

UNITED STATES OF AMERICA
CIVIL AERONAUTICS BOARD
WASHINGTON, D. C.

Civil Air Regulations Amendment 3-2
Effective: August 12, 1957
Adopted: July 8, 1957

AIRPLANE AIRWORTHINESS; NORMAL, UTILITY,
AND ACROBATIC CATEGORIES

MISCELLANEOUS AMENDMENTS RESULTING FROM THE
1956 ANNUAL AIRWORTHINESS REVIEW

There are contained herein amendments with respect to various issues stemming from the 1956 Annual Airworthiness Review.

Of the amendments included herein, the most important substantive ones relate to the design of pressurized cabins and powerplant fire protection. The currently effective regulations contain no specific requirements with respect to pressurization effects on the airplane's structural integrity. In view of the recent trend to develop small pressurized airplanes, it is considered appropriate to establish specific relevant requirements. Accordingly, the provisions in new §§ 3.197, 3.270, and 3.394 through 3.396 and the changes to § 3.383 are intended to cover pressurized cabins from the standpoint of design, basic loads, fatigue evaluation, and testing. These criteria were developed by using the principles which are applicable to pressurized cabins on transport category airplanes and, therefore, in many respects the aforementioned provisions are substantially the same as those which apply to transport category airplanes.

The record of past powerplant fires on small airplanes indicates the need for certain improvements in the fire protection provisions for such airplanes, particularly with respect to fuel system lines and fittings. In this regard, § 3.550 is being amended to require that provisions for flexibility in fuel lines which are subject to internal pressure and axial loading be made by flexible hose assemblies rather than by hose and hose-clamp assemblies which are subject to loosening. In addition, there is being incorporated in § 3.550 a provision which prohibits the use of flexible hose assemblies which might be adversely affected by temperature in locations where high temperatures will exist. With these changes, the provisions of § 3.550 will be consistent with those governing transport category airplanes. The currently effective provisions of § 3.637 require shutoff means for lines carrying flammable fluids into the engine compartment on multiengine airplanes having a stall speed greater than 70 mph or a weight greater than 6,000 pounds. These provisions are being amplified to set forth specific design criteria. In addition, a new § 3.638 is being added which requires lines and fittings carrying flammable fluids or gases in the engine compartment to be fire resistant.

Among other substantive changes being made, there is a revision of § 3.111 which reduces the prescribed minimum control speed (V_{MC}) applicable to multiengine airplanes with one engine inoperative from $1.3 V_{S1}$ to $1.2 V_{S1}$. In view of the relatively low all-engines-operating climb speeds associated with small multiengine airplanes, this change is intended to assure that the all-engines-operating climb speed will be sufficiently above V_{MC} to minimize the probability of flight speeds below V_{MC} in the event of an engine failure.

Changes are being made to the provisions of § 3.667 to incorporate more up-to-date safety standards with respect to the design and performance of auto-pilot systems.

There are included also a few other changes which are less substantive, or which are editorial or clarifying in nature.

Interested persons have been afforded an opportunity to participate in the making of this amendment (21 F.R. 9217), and due consideration has been given to all relevant matter presented.

In consideration of the foregoing, the Civil Aeronautics Board hereby amends Part 3 of the Civil Air Regulations (14 CFR Part 3, as amended) effective August 12, 1957.

1. By amending § 3.75 by deleting paragraphs (c) and (d) and by inserting a new paragraph (c) to read as follows:

3.75 Minimum weight. * * *

(c) Fuel and Oil quantities not greater than the minima specified in § 3.74 (b) (1).

2. By amending § 3.111 (a) by deleting from the last sentence the expression " $1.3 V_{S_1}$ " and inserting in lieu thereof the expression " $1.2 V_{S_1}$ ".

3. By amending § 3.118 (a) (1) and (2) by inserting between the words "all" and "flap" in each subparagraph the words "landing gear and".

4. By adding a new § 3.197 to read as follows:

3.197 Pressurized cabin loads. The provisions of paragraphs (a) through (d) of this section shall apply to pressurized compartments.

