INTERNATIONAL

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Standard Practice for Aircraft Simplified Loads Criteria[1]

This standard is issued under the fixed designation F3396/F3396M; 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 reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This practice provides an acceptable means of meeting the airworthiness requirements for the flight design loads and conditions of small normal category level 1 and 2 aeroplanes. The material was developed through open consensus of international experts in general aviation. This information was created by focusing on Normal Category aeroplanes. 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: Simplified Design Load Criteria, Acceptable Methods for Control Surface Loads Calculations, Acceptable Methods for Primary Control System Loads Calculations, and Control Surface Loading (Level 1 Aeroplanes).

1.2 This practice is applicable to normal category, low-speed, level 1 and 2 aeroplanes. Use of the term aeroplane used throughout this practice will mean "normal category, low-speed, level 1 or 2 aeroplane," unless otherwise stated.

1.3 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 CAAs) concerning the acceptable use and application thereof. For information on which oversight authorities have accepted this standard (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).

1.4 This document may present information in either SI units, English Engineering units, or both. The values stated in each system are not necessarily exact equivalents; therefore, to ensure conformance with the standard, each system shall be used independently of the other, and values from the two systems shall not be combined.

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

1.6 *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]

F3060 Terminology for Aircraft

F3116/F3116M Specification for Design Loads and Conditions

2.2 *U.S. Code of Federal Regulations:*[3]

14 CFR Part 23 Airworthiness Standards: Normal, Utility, Aerobatic and Commuter Category Airplanes (Amendment 62)

2.3 *European Aviation Safety Agency (EASA) Regulations:*[4]

CS-23, Amendment 4 Certification Specifications for Normal, Utility, Aerobatic, and Commuter Category Aeroplanes

CS-VLA, Amendment 1 Certification Specifications for Very Light Aeroplanes

3. Terminology

3.1 A listing of terms, abbreviations, acronyms, and symbols related to aircraft covered by ASTM Committees F37 and F44 airworthiness design standards can be found in Terminology F3060. Items listed below are more specific to this standard.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *chordwise, n*—directed, moving, or placed along the chord of an airfoil section.

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[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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[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] Available from U.S. Government Publishing Office (GPO), 732 N. Capitol St., NW, Washington, DC 20401, http://www.gpo.gov.

[4] Available from the European Aviation Safety Agency (EASA), Postfach 10 12 53, D-50452 Koeln, Germany, https://www.easa.europa.eu/.

3.2.2 *downwash, n*—the downward deflection of an airstream by an aircraft wing.

3.2.3 *flight envelope, n*—any combination of airspeed and load factor on and within the boundaries of a flight envelope that represents the envelope of the flight loading conditions specified by the maneuvering and gust criteria.

3.2.4 *flight load factor, n*—represents the ratio of the aerodynamic force component (acting normal to the assumed longitudinal axis of the aeroplane) to the weight of the aeroplane. A positive flight load factor is one in which the aerodynamic force acts upward, with respect to the aeroplane.

3.2.5 *propeller slipstream, n*—the airstream pushed back by a revolving aircraft propeller.

3.2.6 *spanwise, n*—directed, moving, or placed along the span of an airfoil.

3.2.7 *winglet, n*—a nearly vertical airfoil at an aeroplane's wingtip.

3.3 *Symbols and Abbreviations:*

3.3.1 C_{NA}—maximum aeroplane normal force coefficient

3.3.2 M_C—design cruising speed (Mach number)

3.3.3 *MCP*—maximum continuous power

3.3.4 n_1—aeroplane positive maneuvering limit load factor

3.3.5 n_2—aeroplane negative maneuvering limit load factor

3.3.6 n_3—aeroplane positive gust limit load factor at V_C

3.3.7 n_4—aeroplane negative gust limit load factor at V_C

3.3.8 n_{flap}—aeroplane positive limit load factor with flaps fully extended at V_F

3.3.9 $V_{A\ min}$—minimum design maneuvering speed = $15.0\sqrt{n_1 W/S}$ knots (however this need not exceed V_C used in design)

