AIRCRAFT
INSPECTION, REPAIR & ALTERATIONS

Acceptable Methods, Techniques & Practices

U.S. Department of Transportation

FEDERAL AVIATION ADMINISTRATION

Includes:

AC 43.13-1B

September 1998

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AC 43.13-2B

March 2008

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Advisory Circular 43.13-1B

Acceptable Methods, Techniques and Practices—
Aircraft Inspection and Repair

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Acceptable Methods, Techniques and Practices—
Aircraft Alterations

March 2008

AVIATION SUPPLIES & ACADEMICS, INC.
NEWCASTLE, WASHINGTON

U.S. Department of Transportation
Federal Aviation Administration

Advisory Circular

Subject: Acceptable Methods, Techniques, and Practices—Aircraft Inspection and Repair

Date: 9/8/98
Initiated by: AFS-300

AC No: 43.13-1B
Change: 1

1. PURPOSE OF THIS ADVISORY CIRCULAR (AC).

a. This AC contains methods, techniques, and practices acceptable to the Federal Aviation Administration (FAA) for performing inspections and minor repairs of nonpressurized areas of civil aircraft unless the repair at issue is recommended against in the applicable manufacturer's maintenance or repair instructions. The repair data described in this AC may be used as a basis for FAA-approved data for major repairs. The repair data may be used as FAA-approved data for repairs of nonpressurized areas of civil aircraft provided the AC chapter, page, and paragraph are listed in Block 8 of FAA Form 337, Major Repair and Alteration (Airframe, Powerplant, Propeller, or Appliance) and the data are:

(1) Appropriate to the product being repaired;

(2) Directly applicable to the repair being made; and

(3) Not contrary to manufacturer's data.

b. The contents of this document do not have the force and effect of law and are not meant to bind the public in any way, and the document is intended only to provide information to the public regarding existing requirements under the law or agency policies.

2. AUDIENCE. This AC is intended for use by persons performing maintenance, alteration, or preventive maintenance on aircraft, engines, propellers, or appliances in accordance with Title 14 of the Code of Federal Regulations (14 CFR) part 43.

3. WHERE YOU CAN FIND THIS AC. You can find this AC on the FAA's website at https://www.faa.gov/regulations_policies/advisory_circulars and the Dynamic Regulatory System (DRS) at https://drs.faa.gov.

4. WHAT THIS AC CANCELS. AC 43.13-1A, Acceptable Methods, Techniques, and Practices—Aircraft Inspection and Repair, dated December 22, 1976, is canceled.

5. REFERENCE. Title 14 CFR part 43, § 43.13(a) states that each person performing maintenance, alteration, or preventive maintenance on an aircraft, engine, propeller, or appliance shall use the methods, techniques, and practices prescribed in the current manufacturer's maintenance manual or instructions for continued airworthiness (ICA) prepared by its manufacturer, or other methods, techniques, or practices acceptable to the Administrator, except as noted in § 43.16. FAA inspectors are prepared to answer questions that may arise in this regard. Persons engaged in the inspection and repair of civil aircraft should be familiar with 14 CFR Part 43, Maintenance, Preventive Maintenance, Rebuilding, and Alteration, and Part 65, Certification: Airmen Other Than Flight Crewmembers, subparts A, D, and E, and the applicable airworthiness requirements under which the aircraft was type certificated.

6. ACKNOWLEDGMENTS. The FAA would like to thank the following persons and organization for their assistance in producing AC 43.13-1B: Richard Finch, Richard Fischer, Michael Grimes, Ray Stits, William A. Watkins, and the SAE, Aerospace Electronics and Electrical Systems Division. Acknowledgment is also extended to all in the aviation community who commented on the document.

7. AC FEEDBACK FORM. For your convenience, the AC Feedback Form is the last page of this AC. Note any deficiencies found, clarifications needed, or suggested improvements regarding the contents of this AC on the Feedback Form.

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Acting Deputy Director, Flight Standards Service

CHAPTER 1. WOOD STRUCTURE

SECTION 1. MATERIALS AND PRACTICES

1-1. GENERAL. Wood aircraft construction dates back to the early days of certificated aircraft. Today only a limited number of wood aircraft structures are produced. However, many of the older airframes remain in service. With proper care, airframes from the 1930s through the 1950s have held up remarkably well considering the state of technology and long-term experience available at that time. It is the responsibility of the mechanic to carefully inspect such structures for deterioration and continuing airworthiness.

