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20 May 1987
SUPERSEDING
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18 May 1960

MILITARY SPECIFICATION

AIRPLANE STRENGTH AND RIGIDITY MISCELLANEOUS LOADS

This specification is approved for use within the Naval Air Systems Command, Department of the Navy, and is available for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification contains the strength and rigidity requirements for miscellaneous loads applicable to acquisition of airplanes.

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications. The following specifications form a part of this specification to the extent specified herein. Unless otherwise specified, the issues of these documents shall be those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation.

SPECIFICATIONS

MILITARY

MIL-D-8708	Demonstration Requirements for Airplanes.
MIL-A-8867	Airplane Strength and Rigidity - Ground Tests.
MIL-A-8868	Airplane Strength and Rigidity - Data and Reports.

(Copies of specifications required by contractors in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting activity.)

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Systems Engineering and Standardization Department (Code 93), Naval Air Engineering Center, Lakehurst, NJ 08733-5100, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A FSC 1510

2.2 Order of precedence. In the event of a conflict between the text of this specification and the references cited herein (except for associated detail specifications, specification sheets or MS standards), the text of this specification shall take precedence. Nothing in this specification, however, shall supersede applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Loads. The loads specified in 3.2, 3.3, and 3.4 are ultimate loads. For paragraphs other than 3.2, 3.3, and 3.4, the loads are limit loads.

3.2 Crash loads. The loads and loading conditions specified herein are ultimate and are applicable to the design of crew seats, passenger seats, troop seats, litters, capsules, mechanisms for holding canopies and doors in their open positions, attachments of equipment items, cargo, engines, fuel tanks, turrets, and aerial delivery equipment, and their carry-through structures. These loads may be neglected for those items the failure of which could not result in injury to personnel or prevent egress from the crashed airplane. Fuel tanks shall contain that fuel which remains after one-half of the total internal fuel has been expended in a normal manner. The loads of 3.2.1 shall apply, except that litter loads shall be in accordance with 3.2.2.

3.2.1 Crash load factors. The minimum longitudinal, vertical, and lateral load factors shall equal the ultimate load factors required for the strength of crew or passenger seats as specified in the applicable specifications for such seats, or shall be in accordance with Table I if no seat specification is applicable.

TABLE I. Longitudinal load factors for seat installations. 1/

Type of airplane	Pilot and other flight deck crew	Nonflight deck crew passengers, and troops
All carrier-based airplanes. All land-based airplanes except VR, VP, , VS, VU, VA, VE, VT or VC 2/	40	40
Land-based VR, VP, VE, VS, VU, VA, or VT 2/	20	20
Land-based VC	20	10

TABLE I. Longitudinal load factors for seat installations. 1/ - Continued

1/ The longitudinal load factor shall be directed in all forward azimuths within 20° from the longitudinal axis. The vertical load factor shall be directed downward, normal to the longitudinal axis, and equal to one-half of the longitudinal values. The specified load factors shall act separately.

2/ Mission symbols:

A = Attack
C = Cargo
E = Electronic
P = Patrol
R = Reconnaissance
S = Antisubmarine
T = Trainer
U = Utility

3.2.2 Litter installation loads. For litter installations, the following load factors, acting separately, shall apply to a 250-pound litter load:

Longitudinal	8.0 forward
Lateral	1.5 to right and to left
Vertical	4.5 down
	2.0 up

3.3 Assisted takeoff. The loads specified in this paragraph shall be considered as airplane loading conditions rather than local loading conditions. A forward acting load of 2.5 times the rated thrust at 60°F shall act separately and in combination with all critical combinations of the following inertial loads acting at the attachments of each unit: A downward load of 3.0W, an upward load of 1.5W, and a lateral load of 1.5W to the right and alternately to the left, in which W is the weight of the fully loaded unit.

3.4 Ditching. When the ditching specified ultimate loads are applied to the structure, there shall be no structural failure which, if occurring at sea, would cause the airplane to submerge rapidly, cause injury to the crew, or in any other way prevent the crew from making a satisfactory escape from the ditched airplane. In general, it is unnecessary to provide strength for preventing failures which do not lead to complete rupture of the local structure concerned. It is intended that strength be provided only to the extent necessary to prevent failures which reduce the crew's chance of effecting a safe escape.