(a) The airplane structure shall have sufficient strength to withstand the flight loads combined with pressure differential loads from zero up to the maximum relief valve setting. Account shall be taken of the external pressure distribution in flight. Stress concentrations shall be taken into account in the design of the pressurized structure. (See § 3.270.)

(b) If landings are to be permitted with the cabin pressurized, landing loads shall be combined with pressure differential loads from zero up to the maximum permitted during landing.

(c) The airplane structure shall have sufficient strength to withstand the pressure differential loads corresponding with the maximum relief valve setting multiplied by a factor of 1.33. It shall be acceptable to eliminate all other loads in this case.

(d) Where a pressurized cabin is separated into 2 or more compartments by bulkheads or floor, the primary structure shall be designed for the effects of sudden release of pressure in any compartment having external doors or windows. This condition shall be investigated for the effects resulting from the failure of the largest opening in a compartment. Where intercompartment venting is provided, it shall be acceptable to take into account the effects of such venting.

5. By amending § 3.211 by adding at the end thereof a note to read as follows:

3.211 General. * * *

NOTE: For a seaplane version of a landplane, it is normally acceptable to use the wing loading of the landplane in determining the limit maneuvering control surface loadings from Figure 3-3(b) provided the power of the engines and the placard maneuver speed of the seaplane do not exceed those established for the landplane; the maximum certificated weight of the seaplane does not exceed the corresponding weight of the landplane by more than 10 percent; and service experience with the landplane is such that no evidence of any serious control-surface load problems is indicated and is such that the service experience is of sufficient scope to deduce with reasonable accuracy that no serious control-surface load problems will develop on the seaplane.

6. By adding a new heading and a new § 3.270 to read as follows:

FATIGUE EVALUATION

3.270 Pressurized cabins. The strength, detail design, and fabrication of the pressure cabin structure shall be evaluated in accordance with the provisions of either paragraph (a) or paragraph (b) of this section.

(a) Fatigue strength. The structure shall be shown by analysis and/or tests to be capable of withstanding the repeated loads of variable magnitude expected in service.

(b) Fail safe strength. It shall be shown by analysis and/or tests that catastrophic failure is not probable after fatigue failure or obvious partial failure of a principal structural element. After such failure the remaining structure shall be capable of withstanding a static ultimate load factor of 75 percent of the limit load factor at V_G , taking into account the combined effect of normal operating pressures, the expected external aerodynamic pressures, and flight loads. These loads shall be multiplied by a factor of 1.15 unless the dynamic effects of failure under static load are otherwise taken into consideration.

7. By amending § 3.343 by inserting after the first sentence a new sentence to read as follows: "For secondary control systems including adjustable stabilizers, the system loading in the operation test need not exceed that corresponding to the maximum pilot effort established in accordance with § 3.234."

8. By amending § 3.371 (b) to read as follows:

3.371 Seaplane main floats: * * *

(b) Compartmentation. Each seaplane main float shall contain a sufficient number of watertight compartments to provide reasonable assurance that the airplane will stay afloat in the event that any 2 compartments of the main floats are flooded. In any case, a main float shall contain at least 4 watertight compartments. The compartments shall have approximately equal volumes.

9. By amending § 3.383 to read as follows:

3.383 Windshields, windows, and canopies.

(a) All internal glass panes shall be of a nonsplintering safety type.

(b) The design of windshields, windows, and canopies on pressurized airplanes shall be based on factors peculiar to high altitude operation. (See also § 3.394.)

NOTE: Factors peculiar to high altitude operation normally include the effect of continuous and cyclic pressurization loadings, the inherent characteristics of the material used, the effects of temperatures and temperature gradients, etc.

(c) On pressurized airplanes, an enclosure canopy including a representative portion of the installation shall be subjected to special tests to account for the combined effects of continuous and cyclic pressurization loadings and flight loads.

10. By amending § 3.388 (b) by adding a new sentence at the end thereof to read as follows: "In addition to the components provided for normal continuous control of air temperature, air flow, and fuel flow, means independent of such components shall be provided for each heater to automatically shut off and hold off the ignition and fuel supply to the heater at a point remote from the heater when the heat exchanger temperature or ventilating air temperature exceeds safe limits or when either the combustion air flow or the ventilating air flow becomes inadequate for safe operation."