1-2. WOODS.

a. Quality of Wood. All wood and plywood used in the repair of aircraft structures should be of aircraft quality (refer to Air Force Navy Commerce Department Bulletin ANC-19, Wood Aircraft Inspection and Fabrication). Table 1-1 lists some permissible variations in characteristics and properties of aircraft wood. However, selection and approval of woodstock for aircraft structural use are specialized skills and should be done by personnel who are thoroughly familiar with inspection criteria and methods.

b. Substitution of Original Wood. The wood species used to repair a part should be the same as that of the original whenever possible; however, some permissible substitutes are given in Table 1-1. Obtain approval from the airframe manufacturer or the Federal Aviation Administration (FAA) for the replacement of modified woods or other nonwood products with a substitute material.

TABLE 1-1. SELECTION AND PROPERTIES OF AIRCRAFT WOOD
(See notes following table)

Species of Wood	Strength properties as compared to spruce	Maximum permissible grain deviation (slope of grain)	Remarks
1.	2.	3.	4.
Spruce (Picea) Sitka (P. Sitchensis) Red (P. Rubra) White (P. Glauca).	100%	1:15	Excellent for all uses. Considered as standard for this table.
Douglas Fir (Pseudotsuga Taxifolia).	Exceeds spruce.	1:15	May be used as substitute for spruce in same sizes or in slightly reduced sizes providing reductions are substantiated. Difficult to work with hand tools. Some tendency to split and splinter during fabrication and considerable more care in manufacture is necessary. Large solid pieces should be avoided due to inspection difficulties. Gluing satisfactory.
Noble Fir (Abies Nobiles).	Slightly exceeds spruce except 8% deficient in shear.	1:15	Satisfactory characteristics with respect to workability, warping, and splitting. May be used as direct substitute for spruce in same sizes providing shear does not become critical. Hardness somewhat less than spruce. Gluing satisfactory.
Western Hemlock (Tsuga Heterpphylla).	Slightly exceeds spruce.	1:15	Less uniform in texture than spruce. May be used as direct substitute for spruce. Upland growth superior to lowland growth. Gluing satisfactory.
Pine, Northern White (Pinus Strobus).	Properties between 85% and 96% those of spruce.	1:15	Excellent working qualities and uniform in properties, but somewhat low in hardness and shock-resisting capacity. Cannot be used as substitute for spruce without increase in sizes to compensate for lesser strength. Gluing satisfactory.

Species of Wood	Strength properties as compared to spruce	Maximum permissible grain deviation (slope of grain)	Remarks
White Cedar, Port Orford (Charaecyparis Lawsoniana).	Exceeds spruce.	1:15	May be used as substitute for spruce in same sizes or in slightly reduced sizes providing reductions are substantiated. Easy to work with hand tools. Gluing difficult, but satisfactory joints can be obtained if suitable precautions are taken.
Poplar, Yellow (Liriodendrow Tulipifera).	Slightly less than spruce except in compression (crushing) and shear.	1:15	Excellent working qualities. Should not be used as a direct substitute for spruce without carefully accounting for slightly reduced strength properties. Somewhat low in shock-resisting capacity. Gluing satisfactory.