3.3.10 $V_{C\ min}$—minimum design cruising speed = $17.0\sqrt{n_1 W/S}$ knots (however this need not exceed $0.9V_H$, see 5.2.5.2)

3.3.11 $V_{D\ min}$—minimum design dive speed = $24.0\sqrt{n_1 W/S}$ knots (however this need not exceed $1.4V_{C\min}\sqrt{n_1/3.8}$)

3.3.12 V_E—design dive speed at zero or negative load factor

3.3.13 $V_{F\ min}$—minimum design flap speed = $11.0\sqrt{n_1 W/S}$ knots

3.3.14 V_{SF}—stalling speed with flaps fully extended

4. Significance and Use

4.1 This practice provides one means for determining the aeroplane structural loads for flight, control surfaces, and control systems. This practice satisfies the simplified loads requirements set forth in Specification F3116/F3116M for Normal Category Aeroplanes.

5. Simplified Design Load Criteria

5.1 *Limitations:*

5.1.1 The methods provided in this section provide one possible means (but not the only possible means) of compliance and can only be applied to Normal Category, low-speed, level 1 and level 2 aeroplanes.

5.1.2 These methods may be applied to aeroplanes meeting the following limitations without further justification:

5.1.2.1 A single engine excluding turbine powerplants.

5.1.2.2 A main wing located closer to the aeroplane's center of gravity than to the aft, fuselage-mounted, empennage.

5.1.2.3 A main wing that contains a quarter-chord sweep angle of not more than 15° fore or aft.

5.1.2.4 A main wing that is equipped with trailing-edge controls (ailerons or flaps, or both).

5.1.2.5 A main wing aspect ratio not greater than 7.0.

5.1.2.6 A main wing that does not have winglets, outboard fins, or other wingtip devices.

5.1.2.7 A horizontal tail aspect ratio not greater than 4.0.

5.1.2.8 A horizontal tail volume coefficient not less than 0.34.

5.1.2.9 A vertical tail aspect ratio not greater than 2.0.

5.1.2.10 A vertical tail planform area not greater than 10 % of the wing planform area.

5.1.2.11 Horizontal and vertical tail airfoil sections must both be symmetrical.

5.1.3 This section may be used outside of the limitations in 5.1.2 when evidence can be provided that the method provides safe and reliable results.

5.1.4 Aeroplanes with any of the following design features shall not use this section:

5.1.4.1 Canard, tandem-wing, close-coupled, or tailless arrangements of the lifting surfaces;

5.1.4.2 Biplane or multiplane wing arrangements;

5.1.4.3 V-tail or any arrangement where the horizontal stabilizer is supported by the vertical stabilizer (T-tail, cruciform-tail (+), etc.);

5.1.4.4 Wings with slatted lifting surfaces; and

5.1.4.5 Full-flying stabilizing surfaces (horizontal and vertical).

5.2 *Flight Loads:*

5.2.1 Each flight load may be considered independent of altitude and, except for the local supporting structure for dead weight items, only the maximum design weight conditions must be investigated.

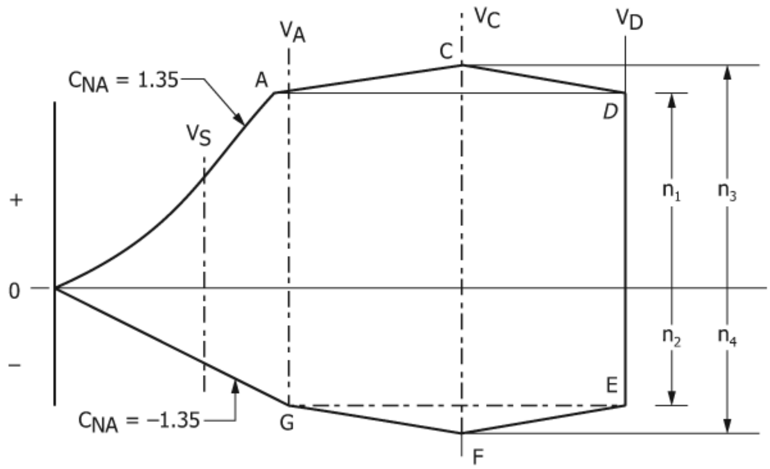
5.2.2 Table 1 must be used to determine values of n_1, n_2, n_3, and n_4, corresponding to the maximum design weights. Fig. 1 presents a generalized flight envelope.

