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

Civil Air Regulations Amendment 4b-9
Effective: September 1, 1958
Adopted: August 27, 1958

AIRPLANE AIRWORTHINESS; TRANSPORT CATEGORIES

SUPPLEMENTAL OXYGEN REQUIREMENTS

The advent of turbine-powered airplanes with normal operating altitudes higher than has been the case with airplanes powered by reciprocating engines has made necessary a reconsideration of supplemental oxygen requirements. Following a study of this problem by representatives of the Government and industry, a proposal to amend the existing supplemental oxygen requirements of Part 4b and the operating rules was published in accordance with public rule making procedures and circulated as Civil Air Regulations Draft Release No. 58-7 dated March 27, 1958.

In this draft release it was proposed to consolidate all controls, instruments, and warning devices at a single location to permit all phases of monitoring and operation of the pressurization and oxygen systems by a single crew member. However, after consideration of the comments received the Board has concluded that such requirement, while stating a desirable objective, would actually result in a potentially lower level of safety because of the added complexity that would result. With regard to warning devices, it was proposed also to require both visible and audible warnings to give alarm in the event of cabin depressurization. Comments received in this matter pointed out that, in contrast to past practice, airplanes in the next few years will almost certainly incorporate other audible warning devices that may operate at cruise altitude and require immediate conditioned response, and that confusion could result from providing too many such audible warnings. Considering these comments, the Board concluded that the current requirements in § 4b.375 (f) provide for adequately effective warnings.

High rates of fuel consumption at low altitudes lead to the possible necessity for turbine-powered transport airplanes to cruise at altitudes that would require sustaining oxygen for all occupants for extended periods of time. This has emphasized a need for regulations as to the minimum quantity of oxygen which may be carried to insure adequate protection for the passengers. The quantities prescribed by the current requirements of § 4b.651 are generally conceded to be in excess of actual needs for sustenance. The new oxygen flow rates contained herein will provide a level of safety acceptable for sustaining purposes without reducing the quantity carried below a safe minimum.

Some difference of opinion was expressed concerning the provisions for oxygen in the altitude range above 25,000 feet where its main purpose is to prevent physical harm to the passengers following cabin depressurization. One position was that it would be adequate to apply the same prescription as proposed for sustaining oxygen. The opposing view was held that while this might be adequate for sustenance at altitudes above 25,000 feet it would not be satisfactory following cabin decompression at these altitudes because of the problem of removing nitrogen from the lungs, and that for this reason a greater quantity of oxygen should be prescribed. The problem associated with this view is that either the flow rate must be equivalent to the higher requirement throughout the altitude range, or equipment must be provided to enable the oxygen system to differentiate between two situations. In weighing these opposing views, the Board took into consideration that the prescription in the regulation is a minimum value; that previous requirements, although prescribing a greater quantity of oxygen, have not accounted for over-all system efficiency; that additional system complexity would decrease reliability; and that the objective of oxygen following a decompression is to prevent physical harm and not necessarily to provide passengers with the same amount of oxygen which would be available at sea level.

There was some expression of opinion that the flow rate provided for flight crew members was not adequate. In considering these opinions, the Board was not able to establish that the 5,000-foot equivalent provided by the prescription for demand-type equipment was unsatisfactory. Consideration was also given to the fact that the prescription is a minimum and that normal operating tolerances will invariably insure that a somewhat greater quantity is furnished. Since this prescription could result in the crew being unable to draw oxygen from the demand-type system while the cabin is pressurized, a requirement is being added that undiluted oxygen be available to the crew.

The provision for insuring that oxygen masks be immediately available to the users is believed to be proper in light of the problems associated with flight at these altitudes. The time available to begin breathing supplemental oxygen becomes less with increasing altitude due to the decrease in the period of useful consciousness. Thus the requirements for making the dispensing units available to the users become more severe as the maximum certificated altitude becomes higher.

A prescription is being added to define the quantity of oxygen to be made available for first-aid use. To avoid having to predict the pressure altitudes at which such will be used, the prescription is in terms of flow at standard temperature and pressure.

The provisions of this regulation require two outlets and units of oxygen-dispensing equipment in the washroom and in the lavatory.

The cabin attendants, in the course of their normal duties, may be at any place in the cabin at the time of depressurization. Since, at the normal cruising altitude of turbine-powered airplanes, sufficient time may not be available for the attendants to return to a designated oxygen station, it is necessary that either a portable oxygen supply be carried by each attendant or that sufficient additional outlets and units of dispensing equipment be immediately available throughout the cabin to insure that it will be attainable at all times. The likelihood of turbine-powered airplanes having to continue operations at flight altitudes requiring sustaining oxygen makes necessary the provision of portable oxygen equipment for cabin attendants in order to insure their mobility even though such equipment may not be required to satisfy the emergency descent provisions. To avoid, as much as possible, the problems associated with changing over from a spare outlet of the installed system to a portable unit, these portable units should have, to the degree practicable, a uniform distribution in the cabin. To provide for this, the portable oxygen units are required to be immediately available.

The proposal regarding means of determining delivery of oxygen to the dispensing units was intended to provide an indication that the oxygen system is in operation and that oxygen is being released from the storage containers to the distribution system. Determination of delivery to individuals, as in the past, by observation of the storage bags on the masks or similar type examinations is felt to be inadequate.

