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

Civil Air Regulations Amendment 4b-7
Effective: October 17, 1957
Adopted: September 12, 1957

AIRPLANE AIRWORTHINESS; TRANSPORT CATEGORIES

INSTRUMENT INSTALLATIONS

In 1953 the Civil Aeronautics Board promulgated § 4b.611 (b) of Part 4b of the Civil Air Regulations and established a standard arrangement for the location on the instrument panel of required basic flight instruments. This amendment to § 4b.611 (b) prescribes a new standard for the arrangement of basic flight instruments.

Studies made by representatives of the Government and industry indicated that the standard prescribed in § 4b.611 (b) no longer reflects the optimum instrument arrangement, and does not provide the flexibility needed to include new instruments, or to integrate related instruments, which have been or may be developed in the future. Accordingly, a proposal to replace the existing standard for flight instrument arrangement with a new one commonly referred to as the "Basic T" was published for comment in accordance with public rule making procedures and circulated as Civil Air Regulations Draft Release No. 57-5 on April 3, 1957.

In this draft release it was proposed to establish a "Basic T" arrangement consisting of a group of 6 instruments giving the following information: (1) speed, (2) attitude, (3) altitude, (4) flight path deviation, (5) direction, and (6) climb. However, after consideration of the comment received in response to the proposal and after further analysis of the problem, the Board has concluded that there are only 4, rather than 6, basic flight instruments that require a standard location on the instrument panel. The 4 instruments are those which present basic information as to air speed, attitude, altitude, and direction.

While it was originally proposed to establish standard positions for those instruments giving information as to flight path deviation and climb, it is believed such a proposal would make the standard so inflexible as to interfere with the possible integration of such instruments with the 4 basic instruments, and the use of newly developed instruments. Accordingly, this amendment prescribes standard positions on the instrument panel for only the 4 instruments which present basic information as to air speed, attitude, altitude, and direction.

The concept of the "Basic T" involves more than location of specifically named instruments. The theory is that it will constitute a system by which various items of related flight information will be cataloged and placed in certain standard locations in all instrument panels, regardless of type or make of instruments used. In this manner the "Basic T" takes advantage of the new types of integrated instruments which display more than one item of flight information. It is apparent, however, that if the proposed standard is to be a standard in fact, one basic indication must be specified for each instrument position. This eliminates, for example, the possibility of air speed being replaced by angle of attack under the theory that air speed is no longer required except for navigational purposes. It appears to be generally agreed that the basic indication of position 1 is air speed. In this location may be added related flight information such as Mach number and angle of attack. It also appears to be generally agreed that the basic indications for positions 2 and 3 are pitch and bank, and (barometric) altitude. Command signals for adjusting pitch or turning right or left may be added to the attitude instrument (pitch and bank) and similarly, terrain clearance information and rate of climb may be included in position 3 with the altimeter.

Some difference of opinion was registered by interested parties with respect to position 4, previously position 5 in Draft Release 57-5. This instrument has been labeled "direction," and is intended primarily for navigational information. Certain groups have contended that the basic indication for this location should be heading. Their reason is that heading is paramount in maintaining a course, or making good a desired track, and that a gyroscopically stabilized indication of heading logically belongs immediately below the attitude instrument where it can be read simultaneously with the attitude instrument for three-dimensional control of the airplane. Others, on the other hand, contend that there should be a choice left to the operator to place a display for heading, flight path deviation, or both in this location. The reasoning is that certain carriers desire to use an integrated instrument in this position which shows pictorially the airplane's position in reference to a desired track, but not a quantitative indication of heading.

In considering the above issue the Board takes cognizance of the fact that most air transports of today do not have installed a flight path director or steering computer. In these airplanes heading must be read continually to give significance to the signals received from radio navigation aids.

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Accordingly, heading is the basic indication to be required in position 4. However, with increased use of electronic computers and installation of instrument systems which include command signals to make good required flight tracks there will be less dependence upon heading, and it is possible, therefore, that in the future the basic indication required by the pilot to maintain a given track will not be heading. Consequently, the rule establishes that the number 4 position shall be that instrument which most effectively indicates direction of flight with the understanding that the basic indication of this instrument shall be heading but that if future developments prove it feasible the basic indication of this instrument may be changed so long as it is demonstrated that it is the instrument which most effectively indicates direction of flight. It is believed that this solution is consonant with present and known future aircraft flight instrument systems and will at the same time provide sufficient flexibility to permit use of newer direction instruments if these prove more operationally feasible.

