CIVIL AERONAUTICS MANUAL 8

U. S. Department of Commerce Civil Aeronautics Administration

Civil Aeronautics Manuals and supplements thereto are issued by the Office of Aviation Safety, Civil Aeronautics Administration, for the guidance of the public and are published in the Federal Register and the Code of Federal Regulations.

Supplement No. 4 January 20, 1956

Subject: Design Speeds and Loads
Spray Tank Testing

This supplement is issued to provide holders of Civil Aeronautics Manual 8 with changes to Appendix B.

A change in the testing procedures for spray tanks offers a more rational method of calculation. As presently worded, the suggested pressure formula for testing tank depths of 25 inches or greater results in an unduly conservative value. The changes to paragraphs .2100 and .211 allow the substitution of the design air speeds of section 3.184 of CAR 3 in order to take advantage of those provisions of Part 3 which permit design speeds to be limited by V_h.

Remove and destroy the following pages:	Insert in lieu thereof the following pages:
.2-.203 and .21-.2120	.2-.203 and .21-.2120
.3511-.3512	.3511-.3512
Figure .2131 and Table .214	Figure .2131 and Table .214
	Figure .3511

Ink revisions:

Add Figure .3511 to the end of the list of figures in the Table of Contents for Appendix B.

NOTE: New and revised material is indicated by brackets [ ]

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for E. B. Franklin
Acting Director
Office of Aviation Safety

Attachments

.2 STRENGTH CRITERIA

.20 General

.200 LOADS. The strength criteria of the following sections are specified in terms of limit and ultimate loads. Limit loads are the maximum loads anticipated in service. Ultimate loads are equal to the limit loads multiplied by the factor of safety.

.2000 *Applicability of Loads*. The air and ground loads specified in sections .21 and .22 are considered to be adequate for design of a conventional type aircraft suitable for agricultural and similar special purposes and may be used without further substantiation. For unconventional type aircraft for which little experience is available or for which it is evident that the loadings specified in the following sections are either unconservative or inapplicable, the applicant should propose suitable loading criteria for approval or comment by CAA. The term unconventional as used above refers to the basic design and Aerodynamic characteristics of the airplane as a whole and/or its major components and for which considerable experience and reliable test data are already available.

.201 FACTOR OF SAFETY. The factor of safety should be 1.5 unless otherwise specified.

.202 STRENGTH AND DEFORMATIONS. The structure should be capable of supporting limit loads without suffering detrimental permanent deformations. At all loads up to limit loads the deformation should be such as not to interfere with the safe operation of the airplane. The structure should be capable of supporting ultimate loads without failure for at least three seconds, except that when proof of strength is demonstrated by dynamic tests simulating actual conditions of load application, the three-second limit does not apply.

.203 PROOF OF STRUCTURE. Structural analysis may be used for proof of compliance with these criteria provided the structure conforms to types for which experience has shown such methods to be reliable. Structural static tests or dynamic tests, including flight tests, may also be used to demonstrate compliance with these criteria. If desired, combinations of structural tests, flight tests, and analyses may be employed. If static tests are used for proof of compliance, these tests should be carried to ultimate load unless supplemented by analyses. No material correction factor need be applied in cases of tests of structural components. If dynamic tests, including flight tests, are used for demonstration of compliance, they need only be carried to 1.15 times limit load and need not be supplemented by analyses. In the event that dynamic tests, including flight tests are employed, the aircraft used for the tests should be instrumented sufficiently to show that the design conditions have been met. In all cases certain portions of the structure should be subjected to tests as described in section .216.

.21 Flight Loads

.210 GENERAL. The flight loads specified may be considered to be independent of altitude and only the maximum design weight condition need be investigated. If loading conditions other than those specified are used, it should be shown that the level of safety specified will be met at all critical weights between the minimum design weight and the maximum design weight with any practicable distribution of disposable load within expected operating limits. The loads and loading conditions specified in the following sections are the minimum for which strength should be provided in the structure. These loads and loading conditions will generally cover loads incident to flight, but will not necessarily cover such loads as ground handling loads.