Interested persons have been afforded an opportunity to participate in the making of this amendment (23 F.R. 2229), and due consideration has been given to all relevant matter presented. In view of the imminence of operations to be conducted pursuant to this amendment, the Board finds that further notice and public procedure hereon would be contrary to the public interest and that this amendment may be made effective on less than 30 days' notice.

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 September 1, 1958.

1. By deleting figure 4b-21.

2. By amending § 4b.651 (a) to read as follows:

4b.651 Oxygen equipment and supply. * * *

(a) General. The oxygen system installed shall be free from hazards in itself, in its method of operation, and in its effect upon other components of the airplane. Means shall be provided to enable the crew to determine readily during flight the quantity of oxygen available in each source of supply. For airplanes certificated for operation at flight altitudes above 40,000 feet, oxygen flow rate and equipment shall be approved by the Administrator.

3. By amending § 4b.651 (b) to read as follows:

(b) Required minimum mass flow of supplemental oxygen. The minimum mass flow of supplemental oxygen required per person at various cabin pressure altitudes shall be that necessary to comply with the following requirements as applicable:

(1) Where continuous flow equipment is used by flight crew members, the minimum mass flow of supplemental oxygen required for each crew member shall not be less than that which will maintain during inspiration a mean tracheal oxygen partial pressure of 149 mm.Hg. when breathing 15 liters per minute, BTPS, and having a maximum tidal volume of 700 cc. with a constant time interval between respirations.

(2) Where demand equipment is used by flight crew members, the minimum mass flow of supplemental oxygen required for each crew member shall not be less than that which will maintain during inspiration a mean tracheal oxygen partial pressure of 122 mm.Hg. to and including a cabin pressure altitude of 35,000 feet and 95 percent oxygen between cabin pressure altitudes of 35,000 and 40,000 feet, when breathing 20 liters per minute BTPS. Provision shall be made to allow use of undiluted oxygen by crew members when they so desire.

(3) For passengers and cabin attendants the minimum mass flow of supplemental oxygen required for each person at various cabin pressure altitudes shall not be less than that which will maintain during inspiration the following mean tracheal oxygen partial pressures when using the oxygen equipment provided, including masks:

(i) At cabin pressure altitudes above 10,000 feet to and including 18,500 feet, a mean tracheal oxygen partial pressure of 100 mm.Hg. when breathing 15 liters per minute, BTPS, and having a tidal volume of 700 cc. with a constant time interval between respirations.

(ii) At cabin pressure altitudes above 18,500 feet to and including 40,000 feet, a mean tracheal oxygen partial pressure of 83.8 mm.Hg. when breathing 30 liters per minute, BTPS, and having a tidal volume of 1,100 cc. with a constant time interval between respirations.

(4) Where first-aid oxygen equipment is required, the minimum mass flow of oxygen to each user shall not be less than 4 liters per minute, STPD, except that means may be provided to decrease this flow to not less than 2 liters per minute, STPD, at any cabin altitude. The quantity of oxygen required shall be based upon an average flow rate of 3 liters per minute per person for whom first-aid oxygen is required.

(5) Where portable oxygen equipment is required for crew members, the minimum mass flow of supplemental oxygen shall be as specified in § 4b.651 (b) (1) or (2), whichever is applicable.

4. By amending § 4b.651 (d) to read as follows:

(d) Equipment standards for dispensing units. Where oxygen dispensing units are required, they shall comply with the provisions of subparagraphs (1) through (3) of this paragraph.

(1) An individual dispensing unit shall be provided for each occupant for whom supplemental oxygen is required to be furnished. All units shall be designed to cover the nose and mouth and shall be equipped with a suitable means for retaining the unit in position on the face for use. Flight crew masks for supplemental oxygen shall provide for the use of communication equipment. (For crew masks to be used for protective breathing purposes, see paragraph (h) of this section.)

(2) In airplanes certificated to operate at flight altitudes to and including 25,000 feet, there shall be available to and within reach of each flight crew member an oxygen supply terminal and unit of oxygen dispensing equipment to provide for the immediate use of oxygen by such crew member. For all other occupants the supply terminals and dispensing equipment shall be located so as to permit the use of oxygen as required by the operating rules of the regulations in this subchapter.

(3) In airplanes certificated to operate above 25,000 feet flight altitude, the provisions of subdivisions (i) through (iv) of this subparagraph shall apply:

(i) An oxygen dispensing unit connected to oxygen supply terminals shall be immediately available to each occupant wherever seated. In addition, in airplanes certificated to operate above 30,000 feet, the dispensing units providing the required oxygen flow rate shall be automatically presented to the occupants. To insure that sufficient dispensing units and outlets are available for all occupants, the total number shall exceed the number of seats by at least 10 percent with the extra units being as uniformly distributed throughout the cabin as practicable;

(ii) Crew members on flight deck duty shall be provided with demand equipment. An oxygen dispensing unit connected to an oxygen supply terminal shall be immediately available to each flight crew member when seated at his station;

(iii) Not less than two outlets and units of dispensing equipment of a type similar to that required by § 4b.651 (d) (3) (i) shall be located in each washroom; and in each lavatory if separate from the washroom; and

(iv) Portable oxygen equipment shall be immediately available for each cabin attendant.

5. By amending § 4b.651 (e) to read as follows:

(e) Means for determining use of oxygen. Means shall be provided to enable the crew to determine whether oxygen is being delivered to the dispensing units.

(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/ Mabel McCart

Mabel McCart
Acting Secretary

(SEAL)

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