11. By adding a new § 3.394 to read as follows:

3.394 Pressurized cabins; general. The design of pressurized cabins shall comply with the requirements of §§ 3.395 and 3.396. (See also §§ 3.197, 3.270, and 3.383.)

12. By adding a new § 3.395 to read as follows:

3.395 Pressure control. Pressurized cabins shall be provided with at least the following valves, controls, and indicators for controlling cabin pressure:

(a) Two pressure relief valves, at least one of which is the normal regulating valve, shall be installed to limit automatically the positive pressure differential to a predetermined value at the maximum rate of flow delivered by the pressure source. The combined capacity of the relief valves shall be such that the failure of any one valve would not cause an appreciable rise in the pressure differential. The pressure differential shall be considered positive when the internal pressure is greater than the external.

(b) Two reverse pressure differential relief valves (or equivalent) shall be installed to prevent automatically a negative pressure differential which would damage the structure, except that one such valve shall be considered sufficient if it is of a design which reasonably precludes its malfunctioning.

(c) Means shall be provided by which the pressure differential can be rapidly equalized.

(d) An automatic or manual regulator for controlling the intake and/or exhaust air flow shall be installed so that the required internal pressures and air flow rates can be maintained.

(e) Instruments shall be provided for the pilot to show the pressure differential, the absolute pressure in the cabin, and the rate of change of the absolute pressure.

(f) Warning indication shall be provided for the pilot to indicate when the safe or preset limits on pressure differential and on absolute cabin pressure are exceeded.

(g) If the structure is not designed for pressure differentials up to the maximum relief valve setting in combination with landing loads (see § 3.197 (b)), a warning placard shall be provided for the pilot.

(h) If continued rotation of an engine-driven cabin compressor or if continued flow of any compressor bleed air will constitute a hazard in case malfunction occurs, means shall be provided to stop rotation of the compressor or to divert air flow from the cabin.

13. By adding a new § 3.396 to read as follows:

3.396 Tests.

(a) Strength test. The complete pressurized cabin, including doors, windows, canopy, and all valves shall be tested as a pressure vessel for the pressure differential specified in § 3.197 (c).

(b) Functional tests. The following functional tests shall be performed:

(1) To simulate the condition of regulator valves closed, the functioning and the capacity shall be tested of the positive and negative pressure differential valves and of the emergency release valve.

(2) All parts of the pressurization system shall be tested to show proper functioning under all possible conditions of pressure, temperature, and moisture up to the maximum altitude selected for certification.

(3) Flight tests shall be conducted to demonstrate the performance of the pressure supply, pressure and flow regulators, indicators, and warning signals in steady and stepped climbs and descents at rates corresponding with the maximum attainable without exceeding the operating limitations of the airplane up to the maximum altitude selected for certification.

(4) All doors and emergency exits shall be tested to ascertain that they operate properly after being subjected to the flight tests prescribed in subparagraph (3) of this paragraph.

14. By amending § 3.550 to read as follows:

3.550 Fuel system lines and fittings. (See § 3.638.)

(a) Fuel lines shall be installed and supported to prevent excessive vibration and to withstand loads due to fuel pressure and due to accelerated flight conditions.

(b) Fuel lines which are connected to components of the airplane between which relative motion could exist shall incorporate provisions for flexibility.

(c) Provisions for flexibility in fuel lines which may be under pressure and subjected to axial loading shall employ flexible hose assemblies rather than hose-clamp connections.

(d) Flexible hose shall be of an approved type or shall be shown to be suitable for the particular application.

(e) Flexible hoses which might be adversely affected by exposure to high temperatures shall not be employed in locations where excessive temperatures will exist during operation or after engine shutdown.

15. By amending § 3.564 (a) to read as follows:

3.564 Oil tank tests. * * *

(a) The applied pressure shall be 5 p.s.i. for all tank constructions instead of those specified in § 3.441 (a).