.2100 *Design Air Speeds.* Design air speeds include V_M(design maneuvering speed) and V_d (design diving speed). These speeds may be selected by the aircraft designer, except as follows: (a) the selected design diving speed need not be more than 1.50 V_M, but should not be less than 1.40 times V_M; (b) the design maneuvering speed should be at least equal to the speed obtained from Figure .2100 for the maximum wing loading W/S of the design.[However, V_M need not exceed .9 V_h.]

.2101 *Load Factors.* The load factors specified in the following paragraphs represent load factors acting perpendicular or parallel as the case may be to the assumed longitudinal axis of the airplane. To obtain loads from the load factors specified, multiply the weight in pounds of the supported object by the load factor.

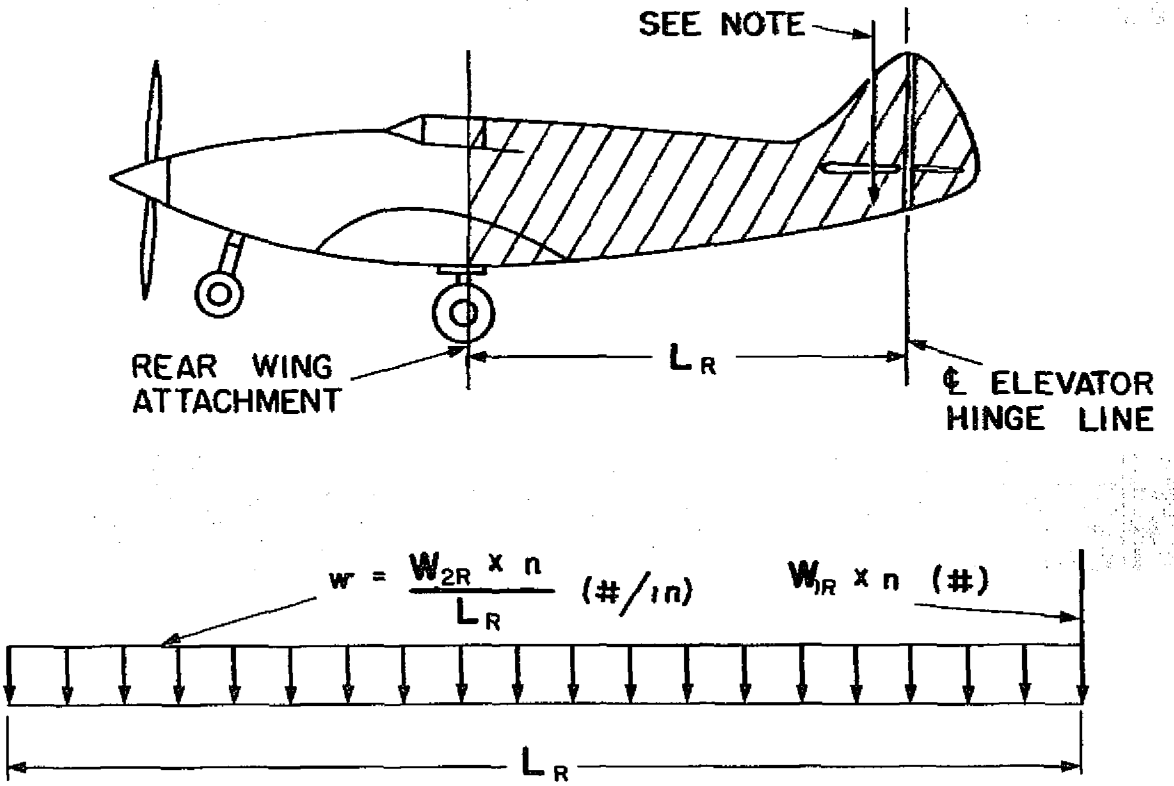
.211 FLIGHT LOAD FACTORS. The strength and deformation criteria of section .202 should be met for the airplane as a whole and the supports for dead weight items in the airplane at a limit positive vertical flight load factor of 4.2 and a limit negative vertical flight load factor of 1.0. [However, the limit positive vertical load factor need not exceed the maximum load factor obtainable at V_D.]