Notes for Table 1-1

1. **Defects Permitted.**
   - **a. Cross grain.** Spiral grain, diagonal grain, or a combination of the two is acceptable providing the grain does not diverge from the longitudinal axis of the material more than specified in column 3. A check of all four faces of the board is necessary to determine the amount of divergence. The direction of free-flowing ink will frequently assist in determining grain direction.
   - **b. Wavy, curly, and interlocked grain.** Acceptable, if local irregularities do not exceed limitations specified for spiral and diagonal grain.
   - **c. Hard knots.** Sound, hard knots up to 3/8 inch in maximum diameter are acceptable providing: (1) they are not projecting portions of I-beams, along the edges of rectangular or beveled unrouted beams, or along the edges of flanges of box beams (except in lowly stressed portions); (2) they do not cause grain divergence at the edges of the board or in the flanges of a beam more than specified in column 3; and (3) they are in the center third of the beam and are not closer than 20 inches to another knot or other defect (pertains to 3/8 inch knots—smaller knots may be proportionately closer). Knots greater than 1/4 inch must be used with caution.
   - **d. Pin knot clusters.** Small clusters are acceptable providing they produce only a small effect on grain direction.
   - **e. Pitch pockets.** Acceptable in center portion of a beam providing they are at least 14 inches apart when they lie in the same growth ring and do not exceed 1-1/2 inches length by 1/8 inch width by 1/8 inch depth, and providing they are not along the projecting portions of I-beams, along the edges of rectangular or beveled unrouted beams, or along the edges of the flanges of box beams.
   - **f. Mineral streaks.** Acceptable, providing careful inspection fails to reveal any decay.
2. **Defects Not Permitted.**
   - **a. Cross grain.** Not acceptable, unless within limitations noted in 1a.
   - **b. Wavy, curly, and interlocked grain.** Not acceptable, unless within limitations noted in 1b.
   - **c. Hard knots.** Not acceptable, unless within limitations noted in 1c.
   - **d. Pin knot clusters.** Not acceptable, if they produce large effect on grain direction.
   - **e. Spike knots.** These are knots running completely through the depth of a beam perpendicular to the annual rings and appear most frequently in quarter-sawed lumber. Reject wood containing this defect.

f. Pitch pockets. Not acceptable, unless within limitations noted in 1e.
g. Mineral streaks. Not acceptable, if accompanied by decay (see 1f).
h. Checks, shakes, and splits. Checks are longitudinal cracks extending, in general, across the annual rings. Shakes are longitudinal cracks usually between two annual rings. Splits are longitudinal cracks induced by artificially induced stress. Reject wood containing these defects.
i. Compression wood. This defect is very detrimental to strength and is difficult to recognize readily. It is characterized by high specific gravity, has the appearance of an excessive growth of summer wood, and in most species shows little contrast in color between spring wood and summer wood. In doubtful cases reject the material, or subject samples to toughness machine test to establish the quality of the wood. Reject all material containing compression wood.
j. Compression failures. This defect is caused from the wood being overstressed in compression due to natural forces during the growth of the tree, felling trees on rough or irregular ground, or rough handling of logs or lumber. Compression failures are characterized by a buckling of the fibers that appear as streaks on the surface of the piece substantially at right angles to the grain, and vary from pronounced failures to very fine hairlines that require close inspection to detect. Reject wood containing obvious failures. In doubtful cases reject the wood, or make a further inspection in the form of microscopic examination or toughness test, the latter means being the more reliable.
k. Decay. Examine all stains and discoloration carefully to determine whether or not they are harmless, or in a stage of preliminary or advanced decay. All pieces must be free from rot, dote, red heart, purple heart, and all other forms of decay.

c. Effects of Shrinkage. When the moisture content of a wooden part is lowered, the part shrinks. Since the shrinkage is not equal in all directions, the mechanic should consider the effect that the repair may have on the completed structure. The shrinkage is greatest in a tangential direction (across the fibers and parallel to the growth rings), somewhat less in a radial direction (across the fibers and perpendicular to the growth rings), and is negligible in a longitudinal direction (parallel to the fibers). Figure 1-1 illustrates the different grain directions and the effects of shrinkage on the shape of a part. These dimensional changes can have several detrimental effects upon a wood structure, such as loosening of fittings and wire bracing and checking or splitting of wood members. A few suggestions for minimizing these shrinkage effects are:

(1) Use bushings that are slightly short so that when the wood member shrinks the bushings do not protrude and the fittings may be tightened firmly against the member.

(2) Gradually drop off plywood faceplates by feathering as shown in Figure 1-2.

(3) Thoroughly seal all wood surfaces, particularly end grain and bolt holes, with varnish, epoxy, or other acceptable sealer to slow or prevent moisture changes in the member. (See Section 5, Finishing Wood Structures.)