With respect to the specific location of the basic flight instruments, we believe that the attitude (bank and pitch) indicator is the keystone of any instrument arrangement, and should, therefore, be located in the central position on the panel, with the other basic instruments disposed around it. The indicator providing directional information is constantly monitored along with the attitude indicator, in order to provide continuous three-dimensional control of the flight path. Since directional information is associated with the longitudinal axis of the airplane, this instrument should be most naturally positioned centrally beneath the attitude indicator. Control of air speed and altitude are directly related to attitude, so their location laterally adjacent to the attitude indicator is a natural one.

Interested persons have been afforded an opportunity to participate in the making of this amendment (22 F.R. 2538), and due consideration has been given to all relevant matter presented.

In consideration of the foregoing, the Civil Aeronautics Board hereby amends Part 4b of the Civil Air Regulations (14 CFR Part 4b, as amended) effective October 17, 1957.

1. By amending § 4b.611 (b) to read as follows:

4b.611 Arrangement and visibility of instrument installations. * * *

(b) Flight instruments required by § 4b.603 shall be grouped on the instrument panel and centered as nearly as practicable about the vertical plane of the pilot's forward vision. The four basic instruments specified in subparagraphs (1) through (4) of this paragraph shall be located on the flight instrument panel as follows:

(1) The top center position on the panel shall contain that instrument which, of all instruments on the panel, most effectively indicated attitude.

(2) The position adjacent to and directly to the left of the top center position shall contain that instrument which, of all instruments on the panel, most effectively indicates air speed.

(3) The position adjacent to and directly to the right of the top center position shall contain that instrument which, of all instruments on the panel, most effectively indicates altitude.

(4) The position adjacent to and directly below the top center position shall contain that instrument which, of all instruments on the panel, most effectively indicates direction of flight.

2. By deleting Figure 4b-23.

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

By the Civil Aeronautics Board:

/s/ M. C. Mulligan

M. C. Mulligan
Secretary

(SEAL)

Part 4b last printed December 31, 1953.

profile may be established such that the design limit load factor as defined in 4b.211(a)(1) will not be exceeded. The airplane response shall result in pitching accelerations not less than those specified in subparagraph (2) unless it is shown that lesser values cannot be exceeded.

§ 4b.216 [Amendment]

10. By amending § 4b.216(a) by adding at the end thereof a new sentence to read as follows: "For turbine propeller installations the limit torque shall be obtained by multiplying the mean torque by a factor of 1.25."

11. By amending § 4b.216(a)(3) by deleting the factor "2.0" and inserting in lieu thereof "1.6".

12. By adding a new § 4b.217 to read as follows:

§ 4b.217 Speed control devices.

When speed control devices (e.g., spoilers, drag flaps, etc.) are incorporated for use in en route conditions, the following conditions shall apply:

(a) The airplane shall be designed for the symmetrical maneuvers and gusts prescribed in § 4b.211 and the yawing maneuvers and lateral gusts in § 4b.215 with the device extended at all speeds up to the placard device extended speed.

(b) When the speed control device incorporates automatic operation or load limiting features, the airplane shall be designed for the maneuver and gust conditions prescribed in paragraph (a) of this section, at the speeds and corresponding device positions which the mechanism permits.

§ 4b.231 [Amendment]

13. By amending § 4b.231(a)(1) by deleting the second sentence and inserting in lieu thereof: "It shall be acceptable to establish the coefficient of friction between the tires and the ground by considering the effects of skidding velocity and tire pressure, except that it need not be greater than 0.8."

§ 4b.235 [Amendment]

14. By amending § 4b.235(e)(2) by adding at the end thereof a new sentence to read as follows: "Where this condition results in a nose gear side load in excess of 0.8 times the vertical nose gear load, it shall be acceptable to limit the design nose gear side load to 0.8 times the vertical load with the unbalanced yawing moments assumed to be resisted by aircraft inertia forces."

§ 4b.236 [Amendment]

15. By amending § 4b.236(a) by adding at the end thereof a new sentence to read as follows: "A tandem strut gear arrangement shall be considered to be a multiple-wheel unit."

