NPRM 90-7

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

14 CFR Part 25

[Docket No. 26147, Notice No. 90-7]

RIN 2120-AD37

Use of Nitrogen or Other Inert Gas for Tire Inflation in Lieu of Air

AGENCY: Federal Aviation Administration (FAA), DOT.

ACTION: Notice of proposed rulemaking (NPRM).

SUMMARY: This notice proposes to require that an inert gas, such as nitrogen, be used in lieu of air, for inflation of tires on certain transport category airplanes. This action is prompted by at least three cases in which the oxygen in air-filled tires combined with volatile gases given off by a severely overheated tire and exploded upon reaching autoignition temperature. The use of an inert gas for tire inflation will eliminate the possibility of a tire explosion.

DATES: Comments must be received on or before July 2, 1990.

ADDRESSES: Comments on this proposal may be mailed in triplicate to: Federal Aviation Administration, Office of the Chief Counsel, Attention: Rules Docket (AGC-204), Docket No. 26147, 800 Independence Avenue SW., Washington, DC 20591, or delivered in triplicate to: Room 915G, 800 Independence Avenue SW., Washington, DC 20591. All comments must be marked: Docket No. 26147. Comments may be inspected in Room 915G weekdays, except Federal holidays, between 8:30 a.m. and 5 p.m. In addition, the FAA is maintaining an information docket of comments in the Office of the Assistant Chief Counsel (ANM-7), FAA, Northwest Mountain Region, 17900 Pacific Highway South, C-68966, Seattle, Washington 98168. Comments in the information docket may be inspected in the Office of the Assistant Chief Counsel weekdays, except Federal holidays, between 7:30 a.m. and 4 p.m.

FOR FURTHER INFORMATION CONTACT: Gary D. Lium, Flight Test and Systems Branch, ANM-111, Transport Airplane Directorate, Aircraft Certification Service, 17900 Pacific Highway South, C-68966, Seattle, Washington 98169; telephone (206) 431-2118.

SUPPLEMENTARY INFORMATION:

Comments Invited

Interested persons are invited to participate in the proposed rulemaking by submitting such written data, views, or arguments as they may desire. Comments relating to the environmental, energy, or economic impact that might result from adopting the proposals contained in this notice are invited. Substantive comments should be accompanied by cost estimates. Commenters should identify regulatory docket or notice number and submit comments, in triplicate, to the Rules Docket address above. All comments received on or before the closing date for comments will be considered by the Administrator before taking action on proposed rulemaking. The proposals contained in this notice may be changed in light of comments received. All comments will be available in the Rules Docket for examination by interested persons, both before and after the closing date for comments. A report summarizing each substantive public contact with FAA personnel concerning this rulemaking will be filed in the docket. Commenters wishing the FAA to acknowledge receipt of their comments must submit with those comments a self-addressed, stamped postcard on which the following statement is made: "Comments to Docket No. 26147." The postcard will be date/time stamped and returned to the commenter.

Availability of NPRM

Any person may obtain a copy of this NPRM by submitting a request to the Federal Aviation Administration, Office of Public Affairs, Attention: Public Information Center, APA-230, 800 Independence Avenue SW., Washington, DC 20591; or by calling (202) 267-3484. Communications must identify the notice number of this NPRM. Persons interested in being placed on a mailing list for future NPRMs should also request a copy of Advisory Circular No. 11-2A, Notice of Proposed Rulemaking Distribution System, which describes the application procedures.

Background

The requirements for approval of airplane tires are contained in § 25.733. This section describes the loads and speed ratings required of each tire, and requires that the tires be shown to be suitable for their intended use. In addition, each tire is authorized under a Technical Standard Order (TSO), which means that the tire has passed a series of rigorous dynamometer tests and is produced in accordance with an approved manufacturing process and quality control system. Airplane tires are designed for strength and durability, and since the advent of turbojet transport airplanes, they have had a satisfactory service history.

Despite this emphasis on strength and durability for airplane tires, there have been instances of a tire failure in the wheel well during flight on transport category airplanes. The great majority of these have been classified as tire bursts, with only a few having been identified as tire explosions. This is an important distinction, which is relevant to this proposed rulemaking action.