U.S. Department of Transportation
Federal Aviation Administration

Advisory Circular

Subject: Acceptable Methods, Techniques, and Practices – Aircraft Alterations

Date: 3/3/08
Initiated by: AFS-300

AC No: 43.13-2B

1. PURPOSE. This advisory circular (AC) contains methods, techniques, and practices acceptable to the Administrator for the inspection and alteration on non-pressurized areas of civil aircraft of 12,500 lbs gross weight or less. This AC is for use by mechanics, repair stations, and other certificated entities. This data generally pertains to minor alterations; however, the alteration data herein may be used as approved data for major alterations when the AC chapter, page, and paragraph are listed in block 8 of FAA Form 337 when the user has determined that it is:

a. Appropriate to the product being altered,

b. Directly applicable to the alteration being made, and

c. Not contrary to manufacturer's data.

2. CANCELLATION. AC 43.13-2A, Acceptable Methods, Techniques, and Practices—Aircraft Alterations, dated January 1, 1977, is canceled.

3. REFERENCE. Title 14 of the Code of Federal Regulations (14 CFR) part 43, § 43.13(a) states that each person performing maintenance, alteration, or preventive maintenance on an aircraft, engine, propeller, or appliance must use the methods, techniques, and practices prescribed in the current manufacturer's maintenance manual or Instructions for Continued Airworthiness prepared by its manufacturer, or other methods, techniques, or practices acceptable to the Administrator, except as noted in § 43.16. FAA inspectors are prepared to answer questions that may arise in this regard. Persons engaged in the inspection and alteration of civil aircraft should be familiar with 14 CFR part 43, Maintenance, Preventive Maintenance, Rebuilding, and Alterations, and part 65, subparts A, D, and E of Certification: Airmen Other than Flight Crewmembers, and applicable airworthiness requirements under which the aircraft was type-certificated.

4. COMMENTS INVITED. Comments regarding this AC should be directed to DOT/FAA: ATTN: Aircraft Maintenance Division, 800 Independence Ave., SW., Washington, DC 20591, FAX (202) 267-5115.

ORIGINAL SIGNED By

James J. Ballough
Director Flight Standards Service

CHAPTER 1. STRUCTURAL DATA

100. GENERAL. Structural integrity is a major factor in aircraft design and construction. Addition or removal of equipment involving changes in weight could affect the structural integrity, weight, balance, flight characteristics, reliability, or performance of an aircraft. This chapter is generic in nature and meant to assist the aviation maintenance technician in determining structural integrity. It is not meant to circumvent utilizing a Federal Aviation Administration (FAA) engineer or the Aircraft Certification Office (ACO) when necessary.

101. STRUCTURAL DESIGN PROCESS. Structural design processes follows these steps:

a. Determine the overall load factors.

b. Estimate the resulting loads.

c. Distribute these loads over the aircraft.

d. Determine the material, size, and shape of the part.

e. Calculate the resulting stresses in the part.

f. Compare these stresses with the maximum allowable for the material used.

g. Resize the part as necessary.

102. TYPES OF LOADS AND STRESSES.

a. Limit load factors are the maximum load factors which may be expected during service (the maneuvering, gust, or ground load factors established by the manufacturer for type certification).

b. Aircraft parts may be formed out of different types of material and joined together. Each of those parts carries a load and the fastener that brings these parts together has to carry the load from one part to the other.

c. Every aircraft is subject to different types of structural stress. Stress acts on an aircraft whether it is on the ground or in flight. Stress is defined as a load applied to a unit area of material.

d. Tension is a force acting against another force that is trying to pull something apart.

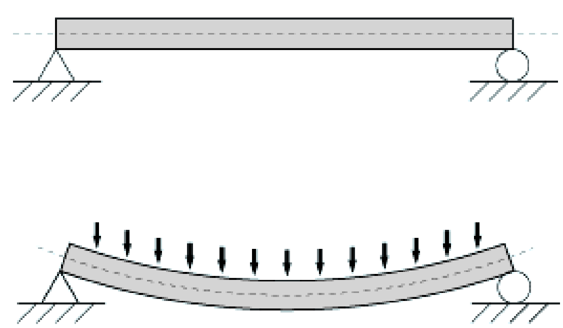
e. Compression is a squeezing or crushing force that tries to make parts smaller.

f. Torsion is a twisting force.

g. Shear stress is when one piece of material slides over another.

h. Bending is a combination of two forces, compression, and tension. During bending stress, the material on the inside of the bend is compressed and the outside material is stretched in tension.