16. By amending § 4b.236(c) by amending the last sentence of the introductory paragraph to read as follows: "The ground reactions shall be applied to the wheels with inflated tires, except that for multiple-wheel gear units incorporating more than one shock strut, it shall be permissible to use a rational distribution of the ground reactions between the deflated and inflated tires, taking into account the differences in shock strut extensions resulting from a deflated tire."

§ 4b.308 [Amendment]

17. By amending § 4b.308(a) by adding at the end thereof a new sentence to read as follows: "If control surface flutter dampers are installed to meet the requirements of this section, it shall be shown that a single failure in the flutter damper system will not preclude continued safe flight of the airplane at any speed up to V_D."

18. By amending § 4b.320 by redesignating the present paragraph as paragraph (a) and by adding a new paragraph (b) to read as follow:

§ 4b.320 General.

* * * * *

(b) Power boost and power-operated control systems shall be designed in accordance with the provisions of subparagraphs (1) and (2) of this paragraph.

(1) When a power boost or power-operated control system is used, an alternate system shall be immediately available such that any single failure in the power portion shall not preclude continued safe flight and landing. Such alternate system may be a duplicate power portion or a manually operated mechanical system. The power portion shall include the power source (e.g., hydraulic pumps), and such items as valves, lines, and actuators. The failure of mechanical parts (such as piston rods and links) and the jamming of power cylinders need not be considered if such failure or jamming is considered to be extremely remote.

(2) Both the primary and alternate systems shall be operable in the event of a single engine failure. For airplanes with more than two engines, at least one system shall be operable in the event of failure of any two engines. It shall be shown by analysis that in the event of loss of power on all engines, the airplane is not uncontrollable.

19. By amending § 4b.352(b) by deleting from the first sentence the opening phrase "The windshield, its supporting structure, and other structure in front of the pilots" and inserting in lieu thereof "The windshield panes which the pilots will be directly behind in the normal conduct of their duties and the supporting structures for such panes", and by deleting the last sentence.

20. By amending § 4b.352 by redesignating paragraph (c) as paragraph (d) and by adding a new paragraph (c) to read as follows:

§ 4b.352 Windshields and windows.

* * * * *

(c) Means shall be provided to minimize the danger to the pilots from flying windshield fragments due to bird impact unless it can be shown by analysis or test that the probability of occurrence of a critical fragmentation condition is of a low order. The provisions of this paragraph are intended to apply to all transparent panes in the cockpit section which appear in the front view of the aircraft, are inclined 15 degrees or more to the longitudinal axis of the aircraft, and have any portion located so that fragmentation thereof will constitute a hazard to the pilots.

§ 4b.362 [Amendment]

21. By amending § 4b.362(c)(1) by deleting the table thereunder and inserting in lieu thereof the following table:

Passenger seating capacity	Emergency exits required on each side of the fuselage			
	Type I	Type II	Type III	Type IV
1-10 inclusive	------	------	------	1
11-19 inclusive	------	------	1	------
20-39 inclusive	------	1	------	1
40-59 inclusive	1	------	------	1
60-79 inclusive	1	------	1	------
80-109 inclusive	1	------	1	1
110-139 inclusive	2	------	1	------
140-179 inclusive	2	------	2	------
180-219 inclusive	2	2	------	------

22. By amending § 4b.362(d) by adding after the first sentence a new sentence to read as follows: "On airplanes with a passenger seating capacity of 10 or less, the minimum dimensions of the exit specified in paragraph (b)(4) of this section shall be acceptable."

23. By amending § 4b.362(g) by adding a new sentence at the end thereof to read as follows: "If it is necessary to pass through a doorway to reach any required emergency exit from any seat in the passenger cabin, the door shall be provided with a means to latch it in the open position. A suitable placard stating that the door is to be latched in the open position during takeoff and landing shall be installed."

24. By amending § 4b.407 to read as follows:

§ 4b.407 Reversing systems.

(a) Reversing systems intended for ground operation only shall be such that no single failure or malfunctioning of the system under all anticipated conditions of airplane operation will result in unwanted reverse thrust. Failure of structural elements need not be considered if occurrence of such failure is expected to be extremely remote.

