



Designation: F3380 – 19

Standard Practice for Structural Compliance of Very Light Aeroplanes¹

This standard is issued under the fixed designation F3380; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reappraisal. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reappraisal.

1. Scope

1.1 This practice covers simplified methods for satisfying structural requirements of very light aeroplanes. The material was developed through open consensus of international experts in general aviation. This information was created by focusing on Level 1 Normal Category aeroplanes which have a single engine, a maximum take-off mass of not more than 750 kg (1654 lbm), a stalling speed in the landing configuration of not more than 83 km/h (45 knots) Calibrated Airspeed (CAS), an unpressurized fuselage, and are non-aerobatic. The content may be more broadly applicable; it is the responsibility of the applicant to substantiate broader applicability as a specific means of compliance. The topics covered within this practice are: Parts of Structure Critical to Safety, Material Strength Properties and Design Values, Design Properties, and Special Factors.

1.2 An applicant intending to propose this information as Means of Compliance for a design approval must seek guidance from their respective oversight authority (for example, published guidance from applicable Civil Aviation Authorities (CAAs)) concerning the acceptable use and application thereof. For information on which oversight authorities have accepted this practice (in whole or in part) as an acceptable Means of Compliance to their regulatory requirements (hereinafter “the Rules”), refer to the ASTM Committee F44 web page (www.astm.org/COMMITTEE/F44.htm).

1.3 *Units*—The values stated in SI units are to be regarded as standard. The values given in parentheses after SI units are provided for information only and are not considered standard.

1.4 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appro-*

priate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.

1.5 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards*:²

F3114 Specification for Structures

F3115 Specification for Structural Durability for Small Airplanes

F3060 Terminology for Aircraft

2.2 *Other Documents*:

ANC-18 Design of Wood Aircraft Structures³

CMH-17 Composite Materials Handbook⁴

EASA CM-S-006 Certification Memorandum - Certification, Type Design Definition, Material and Process Qualification for Composite Light Aircraft⁵

EASA CS-VLA/Amendment 1 Certification Specifications for Very Light Aeroplanes⁵

3. Terminology

3.1 *Definitions*:

3.1.1 *A and B Values*—See CMH-17.

3.2 See Terminology F3060 for additional definitions and abbreviations.

² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

³ Issued June 1944 by the Army-Navy-Civil Committee on Aircraft Design Criteria (USA). Available from Smithsonian Library, <https://library.si.edu/digital-library/book/designofwoodairc00fore>.

⁴ Available from SAE International (SAE), 400 Commonwealth Dr., Warrendale, PA 15096, <http://www.sae.org>.

⁵ Available from European Union Aviation Safety Agency (EASA), Konrad-Adenauer-Ufer 3, D-50668 Cologne, Germany, <https://www.easa.europa.eu>.

¹ This practice is under the jurisdiction of ASTM Committee F44 on General Aviation Aircraft and is the direct responsibility of Subcommittee F44.30 on Structures.

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4. Significance and Use

4.1 The purpose of this practice is to establish simplified methods that can be used to satisfy the materials, processes, and methods of fabrication requirements of Specification **F3114** and the fatigue strength evaluation requirements of Specification **F3115** for very light aeroplanes as defined in **1.1**.

4.2 EASA CM-S-006 provides additional guidance regarding the relevant requirements for aeroplanes defined in **1.1**.

5. Parts of Structure Critical to Safety

5.1 At least the wing main spar, the horizontal tail, and their attachments to the fuselage should be investigated to determine whether or not their stress levels exceed the values given in **Table 1**.

5.2 The use of the stress levels in **Table 1** may be taken as sufficient evidence, in conjunction with good design practices to eliminate stress concentrations, that structural items have adequate safe lives.

5.3 Higher stress levels need further fatigue investigation using one or a combination of the following methods:

5.3.1 By a fatigue test, based on a realistic operating spectrum.

5.3.2 By a fatigue calculation using strength values, which have proven to be sufficient by fatigue tests of specimens or components.

6. Material Strength Properties and Design Values

6.1 Material specifications should be those contained in documents either specifically accepted by the CAA or those having been prepared by an organization or person that the CAA accepts has the necessary capabilities. In defining design properties, these material specification values should be modified or extended, or both, as necessary by the constructor to take account of manufacturing practices (for example method of construction, forming, machining and subsequent heat treatment).

6.2 Test temperature for materials used in an essential component or structure where thermal effects are significant under normal operating conditions:

6.2.1 For white-painted surface and vertical sunlight: 54 °C. If the test cannot be performed at this temperature, an additional factor of 1.25 should be used.

6.2.2 For other colored surfaces, the curve in **Fig. 1** may be used to determine the test temperature.

6.3 When the manufacturer is unable to provide satisfactory statistical justification for A and B values, especially in the case of manufacturing of composite materials, a safety super factor should be applied to ensure that A and B values are met.

TABLE 1 Allowable Normal Stress

Material Used	Allowable Normal Stress Level of Maximum Limit Load
Glass rovings in epoxy resin	25 daN/mm ²
Carbon fiber rovings in epoxy resin	40 daN/mm ²
Wood	In accordance with ANC-18
Aluminum Alloy	Half of rupture tensile strength
Steel Alloy	Half of rupture tensile strength

7. Special Factors

7.1 For composite structures, a special test factor that takes into account material variability and the effects of temperature and absorption of moisture must be used.

7.2 For the substantiation of composite structures, unless more rational means are agreed by the CAA, one of the following may be used:

7.2.1 An additional factor of 1.2 for moisture conditioned specimen tested at maximum service temperature, providing that a well established manufacturing and quality control procedure is used.

7.2.2 An additional factor of 1.5 for specimen tested with no specific allowance for moisture and temperature.

NOTE 1—For cold-cured structures, it may be assumed that the completed structure is fully moisture conditioned.

NOTE 2—The factor in **7.2.1** may be varied based on the coefficient of variation that the manufacturer is able to show for this product (see **Table 2**).

7.3 Coefficient of Variation:

7.3.1 For a population with mean *M* and standard deviation *s*, the coefficient of variation, *Cv*, is defined by:

$$Cv = \sigma/M \quad (1)$$

7.3.2 The coefficient of variation is frequently expressed as a percentage, in which case:

$$Cv(\%) = 100 \sigma/M \quad (2)$$

7.3.3 When the population of coefficient of variation is estimated from tests of critical structural features, the results from tests of at least six specimens should be used.

7.3.4 The sample coefficient of variation should be adjusted to obtain a 95 % confidence estimate of the population coefficient of variation, which may be used in **Table 2**.

7.3.5 In the absence of a more rational method, this may be done by multiplying the sample coefficient of variation by a Factor *F*, defined by:

$$F = \frac{1 + U_p \left\{ \frac{1}{2f} \left(1 - \frac{c^2 U_p^2}{n} \right) + \frac{c^2}{n} \right\}^{1/2}}{1 - \frac{c^2 U_p^2}{n}} \quad (3)$$

where:

U_p = the standardized normal variate corresponding to the confidence level being used (for 95 % confidence, *U_p* = 1.6452),

n = the number of specimens in the sample,

f = the number of statistical degrees of freedom [(*n*−1)], and

c = the population coefficient of variation. The value of the Factor *F* is relatively insensitive to the value of *c* used; in the absence of more rational data, a value of 0.2 should be used.

8. Keywords

8.1 composite light aircraft; composite structures; normal category; small aeroplane; small airplane