FIGURE 1-1. BENDING OF A BEAM



i. An aircraft structure in flight is subjected to variable stresses due to the varying loads that may be imposed. The designer's problem involves anticipating the possible stresses that the structure will have to endure and build the structure strong enough to withstand these stresses.

103. STATIC LOADS. Static loads are loads which do not undergo change in magnitude or direction during a measurement procedure. Load factors are defined as follows:

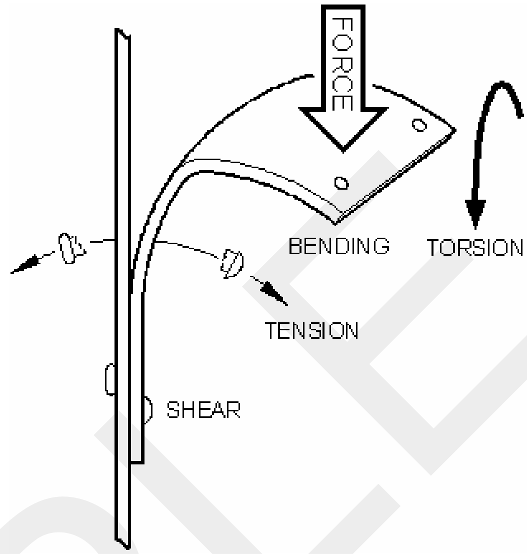
a. Limit load factors are the maximum load factors which may be expected during service (the maneuvering, gust, or ground load factors established for type certification).

b. Ultimate load factors are the limit load factors multiplied by a prescribed factor of safety. Certain loads, such as the minimum ultimate inertia forces prescribed for emergency landing conditions, are given directly in terms of ultimate loads.

c. Static test load factors are the ultimate loads multiplied by the casting, fitting, bearing, and/or other special factors, when applicable. Where no special factors apply, the static test loads are equal to the ultimate loads.

d. Critical static test load factors are the greater of the maneuvering, gust, ground, and inertia load static test load factors for each direction (up, down, starboard, port, fore, and aft).

FIGURE 1-2. TYPICAL LOAD



104. STRUCTURAL SIZING AND ANALYSIS. Design and size your load structures, including wing spars, wing attach fittings, stabilizers, landing gear struts, etc.

a. Static tests using the following load factors are acceptable for equipment installations. The alteration needs to comply with the limit load factors as required by the aircraft's certification basis.

TABLE 1-1. LIMIT LOAD FACTORS

Direction of Force Applied	Normal-Utility Occupant 14 CFR part 23 (CAR 3)	Acrobatic Occupant 14 CFR part 23 (CAR 3)	Items of Mass within the cabin 14 CFR part 23 (CAR 3)	Rotorcraft Occupant and Items of Mass within the cabin 14 CFR part 27 (CAR 6)
Sideward	3.0g	1.5g	4.5 g	8.0g
Upward	3.0g	4.5g	3.0 g	4.0g
Forward	9.0g	9.0g	18.0 g	16.0g
Downward	6.6g	9.0g	---	20.0g
Rearward	---	---	---	1.5 g

*When equipment mounting is located externally to one side, or forward of occupants, a forward load factor of 2.0g is sufficient.

**Due to differences among various aircraft designs in flight and ground load factors, contact the aircraft manufacturer for the load factors required for a given model and location. In lieu of specific information, the factors used for part 23 utility category are acceptable for aircraft that never exceed the speed of 250 knots and the factors used for part 23 acrobatic category.

b. The following is an example of determining the static test loads for a 7-pound piece of equipment to be installed in a utility category aircraft (part 23).

TABLE 1-2. SAMPLE LOAD FACTORS

Load Factors (From the above table)	Static Test Loads (Load factor X 7 pounds)
Sideward 1.5g	10.5 pounds
Upward 3.0g	21.0 pounds
Downward 6.0g	42.0 pounds
Forward 9.0g	63.0 pounds

c. When an additional load is to be added to structure already supporting previously installed equipment, determine the capability of the structure to support the total load (previous load plus added load). If the additional load requires access to applicable design data or the capability to reverse engineer the installation, further assistance may be required from FAA engineering or the ACO or an appropriately rated Designated Engineering Representative (DER).