(b) Turbo-jet reversing systems intended for inflight use shall be such that no unsafe condition will result during normal operations of the system, or from any failure or reasonably likely combination of failures of the reversing system, under all anticipated conditions of operation of the airplane. Failure of structural elements need not be considered if occurrence of such failure is expected to be extremely remote.

25. By amending § 4b.410(a) to read as follows:

4b.410 General.

(a) The fuel system shall be constructed and arranged in such a manner as to assure a flow of fuel at a rate and pressure which have been established for proper engine functioning under all likely operating conditions, including all maneuvers for which the airplane is intended. (For fuel system instruments see § 4b.604.)

26. By amending § 4b.413 to read as follows:

4b.413 Fuel flow demonstration.

(a) The fuel flow available for use by the engine shall be demonstrated to be at least 125 percent of the fuel flow required to develop the maximum horsepower or thrust selected for airplane certification, when the airplane is in operating conditions appropriate to the use of such power or thrust.

(b) The ability of the system to provide at least 100 percent of the fuel flow required by the engines shall be demonstrated when the airplane is in the operating condition, including attitude and altitude, which represents the most adverse condition from the standpoint of fuel feed which the airplane is designed to attain.

(c) During the demonstration prescribed in paragraphs (a) and (b) of this section, the following provisions shall apply:

(1) Fuel shall be delivered to the engine at a pressure within the limits specified in the engine type certificate.

(2) The quantity of fuel in the tank being considered shall not exceed the amount established as the unusable fuel supply for that tank, as determined by demonstrating compliance with the provisions of § 4b.416 (see also §§ 4b.420 and 4b.613(b)), together with whatever minimum quantity of fuel it may be necessary to add for the purpose of conducting flow test.

(3) Such main pumps shall be used as are necessary for each operating condition and airplane attitude for which the demonstrations are made. For each main pump so used, the demonstration shall be repeated, substituting the appropriate emergency pump, when required, for the main pump. (See § 4b.430(b).)

(4) If a fuel flowmeter is provided, the meter shall be blocked only during the flow test prescribed in paragraph (b) of this section and the fuel shall flow through the meter or its bypass.

(5) It shall be acceptable to conduct the demonstrations prescribed in paragraphs (a) and (b) of this section by a ground test on the airplane or on a representative mock-up of the fuel system.

§ 4b.414 [Deletion]

27. By deleting § 4b.414.

§ 4b.415 [Amendment]

28. By amending § 4b.415 by deleting the reference "§ 4b.414" and inserting in lieu thereof "§ 4b.413".

29. By amending § 4b.421(a) to read as follows:

§ 4b.421 Fuel tank tests.

(a) Fuel tanks shall be demonstrated by test to be capable of withstanding the more critical of the pressures resulting from the conditions of subparagraphs (1) and (2) of this paragraph without failure or leakage as mounted in the airplane. In addition, tank surfaces subjected to more critical pressures resulting from the conditions of subparagraphs (3) and (4) of this paragraph shall be demonstrated by means of either analyses or tests to be capable of withstanding such pressures.

(1) Internal pressures of 3.5 psi;

(2) 125 percent of the maximum air pressure developed in the tank from ram effect;

(3) Fluid pressures developed during maximum limit accelerations and deflections of the airplane with a full tank;

(4) Fluid pressures developed during the most adverse combination of airplane roll and fuel load.

30. By amending § 4b.421(b) by inserting the word "Metallic" at the beginning of the first sentence.

31. By amending § 4b.421(c) to read as follows:

(c) Nonmetallic tanks shall withstand the test specified in subparagraph (b)(4) of this section with fuel at a temperature of 110° F. except that this test shall not be required where satisfactory operating experience with a similar tank in a similar installation is shown. During the test a representative specimen of the tank shall be installed in supporting structure which simulates the installation in the airplane.

32. By amending § 4b.430 to read as follows:

§ 4b.430 Fuel pumps.

(a) *Main pumps.* (1) Any fuel pump that is required for proper engine operation or to meet the fuel system requirements of this subpart, except for the provisions of paragraph (b) of this section, shall be considered a main pump.

(2) Provision shall be made to permit the bypass of all positive displacement fuel pumps except fuel injection pumps approved as part of the engine.

(b) *Emergency pumps.* (1) Emergency pumps shall be provided and immediately available to permit supplying all engines with fuel in case of failure of any one main fuel pump except fuel injection pumps approved as part of the engine. This requirement is not intended to prohibit the use of another main pump as an emergency pump after failure of one main pump.

