 hrs)

Level 2

A. Use correct aircraft nomenclature

Level 1

Student Performance Goal

Given:

Information sheets illustrating propulsion devices (propeller, jet and rocket) fuselage, wing and tail configuration, landing gear arrangements, and appropriate reference manuals.

Performance:

The student will label the sketches in the information sheets to classify the types of powerplants and the design features of the airplane.

Standard:

The student will correctly identify and label 80 percent of the features appearing in the drawings or sketches.

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B. Interpret theory of flight

Level 2

Student Performance Goal

Given:

Information sheets containing unlabeled line drawings or sketches illustrating the aerodynamics of flight and/or a model of a fixed wing airplane.

Performance:

The student will explain the aerodynamics of flight, interpret the theories and describe the design features related to lift, thrust, stability and control of fixed wing aircraft. Using a three-view plan, drawing, sketch or model airplane, the student will:

- a. Identify, and label the three axes of the aircraft.
- b. Illustrate the displacement or motion of an airplane about each of the three axes.
- c. Describe the aerodynamic forces acting upon an airplane in flight.
- d. Describe the design features which contribute to the stability of the airplane.
- e. Illustrate the relationship between center of pressure and center of gravity at three different angles of attack. With the aileron and flap in various displaced positions, the student will illustrate the movement of the center of pressure on the airfoil.

Standard:

The student will use correct nomenclature when labeling diagrams or describing aerodynamic effects. Illustrations will be correctly labeled.

24. Check alignment of structures

(EIT = 10.0 hrs, T = 2.0 hrs, L/S = 8.0 hrs)

Level 2

A. Verify alignment of structures

Level 2

Student Performance Goal

Given:

Written procedure sheets, appropriate reference manuals and an airplane or aircraft mock-up with an airplane fuselage, landing gear, wing structure and empennage.

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Performance:

The student will level the fuselage and verify alignment of the structure. On an internally braced wing section, the student will use tools and make adjustments to ensure the alignment of wing spars, squareness of bays and tension of the bracing. Using the data available in the manufacturer's manuals, he/she will interpret the information and make the measurements necessary to verify the alignment of landing gear, wings and fixed tail surfaces.

Standard:

All measurements will be made in accordance with the procedures provided. Adjustments will be made as needed to align the structure within the tolerances specified in the manuals.

25. Assemble aircraft components, including flight control surfaces

(EIT = 7.0 hrs, T = 1.0 hr, L/S = 6.0 hrs)

Level 3

A. Assemble components

Level 3

Student Performance Goal

Given:

An assembly project, mock-up panel or an identifiable assembly of an airplane (landing gear, control surfaces, etc.) and a procedure sheet, drawing or maintenance manual.

Performance:

The student will identify and select the required hardware (bolts, nuts, screws, etc.) from an assortment or supply room. He/she will install, torque and safety these fasteners on the mock-up panel or in the assembly.

Standard:

The procedure, torque values and safeties will be in accordance with the procedure sheets, drawings or the manufacturer's manuals.

26. Balance, rig, and inspect movable and secondary flight control surfaces

(EJT = 24.0 hrs, T = 4.0 hrs, L/S = 20.0 hrs)

Level 3

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A. Identify aircraft control cable.

Level 2

Student Performance Goal

Given:

Assorted samples of aircraft control cables, identification tags, and reference catalogs or appropriate publications.

Performance:

The student will measure the diameter of each cable, determine the material from which the cable was manufactured, tag the cable, identifying the diameter type, material and approximate tensile strength.

Standard:

Identification of the cable diameter, type and material will be without error. Tensile strength will be identified in accordance with reference information.

B. Verify correct control response.

Level 3

Student Performance Goal

Given:

A completely assembled airplane with operating primary and secondary flight controls and diagram, drawing or sketch of the control surfaces of the airplane.

Performance:

The student will, while seated in the pilot or co-pilot's position, physically move each primary and secondary flight control. On the drawing or sketch, he/she will write the direction that the control surface moves, the reaction of the airplane to this applied control. He/she will explain the purpose of differential control and the function of control surface looks.

Standard:

The diagrams will be correctly labeled and explanations will be without error.

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- C. Install and tension a control cable, inspect a cable control system Level 3

Student Performance Goal

Given:

A specified make and model of airplane, the associated service manual, a replacement control cable for one of the flight controls, appropriate tools, and an inspection report form.

Performance:

The student will install an elevator, rudder, or aileron cable, use a tensiometer to establish correct cable tension, safety all turnbuckles and attaching devices in accordance with the service manual. He will inspect the control systems of the airplane for cable wear, tension, pulley wear and rotation, swaged terminal slippage, turnbuckle safety, corrosion and control surface travel, and record discrepancies on a report form.

Standard:

Work accomplished will be of return-to-flight quality. Discrepancies found during inspection of the control system will be recorded in accordance with Chapter 4, AC 43.13-1 and the airplane service manual.

- D. Check static balance of control surface Level 3

Student Performance Goal

Given:

A balanced type aircraft control surface which is not in balance and the manufacturer's service instructions.

Performance:

The student will interpret the manufacturer's instructions, follow procedure and use equipment to check the unbalance of the control surface. He/she will recommend correct action to balance the surface.

Standard:

The corrective action recommended by the student will be in accordance with the procedure recommended in the manual.

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E. Inspect and adjust push-pull control systems Level 3

Student Performance Goal

Given:

Written procedures and inspection report forms and an airplane incorporating a push-pull control system.

Performance:

The student will inspect the bellcranks, push-pull tubes, rod ends, guides, adjust travel of the movable control surfaces and safety the control system in accordance with the service manual for that particular make and model of aircraft.

Standard:

Inspections, adjustments and safetying of the system will meet return-to-flight standards.

27. Jack aircraft Level 3  
(EIT = 3.0 hr, T = 1.0 hr, L/S = 2.0 hrs)

A. Jack aircraft Level 3

Student Performance Goal

Given:

A specified make and model airplane; associated service manual, jacks, jack pads and ballast.

Performance:

The student will use the appropriate equipment, ballast, and follow procedures to raise and subsequently lower the aircraft.

Standard:

Jacking of the airplane will be in accordance with the procedure detailed in the service manual.

**Airframe Inspection**

(Meets the requirements of Part 147, Appendix C-Airframe Structure-G)

28. Perform airframe conformity and airworthiness inspection Level 3  
(EIT = 20.0 hrs, T = 2.0 hrs, L/S = 18.0 hrs)

A. Perform 100-hour or annual inspection Level 3

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## Student Performance Goal

### Given:

Manufacturer's and FAA manuals, written procedures and forms, and a completely assembled airplane.

### Performance:

The student will accomplish a 100 hour or annual inspection of the airplane and record the conditions disclosed as a result of the inspection.

### Standard:

The procedures, nomenclature and technical terms used to describe the conditions detected by the inspection will reflect return-to-flight standards.

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