105. STATIC TESTS.

CAUTION: The aircraft and/or equipment can be damaged in applying static loads, particularly if a careless or improper procedure is used. It is recommended, whenever practicable, that static testing be conducted on a duplicate installation in a jig or mockup which simulates the related aircraft structure. Static test loads may exceed the yield limits of the assemblies being substantiated and can result in partially sheared fasteners, elongated holes, or other damage which may not be visible unless the structure is disassembled. If the structure is materially weakened during testing, it may fail at a later date. Riveted sheet metal and composite laminate construction methods especially do not lend themselves to easy detection of such damage. To conduct static tests:

a. Determine the weight and center of gravity position of the equipment item.

b. Install attachment in the aircraft or preferably in a jig using the applicable static test load factors.

c. Determine the critical ultimate load factors for the sideward, upward, downward, and forward directions. A hypothetical which follows steps (1) through (4) below pertains to the example in Figure 1-3, Hypothetical of Determining Static Test Loads.

(1) Convert the gust, maneuvering, and ground load factors obtained from the manufacturer or FAA engineer or DER to determine the ultimate load factors. Unless otherwise specified in the airworthiness standards applicable to the aircraft, ultimate load factors are limit load factors multiplied by a 1.5 safety factor. (See columns 1, 2, and 3 for items A, B, and C.)

(2) Determine the ultimate inertia load forces for the emergency landing conditions as prescribed in the applicable airworthiness standards. (See items D and E, column 3.)

(3) Determine what additional load factors are applicable to the specific seat, litter, berth, or cargo tiedown device installation. The ultimate load factors are then multiplied by these factors to obtain the static test factors.

(4) Select the highest static test load factors obtained in steps 1, 2, and/or 3 for each direction (sideward, upward, downward, and forward). These factors are the critical static test load factors used to compute the static test load. (See column 6.)

d. Apply a load at center of gravity position (of equipment item or dummy) by any suitable means to demonstrate that the attachment and structure are capable of supporting the required loads. When no damage or permanent deformation occurs after 3 seconds of applied static load, the

AIRCRAFT

INSPECTION, REPAIR & ALTERATIONS

Acceptable Methods, Techniques & Practices

AC 43.13-1B and AC 43.13-2B

U.S. Department of Transportation
FEDERAL AVIATION ADMINISTRATION

This handbook for Aviation Mechanics, Aviation Maintenance Technicians schools (AMT), repair stations, aircraft owners, and homebuilders details the standards for acceptable methods, techniques, and practices for the inspection, repair, and alteration of aircraft. It is a compilation of the two most important Advisory Circulars (ACs) written by the Federal Aviation Administration (FAA) on this topic—namely, *Acceptable Methods, Techniques, and Practices—Aircraft Inspection and Repair* (AC 43.13-1B) and *Acceptable Methods, Techniques, and Practices—Aircraft Alterations* (AC 43.13-2B), which are key references for the Aviation Mechanic FAA Knowledge Exams.

AC 43.13-1B provides details on the materials and practices, health and safety, inspection, repair, and finishes for wood structures, fabric covering, fiberglass and plastics, and metal structures, welding and brazing. It includes chapters dedicated to nondestructive inspection (NDI), corrosion, inspection and protection, aircraft hardware, control cables and turnbuckles, engines, fuel, exhaust, propellers, aircraft systems and components, weight and balance, electrical systems, avionics, and human factors.

AC 43.13-2B is a manual filled with details and instructions for the installation of aircraft components and systems, such as communications, navigation, and emergency systems, anticollision and supplementary lights, skis, oxygen systems in nonpressurized aircraft, rotorcraft external-load devices, cargo slings and external racks, glider and banner tow-hitches, aircraft batteries and more, including guidance on adding or relocating instruments.

These combined manuals provide this pertinent information where no manufacturer repair or maintenance instructions exist. The details and standards for methods and practices covered are applicable to nonpressurized civil aircraft with a gross weight of 12,500 pounds or less. Illustrated throughout; includes a glossary, and a list of useful acronyms and abbreviations.

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