3.4.1 Water pressures. Bomb doors, hatch covers, windows, wheel well covers, and other structures covering cutout areas of the fuselage structure, failure of which would cause undesirable water behavior or allow rapid entry of water, shall not fail under the pressure specified in Table II, when located in the areas over which these pressures are specified to act. Structures covering cutout areas lying in any one of the following combinations of areas, designated in column 1 of Table II, shall be assumed to be loaded simultaneously: a and b, b and c, c and d, and d and e. Strength shall be provided in the carry-through structures supporting the doors, windows, and covers to the extent, and in the amount required to assure

compliance with the general requirements stated in 3.4. Table II defines the pressures and the areas over which these pressures are specified to act. The areas are bounded by the longitudinal stations in column 2, where these stations are specified in percent of the overall length of the airplane aft of the most forward portion of the airplane structure. Columns 3 and 4 specify the pressures to be applied, between the longitudinal stations indicated in column 2, to the lower and upper halves of the fuselage, respectively. These pressures are to be considered as normal pressures.

TABLE II. Water pressures in ditching.

Area	Longitudinal station (in percent)	Pressure over lower half of fuselage, psi	Pressure over upper half of fuselage, psi
a	0 - 5	12	12
b	5 - 10	12	6
c	10 - 25	8	0
d	25 - 60	6	0
e	60 - 80	4	0

3.5 Floor strength. The limit flight loads floor pressures shall be 75 n_z pounds per square foot (psf) for personnel floors, 100 n_z psf for low-density cargo areas, and 300 n_z psf for all other cargo areas where n_z is the maximum symmetrical flight limit load factor. The total load in pounds in any particular area, however, shall be as determined by pertinent weight and balance limitations. Cargo compartment flooring, if constructed in a conventional manner (floor panels attached to permanently installed transverse and longitudinal beams), shall withstand without undue surface wear or evidence of fatigue failure, 1,000 complete trips in a fixed path, of a steel wheel, 8 inches in diameter, with a rim 2-1/2 inches wide, under a 1,000-pound load.

3.6 Control system loads. The pilot-applied loads of Table III shall apply.

3.6.1 Dual control systems. For airplanes which are provided with dual control systems, 75 percent of the loads specified in Table III shall be applied simultaneously at each of the control stations.

3.6.2 Duplicate control systems. For airplanes provided with duplicate control systems, 100 percent of the control system loads shall be applied to each system, assuming the other system to be disconnected.

3.6.3 Powered control systems. For airplanes equipped with powered control systems, the power system shall be considered operative, and also, inoperative.

TABLE III. Pilot applied loads.

Airplane control	Cockpit control	Number of forces	Magnitude of each force (pounds)	Point of application	Direction
1	2	3	4	5	6
Lateral	Stick	1	100	Top of stick grip	A lateral force perpendicular to a straight line joining the top of the stick grip and the pivot point
	Wheel	2	80	One force at any point on circumference of wheel, other force at diametrically opposite point	Each force tangent to wheel rim acting in opposite directions
		1	100	On circumference of wheel	Tangent to wheel rim in plane of wheel
Longitudinal	Stick	1	200	Top of stick grip	A longitudinal force perpendicular to a straight line joining the top of the stick grip and the pivot point
	Wheel	2	100	One force at any point on circumference of wheel, other force at diametrically opposite point	Each force in same direction perpendicular to the plane of the wheel
		1	100	Any point on circumference of wheel	Perpendicular to the plane of the wheel

TABLE III. Pilot applied loads. - Continued

Airplane control	Cockpit control	Number of forces	Magnitude of each force (pounds)	Point of application	Direction
1	2	3	4	5	6
Directional	Rudder pedal	1	300	Point of contact of foot with pedal	Parallel to the projection on the airplane plane of symmetry of a line connecting the point of application and the pilot's hip joint, with the pilot's seat in its mean flying position
		2	300	Each force at point of contact of foot with each pedal	Each force in same direction parallel to the projection on the airplane plane of symmetry of a line connecting the point of application and the pilot's hip joint, with the pilot's seat in its mean flying position
Brake	Brake pedal	1	300	Point of contact of foot with pedal	Parallel to the projection on the airplane plane of symmetry of a line connecting the point of application and the pilot's hip joint, with the pilot's seat in its mean landing position
		2	300	Each force at point of contact of foot with each pedal	Each force in same direction parallel to the projection on the airplane plane of symmetry of a line connecting the point of application and the pilot's hip joint, with the pilot's seat in its mean landing position

