DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

14 CFR Parts 25 and 121

[Docket No. 16854; Amdts. Nos. 25-60 and 121-184]

Airplane Cabin Ozone Contamination

AGENCY: Federal Aviation Administration (FAA), DOT.

ACTION: Final rule.

SUMMARY: This rule establishes specific airplane cabin ozone concentration standards for the issuance of type certificates for transport category airplanes. Cabin ozone standards are also adopted for the operation of large transport category airplanes by air carriers and commercial operators. The circumstances which created the need for this action where complaints of crewmembers and passengers of physical discomfort, due to ozone gas, on high-altitude flights. This action is intended to alleviate problems due to high-altitude ozone by placing limitations on acceptable levels of cabin ozone concentrations.

EFFECTIVE DATE: February 20, 1980.

FOR FURTHER INFORMATION CONTACT: Raymond E. Ramakis, Regulatory Projects Branch (AVS-24), Safety Regulations Staff, Federal Aviation Administration, 800 Independence Avenue, SW., Washington, D.C. 20591; telephone (202) 755-8716.

SUPPLEMENTARY INFORMATION:

History

This final rule is based on Notice of Proposed Rule Making (NPRM) No. 78-15, published in the Federal Register on October 5, 1978 (43 FR 46034). All interested persons have been given an opportunity to participate in the making of the rule, and due consideration has been given to all matters presented. As a result of comments received and further consideration by the FAA, the following changes have been made to the rule as proposed:

1. Each ozone concentration is stated in parts per million by volume (ppmv) and expressed as a sea level equivalent, i.e., the ratio of ozone to air that would exist at 760 millimeters of mercury pressure and 25° C.

2. Under Part 121, a maximum average ozone concentration is imposed only on flight segments of more than 4 hours, instead of more than 3 hours, as proposed.

3. The time for compliance by Part 121 certificate holders has been extended from 6 months to 12 months, with provision for further extension of the compliance date if noncompliance is shown to be beyond the certificate holder's control.

Discussion of the Rule

Background

Notice 78-15 proposed to amend Part 25 by adding cabin ozone concentration standards for the issuance of type certificates for transport category airplanes, and to amend Part 121 to adopt cabin ozone standards for the operation of large transport category aircraft by air carriers. The NPRM sets forth the extensive background supporting its issuance, including studies by the National Aeronautics and Space Administration and the Environmental Protection Agency, as well as responses to the FAA's Advance Notice of Proposed Rule Making No. 77-22 (42 FR 54427; October 6, 1977).

The proposed maximum ozone exposure levels were also supported by U.S. Department of Transportation Report No. FAA-AEQ-77-13 (ADA-046956), Ozone Concentration by Latitude, Altitude, and Month, Near 80° W, and Report No. FAA-EQ-78-03 (ADA-050988), Guidelines for Flight Planning During Periods of High Ozone Occurrence. These reports may be obtained from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22151.

In addition, the FAA Civil Aeromedical Institute recently conducted research in which it studied ozone effects on 83 men and women in an altitude chamber at 6000 feet with a relative humidity of 10-12% and a temperature of 68-74° F (20-23° C). No significant effects attributable to ozone were demonstrated for exercising subjects at an ozone concentration of 0.20 ppmv, sea level equivalent, for 4 hours. However, all exercising subjects at 0.3 ppmv, sea level equivalent, ozone showed some effects on the respiratory system. The most common symptom was coughing, and the most prominent physical effect was restriction of air flow in the bronchioles. The study demonstrated that the threshold for ozone tolerance, expressed as a sea level equivalent, lies between 0.2 and 0.3 ppmv, and the exercise may be an aggravating factor in ozone toxicity, since sedentary subjects were unaffected by an ozone concentration of 0.3 ppmv.

A number of methods to control ozone exposure have been examined, including various filtration and converter systems, disassociation of ozone by use of heat, monitoring of ozone levels with meters, the development of ozone forecasting methods, and avoidance of areas of high ozone concentration. Since each of these methods has certain beneficial aspects, and further technological developments are possible, the FAA does not favor any method over another. However, the method of compliance chosen by a certificate holder must be shown to be effective, and the FAA intends to conduct spot checks to ensure compliance with the standards adopted by these amendments.