§ 4b.431 [Deletion]

33. By deleting § 4b.431.

34. By adding a new § 4b.455 to read as follows:

§ 4b.455 Cooling of turbine engine installations.

For turbine engine installations, tests shall be conducted to demonstrate that all powerplant components for which temperature limits have been established are cooled within those limits.

§ 4b.461 [Amendment]

35. By amending § 4b.461(c) by adding at the end thereof a new sentence to read as follows: "Means to indicate the functioning of the powerplant ice protection system shall be provided."

36. By amending § 4b.483 to read as follows:

§ 4b.483 Lines and fittings.

(a) All lines and fittings carrying flammable fluids in designated fire zones shall be fire-resistant, except as otherwise provided in this section. If flexible hose is used, the assembly of hose and end fittings shall be of an approved type. The provisions of this paragraph need not apply to those lines and fittings which form an integral part of the engine.

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

37. By amending § 4b.603 to read as follows:

§ 4b.603 Flight and navigational instruments.

(See § 4b.612 for installation requirements.)

(a) Air-speed indicating system. If the air-speed limitations vary with altitude, the air-speed indicator shall incorporate a maximum allowable air-speed indication showing the variation of V_{NE} with altitude including compressibility limitations. (See § 4b.732.)

(b) Altimeter (sensitive or precision type),

(c) Rate-of-climb indicator (ver speed),

(d) Free air temperature indicator,

(e) Clock (sweep-second pointer type),

(f) Rate-of-turn indicator (gyroscopic type with integral bank or slip indicator),

(g) Bank and pitch indicator (gyroscopically stabilized),

(h) Direction indicator (gyroscopically stabilized magnetic and/or nonmagnetic type),

(i) Direction indicator (nonstabilized type magnetic compass),

(j) Machmeter for airplanes having compressibility limitations not otherwise indicated to the pilot in accordance with § 4b.732.

38. By amending § 4b.612(e) to read as follows:

§ 4b.612 Flight and navigational instruments.

* * * * *

(e) *Instruments utilizing a power supply.* The following shall apply to each instrument required in § 4b.603 (f), (g), and (h) which utilizes a power supply:

(1) Each instrument shall have a visual type of power failure indicating means, integral with or located adjacent to the instrument, to indicate when adequate power is not being supplied to the instrument (see note) to sustain proper instrument performance. The l r shall be sensed at or near the point w re power enters the instrument. For elec-

tric instruments power shall be deemed adequate when voltage is between approved limits.

Each instrument shall be provided w . two independent sources of power and a means of selecting either power source. When duplicate independent instruments are installed, power source selection need not be provided if each instrument has an independent power source.

(3) The installation and power supply system shall be such that failure of one instrument, or the energy supply from one source, or a fault in any part of the power distribution system, will not interfere with the proper supply of energy from the other source. (See also §§ 4b.606(c) and 4b.623.)

NOTE: The word "instrument" as used herein includes those devices which are physically contained in one unit and those devices which are composed of two or more physically separate units or components connected together; such as a remote indicating gyroscopic direction indicator which includes a magnetic sensing element, a gyroscopic unit, an amplifier, and an indicator connected together.

39. By amending § 4b.613 by adding a new paragraph (f) to read as follows:

§ 4b.613 Powerplant instruments.

* * * * *

(f) *Fuel pressure indication.*

(1) Provisions shall be made to measure the fuel pressure, in all systems supplying reciprocating engines, at a point downstream of all fuel pumps except fuel i' tion pumps. (For instrument re- ments see § 4b.604(e).)

(2) When necessary for the maintenance of the proper fuel delivery pressure, a connection shall be provided to transmit the carburetor air intake static pressure to the proper fuel pump relief valve connection. In such cases, to avoid erroneous fuel pressure reading, the gauge balance lines shall be independently connected to the carburetor inlet pressure.

40. By amending § 4b.625(d) to read as follows:

§ 4b.625 Electrical equipment and installation.