.212 WING AND WING SUPPORTING STRUCTURE DESIGN CONDITIONS. The primary wing structure and the structure affected directly by wing loads should meet the criteria of section .202 using the applied loads specified in sections .2120 through .2124. The wing may be assumed as a free body and the wing loads balanced by reactions at the wing to fuselage attach points. Although no specific unsymmetrical loading is specified, the wing structure should also be capable of sustaining unsymmetrical loads. See section .2134 for design loads on dead weight items and their supports. For biplane type airplanes, the distribution of loading between the upper and lower wings of the cellule may be found from Figure .212a. Figure .212b illustrates the wing loading conditions of sections .2120, .2121, and .2122.

.2120 *Positive High Angle of Attack Condition.* A limit loading per square foot of wing area, with upward and forward acting components, should be uniformly distributed over the wing span. The upward acting component should be equal to the maximum value of W/S multiplied by the positive of flammable materials should be vented overboard and provided with positive seal filler caps. All flammable material discharge, vent, and drainage points should be located so as to obviate possible ignition from engine exhaust or other source. Care should be taken to provide leak proof seams and connections. All metal components, including equipment items of the airplane, should be electrically bonded by means of a flexible conductor attaching the component to the basic structure of the airplane.

[All liquid containers should be baffled so as to prevent rapid movement of their contents and sudden shifting of the aircraft center of gravity. The containers should be designed and tested for pressures obtained from Figure .3511. The g values shown in the figure are the maximum anticipated in flight for the aircraft in which the tank is installed. In using Figure .3511, first select the g value, then obtain the corresponding test pressure shown for the tank height. In no case should the limiting pressure be less than 3.5 psi. Where spraying is done with highly volatile and flammable liquids or where the tank has a return line, it is recommended that an additional pressure differential of the order of 1.5 psi be included.]

.3512 *Aircraft Structure Covering.* Where flammable materials can impinge directly on surfaces of the airplane during dispensing operations, such surfaces should be at least flame resistant.



W_{1R} = WEIGHT OF HORIZONTAL AND VERTICAL TAILS

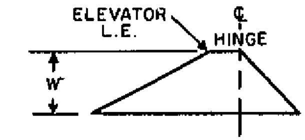
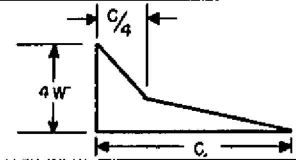
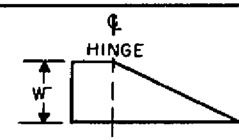
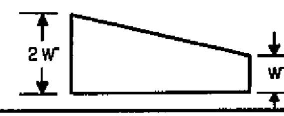
W_{2R} = WEIGHT OF ALL ITEMS IN FUSELAGE AFT OF REAR WING ATTACHMENT INCLUDING STRUCTURE WEIGHT BUT EXCLUDING TAIL (USE WEIGHT ITEMS FOR MOST AFT c.g.)

n = LOAD FACTOR FROM SECTION .2131

NOTE: FOR AFT FUSELAGE OVERALL DESIGN THE HORIZONTAL AND VERTICAL TAIL LOADS FROM SECTION .214 MAY BE ASSUMED CONCENTRATED AT 50% OF THE TAIL SURFACE CHORD.