A tire burst, as referred to in § 25.729(f), is a sudden, sometimes violent, venting of the pressure from within a tire, usually associated with a flaw in the tire, foreign object damage, or tire overheat/overload. The FAA assumes that tire bursts will occasionally occur, given the rather severe operating environment of airplane tires, and the fact that certain tire damage may go undetected until tire failure. With this in mind, equipment installed in wheel wells is evaluated at the time of certification to determine its ability to withstand the effects of a bursting tire. Analyses and laboratory tests are performed to identify critical areas, and design changes are often made to ensure that a single tire burst will not cause loss of critical functions.

A tire explosion is a completely different phenomenon. It results from the autoignition and explosion of a mixture of explosive vapors released from the innerliner of a severely overheated or abused tire, and any oxygen that may be present inside the tire. A tire explosion in the wheel well is an unlikely event, since it is the result of a combination of several related events: a brake must be severely overheated due to some brake system failure; the wheel thermal fuse plugs, because of their orientation when the landing gear are retracted, must fail to respond quickly enough to the overheated condition; the overheated and possibly damaged tire must hold together long enough to allow the gas mixture in the tire to reach autoignition temperature; and there must be sufficient oxygen inside the tire to support an explosion.

It is impossible to design a thermal fuse plug that would be effective in a tire explosion. A thermal fuse plug is a hollow bolt installed in the wheel, with the hole in the bolt filled with a material that melts at a precisely defined temperature. At the desired temperature, the material melts and is ejected from the hollow bolt by tire pressure, allowing the tire to deflate. Because the pressure and temperature rise inside the tire would be nearly instantaneous following ignition, the melting of the fuse plug, which is basically a mechanical

process, would not have time to take place. Also, the cross sectional area of a series of fuse plugs sufficient to safely vent the energy of an explosion would be so large that it would seriously compromise the structural integrity of the wheel. It is more logical to prevent a tire explosion than to attempt to deal with it after it happens. A tire explosion can be prevented by the use of an inert gas such as nitrogen for tire inflation.

Laboratory tests conducted in 1973 show a definite relationship between the quantity of oxygen in a tire and the gas mixture's autoignition temperature. Test data indicate that at nitrogen concentrations between 80 percent and 90 percent (the atmosphere contains approximately 80 percent nitrogen and 20 percent oxygen), ignition of inner tire liner samples occurred in a test chamber with temperatures varying from 478 °F. to 518 °F. Nitrogen concentrations between 90 percent and 95 percent raised the autoignition temperatures to a range of 520 °F. to 531 °F. At nitrogen concentrations greater than 95 percent, there was no pressure increase in the test chamber, even at chamber temperatures of 670 °F., indicating that there was no ignition. Based on these tests, it was concluded that any concentration of oxygen in a tire in excess of 5 percent of the total gas will support a reaction. At a concentration above 10 percent, this reaction is an abrupt autoignition. At concentrations from 5 percent to 10 percent, this reaction is assumed to be a low level autoignition, based on measurement of test chamber pressure and temperature.

If a tire contains at least 95 percent nitrogen or other gases shown to be inert, and is involved in a severe overheat situation as described above, the atmosphere inside the tire would prevent autoignition, or at least delay it long enough either for the fuse plugs to react and release tire pressure, or for the tire itself to fail from overheat, resulting in the less severe tire burst. Section 25.733 currently specifies certain static and dynamic load requirements for airplane tires depending on landing gear configuration. Since the hazard associated with a tire explosion in the wheel well during flight exists on large transport airplanes using tires inflated with air, § 25.733 would be amended to require that tires mounted on braked wheels be inflated with dry nitrogen, or other gases shown to be inert, such that the gas mixture does not contain oxygen in excess of 5 percent by volume.