Favorable Comments

The FAA received comments in response to Notice 78-15 from 268 individuals, airline organizations, labor organizations, research firms, manufacturers, universities, and physicians. Approximately 234 comments were received from individual flight attendants, a majority of which agreed with the one received from the Independent Union of Flight Attendants. All flight attendant comments attested to the adverse physical effects of ozone during and after flight. Shortness of breath, sore throat, bleeding nose, chest pain, fatigue, itching eyes, etc., were commonly cited physical results of ozone contamination and exposure. All flight attendants submitting comments urged that some method be found to alleviate ozone effects. Comments frequently contained information indicating the highest incidence of ozone irritation during flights for long durations at high altitudes.

Of the remaining 32 comments, 20 were in favor of the rule, 10 were opposed, and 2 provided information or made proposals that were outside the scope of the notice.

Included among the 20 additional commenters expressing favor were professional organizations representing flight crewmembers, governmental agencies with direct knowledge of ozone contamination, manufacturers engaged in the development of filters or converters designed to control cabin ozone levels, researchers familiar with the physiological effects of various ozone exposure levels, faculty scientists of two universities, and physicians.

Ozone Concentration

Some commenters expressed confusion as to what was meant by the

(As published in the Federal Register (45 F.R. 3880) on January 21, 1980)

FS-77-202-2

proposed cabin ozone concentrations. The ratios proposed were those that would be expected at the air pressure which is normally maintained in the passenger cabins of the affected aircraft (the air pressure at about 8,000 feet). However, since most ratios of this kind, including those adopted by the Occupational Safety and Health Administration (OSHA) are expressed as sea level equivalents, the ratios in this final rule have been expressed at standard sea level pressure of 760 millimeters of mercury at 25° C.

Since there is more air in a given volume at sea level, the proposed 0.3 ppmv limit converts to 0.25 as a ppmv, sea level equivalent. With this conversion, the proposed time-weighted average of 0.1 ppmv would be reduced to 0.08 ppmv, sea level equivalent. However, it was the intent of the FAA that this average be as consistent as possible with that adopted by OSHA which is an average of 0.1 ppmv on a sea level equivalent scale. Accordingly, the time-weighted average adopted by this final rule is 0.1 ppmv, sea level equivalent.

Flight Segment

Notice 78-15 proposed to impose a time-weighted average ozone concentration of 0.1 ppmv on Part 121 certificate holders for flight segments that exceed 3 hours. As explained in the notice, only about 2 of these 3 hours of scheduled flight time would be above flight level 180. This is based on conservative times for start, taxi, takeoff, climb, descent, approach, and landing. Imposition of a time-weighted average for flights of shorter duration was considered unnecessary, since these flights would have to comply with the basic 0.3 ppmv limit to be imposed on all flights, and, therefore, could not exceed the amount of ozone exposure (i.e. dose) allowed by the OSHA time-weighted average of 0.1 ppmv which is based on an 8-hour period.

Conversion of the proposed limit from 0.3 ppmv to sea level equivalent results in a new limit of 0.25 ppmv. Virtually all of the medical data reviewed by the FAA indicate that below this level short-term exposures have no significant adverse effects, while a higher limit would be expected to result in some adverse effects. In view of this conversion to 0.25 ppmv, the FAA has concluded that the rule should be based on flight segments of 4 or more hours, since operation above flight level 180 for up to 3 hours, instead of 2 hours, could still not exceed the amount of exposure (i.e. dose) allowed by OSHA. In fact, use of the proposed 3-hour flight segment in the final rule would have resulted in a stricter dose standard than that used by OSHA, as well as that adopted in new § 25.832. A stricter standard is unnecessary, since the FAA has received no complaints of ozone contamination from occupants of short-range domestic flights, and its 1978 and 1979 ozone monitoring programs have indicated only minimal ozone contamination on these flights. This revision in the final rule will avoid putting ozone reduction equipment on a large number of short-range airplanes for which no complaints have been received.

For these reasons, the minimum flight segment proposed has been extended to 4 hours. Flights scheduled for longer than this time must not exceed 0.1 ppmv average ozone concentration over the entire flight segment.

Statistical Confidence Level

Two commenters recommended that the proposed 84% confidence level required for statistics used by Part 121 certificate holders to demonstrate compliance with the ozone limits imposed by the rule be raised to 95%. However, the FAA believes that 84%, which represents one standard deviation, establishes a practical level of statistical confidence. It should be noted that the statistical confidence level only pertains to the required validity of the statistical proof of the certificate holder's ability to comply, and does not indicate a number of flights during which the ozone concentration may exceed the limit. This requirement of statistical reliability has been expressly stated in the final rule.