Figure .2131.—Typical Aft Fuselage Loading Diagram

TABLE .214

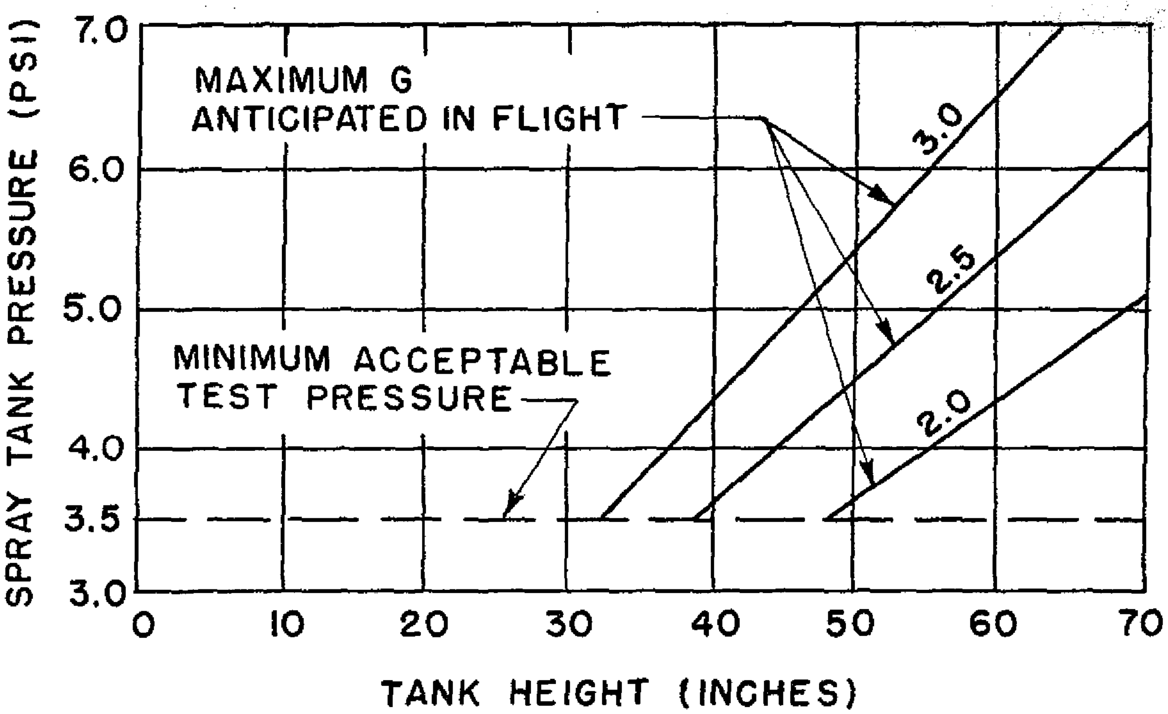
AVERAGE LIMIT CONTROL SURFACE LOADINGS			
SURFACE	DIRECTION OF LOADING	MAGNITUDE OF LOADING	CHORDWISE DISTRIBUTION
HORIZONTAL TAIL	(a) UP AND DOWN	FIGURE .214 CURVE ③ *	Ⓐ 
	(b) DOWN	FIGURE .214 CURVE ③ **	Ⓑ 
	(c) UP	.60 x DOWN LOAD (b) **	
VERTICAL TAIL	(a) RIGHT OR LEFT	FIGURE .214 CURVE ③ *	SAME AS Ⓐ ABOVE
	(b) RIGHT OR LEFT	FIGURE .214 CURVE ② **	SAME AS Ⓑ ABOVE
AILERON	(a) UP AND DOWN	FIGURE .214 CURVE ④ *	Ⓒ 
WING FLAP	(a) UP	FIGURE .214 CURVE ②	Ⓓ 
TRIM TAB	(a) UP AND DOWN	FIGURE .214-CURVE ② *	SAME AS Ⓓ ABOVE

[NOTE - If the design maneuvering speed, V_M, selected for design is different from the value specified in figure .2100, the values marked * shall be multiplied by

$$\left[\frac{V_M \text{ selected}}{V_M \text{ per fig. .2100}}\right]^2$$

and values marked ** shall be multiplied by

$$\left[\frac{V_M \text{ selected}}{V_M \text{ per fig. .2100}}\right].$$



SPRAY TANK PRESSURE
FIGURE .3511

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