The FAA recognizes that nitrogen may not always be available at some airports, and that the prohibition against the use of air to refill a low tire may cause some inconvenience. As indicated by the testing described above, nitrogen in the tire may be diluted with oxygen to a 95 percent concentration without compromising safety. Any maintenance procedure developed by an operator that would assure that any tire refill using air would not allow the nitrogen concentration to drop below 95 percent would be an acceptable method of compliance with the proposed rule. For example, a manufacturer has published in the maintenance manuals of two of its models, a chart which explains a repetitive air refill procedure for a residual tire nitrogen content of 90 percent. While this chart would not be usable for a concentration of 95 percent, it shows that similar procedures for a minimum nitrogen concentration of 95 percent for a range of tire sizes and pressures could be easily developed.

It is proposed to apply this new rule to large transport category airplanes with a maximum certificated takeoff weight greater than 75,000 pounds. A review of service difficulty reports has revealed that more severe tire failures occur on the larger, heavier airplanes. The mechanism of a tire explosion is not fully understood, but it is clear that sufficient energy to raise the air in a tire to autoignition temperature must be provided by an overheated brake. Larger airplanes generally have higher takeoff and landing speeds and, at the higher gross weights, this provides for more kinetic energy to be absorbed by the brakes as heat. The FAA has no records of adverse service history on smaller transport category airplanes that would suggest that the use of air for tire inflation constitutes a hazard.

In addition, it is proposed that the requirement to use an inert gas for tire inflation be limited to braked wheels only, since there is no source of excessive heat present on unbraked wheels.

Regulatory Evaluation

This regulatory evaluation examines the costs and benefits of a proposed rulemaking that would amend part 25 of the Federal Aviation Regulations (FAR) to require tires to be inflated with nitrogen or other gases shown to be inert on transport category airplanes with maximum certificated takeoff weights greater than 75,000 pounds. This proposal would apply only to airplanes type certificated after issuance of a final rule amending part 25.

The purpose of this rulemaking is to reduce or eliminate the potential danger of explosions in tires on new types of large transport airplane, caused by the presence of oxygen in the tire.

Costs of this rulemaking are expected to be extremely small or even negligible, since this proposed rule would mandate what is currently a standard industry practice. An Airworthiness Directive (AD) has already been issued that requires using inert gas to inflate tires on existing types of transport category airplanes. Prior to the issuance of the AD, inflation of airplane tires with nitrogen was a widespread practice among U.S. operators of airplanes certificated under part 25.

Costs

It is likely that air carriers that are currently using inert gas tire inflation equipment and procedures on their existing fleets will voluntarily employ the same equipment and procedures on airplanes with new type certificates, for reasons of efficiency and practicality.

Any costs of this proposed rule would most likely be limited to rare situations where air carriers use newly type certificated airplanes on routes to U.S. or foreign destinations not previously served, where nitrogen and inert gas inflation equipment may not otherwise be readily available. In order to comply with this rulemaking, a carrier that would otherwise service airplane tires with compressed air at these destinations may now have to purchase bottled gas and inert gas inflation equipment.

The FAA assumes, as a worst-case scenario, that 5 percent of newly type certificated large transport airplanes delivered in the U.S. between 1989 and 1998 would have their tires inflated with compressed air, at any given time, in the absence of this proposed rule. The FAA also assumes, as a worst-case scenario, that 20 additional destinations that had not previously accommodated large U.S.-operated transport airplanes would be served between 1989 and 1998 by the new airplane types, and that they would not otherwise have the requisite equipment to comply with the proposed amendments.

The new types of large transport category airplanes affected by this proposed rulemaking are estimated to require between 30 and 40 tires per airplane annually, and 155 cubic feet of nitrogen over the life of each tire. The FAA assumes that bottled dry nitrogen costs $.85 per 100 cubic feet on average.

The FAA also predicts that the following equipment costs would be incurred at the 20 airports where nitrogen inflation equipment would have to be purchased:

- $400 for mobile bottle carts
- $200 for regulators
- $80 for hoses and fittings

These assumptions have yielded the following cost estimates for the 1989–1998 evaluation period:

- Total operating costs, from procurement of bottled dry nitrogen, of $2,915 (discounted present value)
- Total equipment costs of $8,487 (discounted present value)
- Total costs of compliance of $11,402 (discounted present value)

Benefits

The proposed rule would enhance safety by virtually eliminating any remaining possibility of tire explosions caused by tire inflation with compressed air in newly-certificated large transport airplanes.