* * * * *

(d) Storage batteries shall be of such design and be so installed that:

(1) Safe oil temperatures and pressures are maintained during any probable charging or discharging condition. No uncontrolled increase in cell temperature shall result when the storage battery is recharged (after previous complete discharge) at maximum regulated voltage, during a flight of maximum duration, under the most adverse cooling conditions likely to occur in service. Tests to demonstrate compliance with this regulation shall not be required if satisfactory operating experience with similar batteries and installations has shown that maintaining safe cell temperatures and pressures presents no problem.

(2) Explosive or toxic gases emitted by the storage battery in normal operation, or as the result of any probable malfunction in the charging system or battery installation, shall not accumulate in hazardous quantities within the airplane.

(3) Corrosive fluids or gases which may be emitted or spilled from the storage battery shall not damage the surrounding airplane structure or adjacent essential equipment.

41. By adding a new § 4b.628 to read as follows:

§ 4b.628 *Lightning strike protection.*

Those portions of the airplane which are electrically insulated from the main body of the airplane shall be connected to the basic airframe through appropriate lightning arrestors, unless it is shown that a lightning strike on the insulated portion is improbable because of the shielding afforded by other portions of the airplane, or unless it is shown that a lightning strike on the insulated portion would not create a hazard to the airplane or its occupants.

§ 4b.632 [Amendment]

42. By amending § 4b.632(d) by deleting the word "noncombustible" and inserting in lieu thereof the word "flame-resistant".

§ 4b.645 [Amendment]

43. By amending § 4b.645(d) by deleting the last sentence thereof.

44. By adding a new § 4b.647 to read as follows:

§ 4b.647 Flotation means.

If the airplane is not equipped with life preservers in accordance with § 4b.645(d), an approved individual flotation means shall be provided for each occupant. Such flotation means shall be within easy reach of each occupant while seated and readily removable from the airplane.

45. By adding a new § 4b.660 to read as follows:

§ 4b.660 Draining of fluids subject to freezing.

When liquids subject to freezing are drained overboard either in flight or during group operation, drains shall be located and designed to prevent the formation of ice on the airplane as a result of such drainage.

46. By amending § 4b.738 by adding a new paragraph (e) to read as follows:

§ 4b.738 Miscellaneous markings and placards.

* * * * *

(e) *Air-speed placard.* A placard shall be installed in clear view of each pilot giving the maximum air speeds for flap extension to the takeoff, approach, and landing positions.

47. By amending Figure 4b-2 to read as follows:

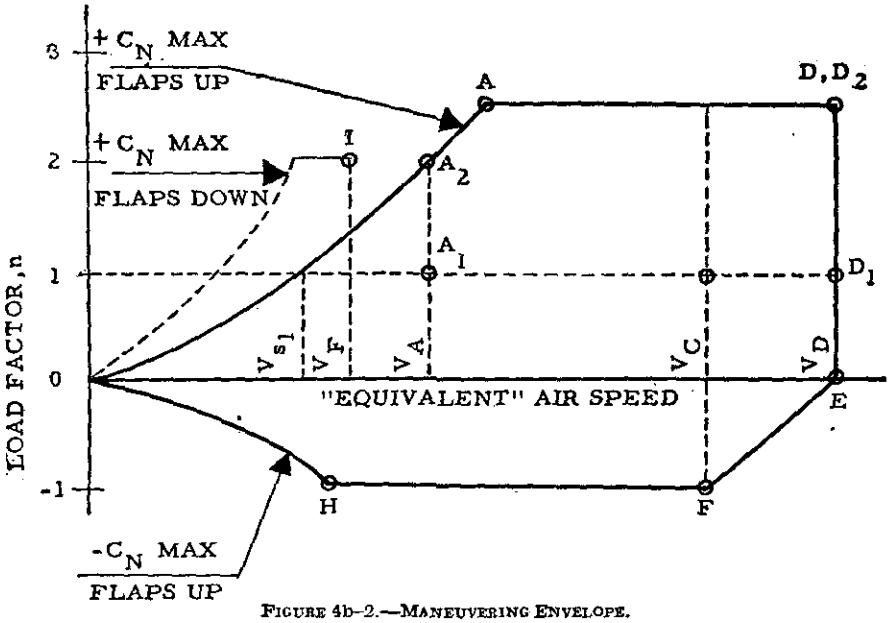

FIGURE 4b-2.—MANEUVERING ENVELOPE.

Issued in Washington, D.C., on August 24, 1959.

E. R. QUESADA,
Administrator.

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