5.2.3 Fig. 2 and Fig. 3 must be used to determine values of n_3 and n_4, corresponding to the minimum flying weights, and, if these load factors are greater than the load factors at the

TABLE 1 Minimum Design Limit Flight Load Factors

Flight Load Factors		Not Approved for Aerobatics	Approved for Aerobatics
Flaps Up	n_1	3.8	6.0
	n_2	–0.5 n_1	
	n_3	Find from Fig. 2	
	n_4	Find from Fig. 3	
Flaps Down	n_{flap}	0.5 n_1	
	n_{flap}	Zero[A]	

[A] Vertical wing load may be assumed equal to zero and only the flap part of the wing need be checked for this condition.



NOTE 1—Conditions "C" and "F" of Fig. 1 need only be investigated when n_3W/S or n_4W/S are greater than n_1W/S and n_2W/S, respectively.

NOTE 2—Condition "G" need not be investigated when the supplementary condition specified for a rear lift truss is investigated.

FIG. 1 Generalized Flight Envelope

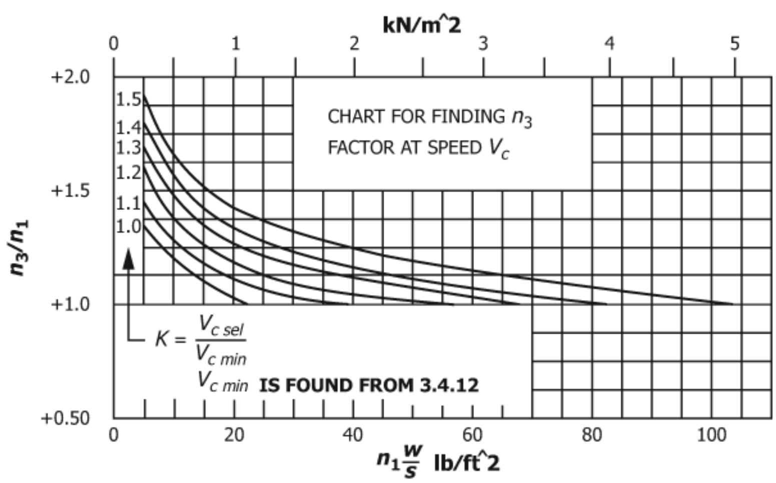


FIG. 2 Chart for Finding n_3 Factor at Speed V_C

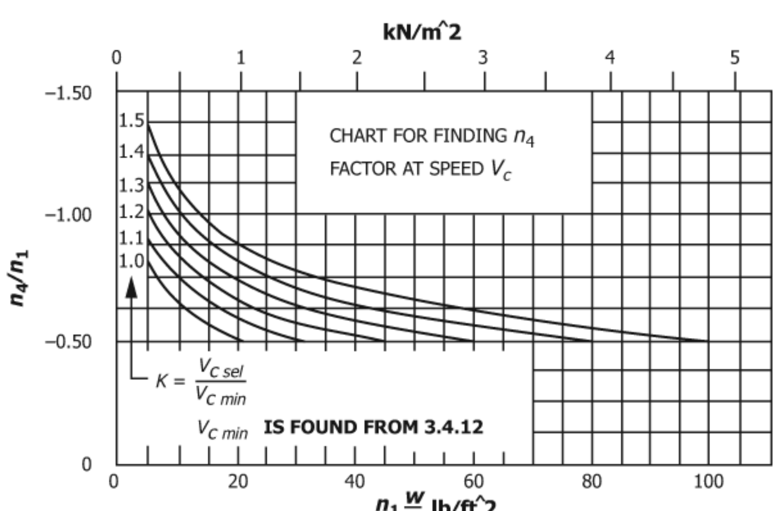


FIG. 3 Chart for Finding n_4 Factor at Speed V_C