The benefit of preventing one accident before 1998 of the magnitude of an accident caused by a tire explosion that occurred in the U.S. in 1973 (valued in 1987 at $675,000, discounted present value), would far outweight the small costs of the proposed amendments. It is notable that expected safety benefits of this proposed regulation would still exceed assumed costs even if there is as small as a 2 percent probability that such an accident would otherwise occur in the U.S., among newly type-certificate airplanes, before 1998.

Regulatory Flexibility Determination

Under the criteria of the Regulatory Flexibility Act of 1980, the FAA has determined that the proposed rule would not have a significant economic impact on a substantial number of small entities.

Since the Act applies to U.S. entities, only U.S. manufacturers of transport category airplanes would be affected. In the United States, there are two manufacturers that specialize in commercial transport category airplanes, the Boeing Company and the McDonnell Douglas Corporation. In addition, there are a number of general aviation entities that manufacture other transport category airplanes such as large business jets, including Cessna Aircraft and Gates Lear Jet.

The FAA size threshold for a determination of a small entity for U.S. airplane manufacturers is 75 employees; any U.S. airplane manufacturer with more than 75 employees is considered not to be a small entity. None of the transport category airplane manufacturers is known to be a small entity. Thus, there would not be a significant economic impact on a substantial number of small entities as the result of the implementation of this proposal.

International Trade Impact Assessment

This proposal is not expected to have an adverse impact either on the trade opportunities of U.S. manufacturers of transport category airplanes doing business abroad or on foreign aircraft manufacturers doing business in the U.S. Since the certification rules are applicable to both foreign and domestic manufacturers selling airplanes in the U.S., there would be no competitive trade advantage to either.

Federalism Implications

The regulations proposed herein would not have substantial direct effects on the States, on the relationship between the national government and the States, or on the distribution of power and responsibilities among the various levels of government. Therefore, in accordance with Executive Order 12612, it is determined that this proposal would not have sufficient federalism implications to warrant the preparation of a Federalism Assessment.

Conclusion: Because the proposed requirement to use inert gas in lieu of nitrogen for tire inflation is not expected to result in a substantial cost, the FAA has determined that this proposed rule is not major as defined in Executive Order 12291. Because this is an issue which has not prompted a great deal of public concern, this proposed rule is not considered to be significant as defined in Department of Transportation Regulatory Policies and Procedures (44 FR 11034; February 26, 1979). In addition, since there are no small entities affected by this rulemaking, it is certified, under the criteria of the Regulatory Flexibility Act, that this proposed rule, at promulgation, would not have a significant economic impact, positive or negative, on a substantial number of small entities. A copy of the initial regulatory evaluation prepared for this project may be examined in the public docket or obtained from the person identified under the caption "**FOR FURTHER INFORMATION CONTACT.**"

List of Subjects in 14 CFR Part 25

Air transportation, Aircraft aviation safety, Safety.

The Proposed Amendment

Accordingly, the FAA proposes to amend part 25 of the Federal Aviation Regulations (FAR) (14 CFR part 25) as follows:

PART 25—AIRWORTHINESS STANDARDS: TRANSPORT CATEGORY AIRPLANES

1. The authority citation for part 25 continues to read as follows:

Authority: 49 U.S.C. 1344, 1354(a), 1355, 1421, 1423, 1424, 1425, 1428, 1429, 1430; 49 U.S.C. 106(g) (Revised Pub. L. 97–449, January 12, 1983), 49 CFR 1.47(a).

2. By amending § 25.733 by adding a new paragraph (e) to read as follows:

§ 25.733 Tires.

* * * * *

(e) For an airplane with a maximum certificated takeoff weight of more than 75,000 pounds, tires mounted on braked wheels must be inflated with dry nitrogen or other gases shown to be inert so that the gas mixture in the tire does not contain oxygen in excess of 5 percent by volume.

Issued in Washington, DC, on February 23, 1990.

William J. Sullivan,

Assistant Director, Aircraft Certification Service.

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