TABLE III. Pilot applied loads. - Continued

Airplane control	Cockpit control	Number of forces	Magnitude of each force (pounds)	Point of application	Direction
1	2	3	4	5	6
Flap, tab, stabilizer, spoiler, alighting gear, arresting hook, and wing-folding operating control	Crank wheel, or lever operated by push or pull force	1	$\frac{(1 + R) \times 50}{3}$ but not less than 50 nor more than 150 R = radius in inches	Circumference of wheel or grip of crank or lever	Any angle within 20° of plane of control
	Small wheel or knob	133 inch-pounds if operated only by twisting			
		100 lbs if operated only by push or pull			

3.6.4 Reactions. Reactions to the loads specified in 3.6 shall be provided as follows:

a. By the control system stops only.

b. By the control system locks only.

c. By components specifically provided for reacting pilot-applied loads.

d. By the irreversible mechanism only, with the irreversible mechanism locked with the control surface in all positions within its limits of motion.

e. By the attachments of the longitudinal control system to the control surface horn only, with the cockpit longitudinal control in all positions within its limits of motion.

f. By the attachments of the lateral control system to either control surface horn only, with the cockpit lateral in all positions within its limits of motion.

g. By the attachments of the directional control system to the control surface horn only, with the cockpit directional control in all positions within its limits of motion.

3.7 Tail-to-wind loads. Loads on ailerons, elevators, and rudder(s) shall be those resulting from a 70-knot horizontal tailwind. The magnitude and distribution of the aerodynamic forces shall be determined by a rational analysis approved by the acquisition activity, or alternatively, the load at each station shall vary linearly from zero at the hinge line to a maximum value at trailing edge which is proportional at each station to the chord length aft of the hinge line, and the resulting moment shall be

$$H = 16.5\ cS$$

where:

H = hinge moments, foot-pounds.
c = average chord length of control surface aft of hinge line, feet.
S = area of control surface aft of hinge line, square feet.

The direction of the resulting load, the position of the surface, and the location of reactions shall be as specified in Table IV.

3.8 In-flight refueling loads. The following specified loads apply for probe-and-drogue and flying-boom types of in-flight refueling system.

3.8.1 Probe and drogue system.

3.8.1.1 Impact. The loads shall be those resulting from a closing speed of 10 knots. The effective weight at the tip of the probe-mast shall be 100 pounds (hose, fuel, coupling equipment, probe-mast).

3.8.1.2 Gust. The loads including dynamic loads on the mast probe shall be those resulting from encountering a 30-foot-per-second (fps)-EAS gust. The gust shall be considered to act at all positions from 0° to 360° in a direction normal to the flight path.

3.8.1.3 Probe and drogue loads. The design limit loads for the probe, other than the droge impact loads are 1000 pounds tension, 1000 pounds radial, and 2000 pounds compression. The tension and radial loads shall act separately, and alternately, shall act in combination.

3.8.1.4 Tanker airplane. A hose load of 2,770 pounds shall be applied in a 160° cone about the normal trial axis.

3.8.2 Flying boom systems.

3.8.2.1 Slipway and slipway doors. Air loads and other loads normally imposed on the structure shall be sustained by the slipway and its doors in both the open and closed positions, in addition to impact loads imposed by contact of the nozzle. Ultimate design loads shall be at least 2,000 pounds laterally and 5,000 pounds vertically.

TABLE IV. Tail-to-wind loads.

1	2	3	4	5
Condition	Control surface	Direction of load	Position of surface	Location of reaction
1	Lateral	Down on each aileron	Neutral and unlocked	At control stick or wheel grip
2		Down on either aileron and up on the other	Against stops	At stops
3	Longi-tudinal	Down		
4		Up		
5	Direction-al	Right		
6		Left		
7	Lateral	Down on either aileron and up on the other		
8	Longi-tudinal	Up	Locked	At locks
9		Down		
10	Direction-al	Right		
11		Left		

3.8.2.2 Reception coupling. The receptacle shall sustain the following ultimate design loads:

a. Emergency disconnect: A load of 2(7,000/Cos A) in tension applied at the nozzle universal in a direction at angle A with respect to the receptacle axis, where maximum A = 30°

b. Transfer load: A load of 3(3,000/Cos B) in tension or compression applied at the nozzle universal, in a direction at angle B with respect to the receptacle axis, where angle B varies between 0° and 17°, and combined with a fuel pressure of 125 psi x 3.

c. Contact load: A load of 20,000 pounds in compression applied at the nozzle universal in a direction at angle C with respect to the receptacle axis, where the angle C varies between 0° and 17°.