Ozone Sensors

The mandatory use of onboard ozone sensors was recommended by a number of commenters. However, the FAA has determined that current technology is available to effectively control cabin ozone levels without the added requirement that flight crewmembers monitor ozone levels. Manufacturers and research organizations providing responses to the notice indicate that effective mechanical or electronic devices have been developed and are producing acceptable test results. The FAA knows of four manufacturers currently conducting airborne tests of control devices, and anticipates that competitive development will produce satisfactory control devices that will be proven by use of scientific test instruments. These amendments require a showing that any device proposed for use in compliance with these regulations function as intended, and the FAA will conduct spot checks to ensure their effectiveness.

Passenger Warning

Two commenters recommended that passengers be warned about the physical effects of ozone exposure. However, the FAA has determined that a warning is unnecessary, since exposure to ozone levels at or below the levels set forth in these regulations will not result in noticeable discomfort to most passengers and crewmembers. Those persons with special respiratory conditions, who may be sensitive to very low levels of ozone, can reasonably be expected to have been advised by their physicians of problems that may be encountered in high-altitude flight.

Opposing Comments

Comments objecting to the proposed rule included U.S. and foreign air carriers, airline organizations and associations, a major industrial corporation, and two physicians.

The commenters considered the proposed rule to be premature, stating that not enough information has been gathered concerning acceptable levels of ozone; that there is a lack of dependable methods to predict ozone levels on a flight-by-flight basis; that ozone attenuation factors are unknown for aircraft other than the Boeing 747; and that a compliance period of 6 months is inadequate because catalytic converter technology is not sufficiently advanced.

Ozone Research

These commenters were generally of the opinion that research on ozone exposure levels is incomplete and that control methods should not be required until physiological and technological studies in progress have been completed. However, a large number of government and industry research studies have been conducted to determine the deleterious effects of ozone exposure. All known studies have been thoroughly reviewed, and the FAA notes that with rare exception these studies are compatible with the findings of its own study conducted by the Civil Aeromedical Institute. For that reason, the FAA considers the maximum ozone exposure levels set forth in these regulations to be necessary.

FAA expects that ongoing research into the physiological effects of ozone and effective methods for its control will continue to provide a greater understanding of its effects on persons and will increasingly provide more efficient methods to eliminate excessive ozone quantities. Nevertheless, current technology is adequate to eliminate excessive levels of ozone in aircraft cabins. The FAA has determined that the available filters and catalytic

converters can be installed on all affected aircraft types, and as improved filtration devices are available, they can be installed with little or no further aircraft modification.

Compliance Period

In response to recommendations that the compliance period in Part 121 be extended, that period has been changed to 12 months in the final rule. The longer period will still result in compliance prior to the 1981 ozone season, but will allow further time for compliance during the summer and fall of 1980, when the concentration of atmospheric ozone is lower.

In addition the new Part 121 requirement allows a certificate holder to obtain an authorization to deviate from these requirements by an amendment to its operations specifications, if it shows that due to circumstances beyond its control or to unreasonable economic burden it cannot comply for a specified period of time, and submits a plan acceptable to the Administrator to effect compliance to the extent possible. A deviation will be authorized in circumstances such as equipment delivery delays or short-term use of aircraft, when the certificate holder shows that through flight planning or other means it will attempt to avoid areas of high ozone concentration.

Economic Costs

Notice 75-15 solicited comments from all interested parties on the economic effect of the proposed amendments. While the FAA did not receive detailed cost information from commenters, sufficient information does exist to estimate the possible economic cost for the aircraft operated by Part 121 certificate holders that are likely to be affected by this amendment.

The aircraft most susceptible to high concentrations of ozone are those capable of operation for extended periods in over-the-pole flights and in the higher latitudes. At present, these aircraft include the B-747, B-707, DC-8, DC-10, and L-1011 aircraft. The FAA estimates that there are approximately 780 of these aircraft now being operated by Part 121 certificate holders. About 500 of these are used in operations in the high latitudes, and may need mechanical modification to effectively control cabin ozone levels. Although no detailed cost estimates were supplied by air carriers to the FAA from modification of aircraft by type, cost information supplied by two manufacturing sources indicates that the unit price for a single catalytic converter will be between $3,500 and $7,000. The FAA estimates that installation costs for each converter will run from $1,000 to $1,350 per unit. Each aircraft involved is expected to need from two to three filters, depending on the design of the pressurization distribution system. Each converter is expected to remain in service more than 3 years.