16. By amending the introductory paragraph § 3.586 by deleting the first sentence and inserting in lieu thereof the following: "The engine cooling tests shall be conducted by stabilizing the engine temperatures in flight with the engines operating at not less than 75 percent of the maximum continuous power rating. After engine temperatures have stabilized, the climb shall be started at the lowest practicable altitude and continued for one minute with the engines operating at the take-off rating."

17. By amending § 3.587 (a) by inserting after the first sentence a new sentence to read as follows: "Temperatures of the operating engines shall be stabilized in flight with the engines operating at not less than 75 percent of the maximum continuous power rating."

18. By amending § 3.637 to read as follows:

3.637 Flammable fluids; shutoff means. The provisions of paragraphs (a) through (d) of this section shall be applicable to multiengine aircraft which are required to comply with the provisions of § 3.85(b).

(a) Means for each individual engine shall be provided for shutting off or otherwise preventing hazardous quantities of fuel, oil, de-icer, and other flammable fluids from flowing into, within, or through the engine compartment except that means need not be provided to shut off flow in lines forming an integral part of an engine. Closing the fuel shutoff valve for any engine shall not make any of the fuel supply unavailable to the remaining engines.

(b) Operation of the shutoff means shall not interfere with the subsequent emergency operation of other equipment, such as feathering the propeller.

(c) The shutoff means shall be located outside of the engine compartment unless an equally high degree of safety is otherwise provided. It shall be shown that no hazardous quantity of flammable fluid could drain into the engine compartment after shutting off has been accomplished.

(d) Provisions shall be made to guard against inadvertent operation of the shutoff means and to make it possible for the crew to reopen the shutoff means in flight after it has once been closed.

19. By adding a new § 3.638 to read as follows:

3.638 Lines and fittings. All lines and fittings carrying flammable fluids or gases in the engine compartment shall comply with the provisions of paragraphs (a) through (c) of this section.

(a) Lines and fittings which are under pressure, or which attach directly to the engine, or which are subject to relative motion between components shall be flexible, fire-resistant lines with fire-resistant end fittings of the permanently attached, detachable, or other approved type.

(b) Lines and fittings which are not subject to pressure or to relative motion between components shall be of fire-resistant materials.

(c) Vent and drain lines and their fittings shall be subject to the provisions of paragraphs (a) and (b) of this section unless a failure of such line or fitting will not result in, or add to, a fire hazard.

20. By amending § 3.667 to read as follows:

3.667 Automatic pilot system. If an automatic pilot system is installed, compliance shall be shown with the provisions of paragraphs (a) through (e) of this section.

(a) The system shall be so designed that the automatic pilot can either be quickly and positively disengaged by the human pilot to prevent it from interfering with the control of the airplane, or be overpowered by the human pilot to enable him to control the airplane.

(b) A means shall be provided to indicate readily to the pilot the alignment of the actuating device in relation to the control system which it operates, except when automatic synchronization is provided.

(c) The manually operated control(s) for the system's operation shall be readily accessible to the pilot. Controls shall operate in the same plane and sense of motion as specified for the cockpit controls in § 3.384 and Figure 3-14. The direction of motion shall be plainly indicated on or adjacent to each control.

(d) The automatic pilot system shall be of such design and so adjusted that, within the range of adjustment available to the human pilot, it cannot produce hazardous loads on the airplane or create hazardous deviations in the flight path under any conditions of flight appropriate to its use either during normal operation or in the event of malfunctioning, assuming that corrective action is initiated within a reasonable period of time.

(e) The system design shall be such that a single malfunction will not produce a hardover signal in more than one control axis. When the automatic pilot integrates signals from auxiliary controls or furnishes signals for operation of other equipment, positive interlocks and sequencing of engagement shall be provided to preclude improper operation. Protection against adverse interaction of integrated components resulting from a malfunction shall be provided.

21. By deleting § 3.676.

(Sec. 205 (a), 52 Stat. 984; 49 U.S.C. 425. Interpret or apply secs. 601, 603, 52 Stat. 1007, 1009, as amended; 49 U.S.C. 551, 553)

By the Civil Aeronautics Board:

(SEAL)

/s/ M. C. Mulligan
M. C. Mulligan
Secretary