3.9 External stores. External stores shall be subjected to a vertical load factor of 1.5 for the weight of a 180-pound man standing on the store or holding on to the store with the airplane's wings folded.

3.10 Parachute brakes. For in-flight deployment, the airspeed shall be the limit speed in the landing configuration, V_{L_F}. For deployment after touchdown, the airspeed shall be 1.3 V_{S_F}.

3.10.1 Steady load. The load shall be equal to the drag load at the specified speed applied at all angles up to 15° from the flight path.

3.10.2 Shock load. The load shall be 1.1 times the steady drag load applied along the flight path axis.

3.10.3 Gust. The load shall be the steady drag load in combination with a 2-fps-EAS gust applied normal to the flight path. After touchdown, only lateral gusts shall be applied. The airplane attitude after touchdown shall be all attitudes up to the maximum permitting tail clearance.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements as specified herein. Unless disapproved by the Government or specified in the contract or purchase order, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.1.1 Responsibility for compliance. All items must meet all requirements of section 3. The inspection set forth in this specification shall become a part of the contractor's overall inspection system or quality program. The absense of any inspection requirements in the specification shall not relieve the contractor of the responsibility of assuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling in quality conformance does not authorize submission of known defective material, either indicated or actual, and does not commit the Government to accept defective material.

4.2 Methods of inspection.

4.2.1 Design data. Structural design and analyses data shall be in accordance with MIL-A-8868.

4.2.2 Laboratory tests. Laboratory tests shall be in accordance with MIL-A-8867.

4.2.3 Flight tests. Navy flight demonstrations shall be in accordance with MIL-D-8708.

5. PACKAGING

This section is not applicable to this specification.

6. NOTES

6.1 Intended use. The requirements of this specification are intended for use in the structural design and substantiation of airplanes.

6.2 Ordering data.

This paragraph is not applicable to this specification.

6.3 Definitions. For definitions of terms used in this specification see section 6 of MIL-A-8860.

6.4 Supersession data. See supersession data in section 6 of MIL-A-8860. This specification supersedes MIL-A-8865(ASG). It also supersedes, in part, MIL-A-008865A(USAF), although MIL-A-008865A(USAF) will remain in effect until cancelled by the Air Force.

6.5 Subject term (key word) listing.

Aerial delivery loads
Airplane
Control system loads
Crash loads
External stores
Flight seats
Flight tests
Floor strength
Flying-boom system
Gust
Litter installation loads
Parachute brakes
Probe-and-drogue system
Refueling loads
Rigidity
Strength
Tail-to-wind loads

6.6 International standardization. Certain provisions of this specification (see 2.3, 3.3.1, and 3.3.3) are the subject of international standardization agreement (ABC Aeronautical Standard 44/12). When an amendment, revision, or cancellation of this specification is proposed which will modify the international agreement, the preparing activity will take appropriate action through international standardization channels, including departmental standardization offices, to change the agreement or make other appropriate accommodations.

6.7 Changes from previous issue. Asterisks or vertical lines are not used in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes.

Preparing activity:
Navy - AS

(Project 1510-N024)

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STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

(See Instructions – Reverse Side)

1. DOCUMENT NUMBER	2. DOCUMENT TITLE
NIL A-8865B(AS)	Airplane Strength and Rigidity, Miscellaneous Loads

3a. NAME OF SUBMITTING ORGANIZATION	4. TYPE OF ORGANIZATION *(Mark one)*
	☐ VENDOR ☐ USER ☐ MANUFACTURER ☐ OTHER *(Specify)*:
b. ADDRESS *(Street, City, State, ZIP Code)*	

5. PROBLEM AREAS

a. Paragraph Number and Wording:

b. Recommended Wording:

c. Reason/Rationale for Recommendation:

6. REMARKS

7a. NAME OF SUBMITTER *(Last, First, MI)* – Optional	b. WORK TELEPHONE NUMBER *(Include Area Code)* – Optional
c. MAILING ADDRESS *(Street, City, State, ZIP Code)* – Optional	8. DATE OF SUBMISSION *(YYMMDD)*

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