If all 500 aircraft are modified, the range of procurement cost for initial installation of catalytic converters would be between $5.2 million and $10.5 million. Since 1 year is being allowed for compliance, it is expected that installation will occur during regular aircraft maintenance, and the total cost of installation is expected to be about $2.0 million.

Editorial Changes

Proposed § 121.578 has been adopted as § 121.220 to include it as a special airworthiness requirement under Subpart J of Part 121.

Sections 25.832(c) and 121.220(d) have been changed to clarify what must be done to show compliance with the standards imposed by those sections.

The Amendment

Accordingly, Parts 25 and 121 of the Federal Aviation Regulations (14 CFR Parts 25 and 121) are amended, effective February 20, 1980, as follows:

PART 25—AIRWORTHINESS STANDARDS: TRANSPORT CATEGORY AIRPLANES

1. By the addition of a new § 25.832 to Part 25 to read as follows:

§ 25.832 Cabin ozone concentration.

(a) The airplane cabin ozone concentration during flight above flight level 180 must be shown not to exceed—

(1) 0.25 parts per million by volume, sea level equivalent, at any point in time; and

(2) 0.1 parts per million by volume, sea level equivalent, time-weighted average during any 3-hour interval;

(b) For the purpose of this section, "sea level equivalent" refers to conditions of 25° C and 760 millimeters of mercury pressure.

(c) Compliance with this section must be shown by analysis or tests based on airplane operational procedures and performance limitations, that demonstrate that either—

(1) The airplane cannot be operated at an altitude which would result in cabin ozone concentrations exceeding the limits prescribed by paragraph (a) of this section; or

(2) The airplane ventilation system, including any ozone control equipment, will maintain cabin ozone concentrations at or below the limits prescribed by paragraph (a) of this section.

PART 121—CERTIFICATION AND OPERATIONS: DOMESTIC, FLAG, SUPPLEMENTAL AIR CARRIERS AND COMMERCIAL OPERATORS OF LARGE AIRCRAFT

2. By the addition of a new § 121.220 to Part 121 to read as follows:

§ 121.220 Cabin ozone concentration.

(a) For the purpose of this section, the following definitions apply:

(1) "Flight segment" means scheduled nonstop flight time between two airports.

(2) "Sea level equivalent" refers to conditions of 25° C and 760 millimeters of mercury pressure.

(b) Except as provided in paragraph (d) of this section, after February 20, 1981, no certificate holder may operate a transport category airplane above flight level 180 unless it has successfully demonstrated to the Administrator that the concentration of ozone inside the cabin will not exceed—

(1) 0.25 parts per million by volume, sea level equivalent, at any point in time; and

(2) For each flight segment that exceeds 4 hours, 0.1 parts per million by volume, sea level equivalent, time-weighted average over that flight segment.

(c) Compliance with this section must be shown by analysis or tests, based on either airplane operational procedures and performance limitations or the certificate holder's operations. The analysis or tests must show either of the following:

(1) Atmospheric ozone statistics indicate, with a statistical confidence of at least 84%, that at the altitudes and locations at which the airplane will be operated cabin ozone concentrations will not exceed the limits prescribed by paragraph (b) of this section.

(2) The airplane ventilation system, including any ozone control equipment, will maintain cabin ozone concentrations at or below the limits prescribed by paragraph (b) of this section.

(d) A certificate holder may obtain an authorization to deviate from the requirements of paragraph (b) of this section, by an amendment to its operations specifications, if—

(1) It shows that due to circumstances beyond its control or to unreasonable economic burden it cannot comply for a specified period of time; and

(2) It has submitted a plan acceptable to the Administrator to effect compliance to the extent possible.

[Secs. 313, 601, 603, 604, Federal Aviation Act of 1958, as amended (49 U.S.C. 1354, 1421, 1423, 1424); sec. 6(c), Department of Transportation Act (49 U.S.C. 1655(c))]

Note.—The FAA has determined that this document involves a proposed regulation which is significant under Executive Order 12044 as implemented by DOT Regulatory Policies and Procedures (44 FR 11034; February 26, 1979). A copy of the final regulatory evaluation prepared for this action is contained in the regulatory docket. A copy of it may be obtained by contacting the person identified above under the caption "FOR FURTHER INFORMATION CONTACT:".

Issued in Washington, D.C., on January 15, 1980.

Langhorne Bond,

Administrator.

[FR Doc. 80-1825 Filed 1-18-80; 8:45 am]

BILLING CODE 4910-13-M