DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

14 CFR Part 25

[Docket No. 26147, Amendment No. 25-78]

RIN 2120-AD37

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

AGENCY: Federal Aviation Administration, DOT.

ACTION: Final rule.

SUMMARY: This amendment to the Federal Aviation Regulations (FAR) requires 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.

EFFECTIVE DATE: March 29, 1993.

FOR FURTHER INFORMATION CONTACT: Robert C. McCracken, Flight Test and Systems Branch, ANM-111, Transport Airplane Directorate, Aircraft Certification Service, 1601 Lind Avenue Southwest, Renton, Washington 98055-4056; telephone (206) 227-2118.

SUPPLEMENTARY INFORMATION:

Background

This amendment is based on Notice of Proposed Rulemaking (NPRM) No. 90-7, which was published in the **Federal Register** on March 5, 1990 (55 FR 7876), and a correction notice published March 21, 1990 (55 FR 10467). Notice 90-7 proposed to require that an inert gas, such as nitrogen, be used in lieu of air, for inflation of tires on certain transport category airplanes.

The airworthiness standards for airplane tires are contained in § 25.733 of the FAR. 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 may be manufactured under 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 tire failures 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 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 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. Most thermal fuse plugs in use today are hollow bolts installed in the wheel rim. The cavity in the bolt is filled with a material that melts at a precisely defined temperature 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 could 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.

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 is 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. As other means may be available to prevent tire explosions, this amendment requires the use of an inert gas for tire inflation unless the tire liner material will not produce volatile gases when heated or means are provided to prevent tire temperatures from reaching unsafe levels.

The Federal Aviation Administration (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 rule. For example, a manufacturer has published in the maintenance manuals 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 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.

This new rule applies 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 tire explosions, as opposed to tire bursts, tend to occur on the larger, heavier airplanes. While the mechanism of a tire explosion is not fully understood, 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. In addition, the volume of gas present in the larger tires installed on larger, heavier airplanes contain more combustible gas than would be found on the smaller airplanes, which would result in a more damaging explosion. Finally, 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 on these airplanes.

In addition, this amendment adds the requirement to use an inert gas for tire inflation for braked wheels only, since there is no source of excessive heat present on unbraked wheels.

In response to the unsafe condition associated with tire explosions, the FAA issued an airworthiness directive (AD) in April 1987 which requires the servicing of tires on certain large transport category airplanes with nitrogen in lieu of air. The AD requires the installation of a placard, either in the wheel well or on or near each landing gear strut incorporating braked wheels, and in a location so as to be easily seen and readable by a person performing routine tire servicing. The placard is to read "INFLATE TIRES WITH NITROGEN ONLY." Alternatively, the operator is to incorporate into the FAA-approved maintenance program procedures to ensure that the gas mixture will not exceed 5% oxygen by volume. The FAA believes that an appropriate placard installed on the airplane and the addition of a suitable limitation on the type certificate data sheet would be an acceptable means of compliance with this new rule. It would also be appropriate to include information regarding servicing tires with an inert gas in the manufacturer's maintenance manuals under Instructions for Continued Airworthiness.

Discussion of Comments

Comments were received from two foreign government agencies, four trade organizations, and one company manufacturing landing gear components. While all of the commenters support the proposal, two parties offer comments suggesting changes of a clarifying nature.

One commenter suggests that control of the inflation media should apply to any aircraft with a maximum certificated takeoff weight (MCTW) of more than 5,700 kilograms (12,560 pounds) that has retractable undercarriage containing braked wheels, and not be limited to aircraft of more than 75,000 pounds MCTW. No information was presented by the commenter to support this suggestion, and the FAA has no information to support the suggestion. As noted in the preamble of Notice 90–7, the FAA has no records showing adverse service history on smaller transport category airplanes that would suggest that the use of the air for tire inflation constitutes a hazard. This is due to the higher energy that must be absorbed by the brakes, wheels, and tires with the higher weights and landing speeds associated with larger airplanes. Limiting the applicability to airplanes with "retractable undercarriages" is not considered appropriate. There will, in all likelihood, be no transport category airplanes with takeoff weights above 75,000 pounds certificated with fixed landing gear. Nevertheless, the hazard associated with tire explosions would exist if such an airplane design were proposed. The rule is therefore adopted as proposed in that regard.

This commenter also notes that, while nitrogen is the most likely inert gas that would be used to inflate tires, it would be necessary to ensure that any other "gases shown to be inert" are approved by the manufacturer as not being detrimental to the tire. The commenter suggests changing the rule to refer to other *suitable* gases shown to be inert, and approved by the tire manufacturer. The FAA shares the concern expressed by the commenter; however the wording in the rule as proposed in Notice 90–7 contains the phrase "nitrogen or other gases shown to be inert." This requires that the applicant manufacturer demonstrate to the FAA that any "other gas" is suitable for use. The term "approved by the manufacturer" is inappropriate since only the FAA or persons authorized to act on behalf of the FAA have the authority to approve the use of another gas. The rule is therefore issued as proposed in this regard.

This commenter also expresses concern regarding servicing of tires at remote locations where dry nitrogen is not currently available, and expresses the assumption that there is an operational counterpart to the proposed change in part 25 of the FAR. The commenter notes that some European countries have a maintenance practice allowing servicing of tires at remote sites where dry nitrogen is not available by either ascertaining that the oxygen content stays below 5 percent or requiring that the tire be purged and inflated with dry nitrogen within 15 flight hours after servicing with air. This practice is also allowable under airworthiness directives issued by the FAA addressing existing airplanes. The FAA infers that the commenter is suggesting a change to the final rule to allow servicing with air at remote sites under the above maintenance practice. The FAA does not concur with this suggestion. The cost of supplying dry nitrogen servicing equipment to airports that are not now equipped to service large transport category airplane tires in accordance with this rule was investigated, as were the benefits that would accrue from promulgation of the rule and, as was noted in the preamble to Notice 90–7, it was determined that the ratio of cost versus benefits was favorable. A tire explosion could occur with catastrophic consequences within the 15 allowed hours following servicing a tire with air. Further, this rule does not affect airplanes now flying and the FAA is confident that suitable service facilities can be supplied where needed prior to new airplanes certificated in accordance with this rule becoming operational.

One commenter recommends revising the new § 25.733(e) to state "For an airplane with a maximum certificated takeoff weight of more than 75,000 pounds, means shall be provided for tires mounted on braked wheels to

preclude tire explosions." The commenter states that "The proposed regulation is a design dictate which precludes alternate designs, more economical solutions, or any advancement in the state of the art beyond the 1980's," and notes that the new rule should "not preclude the search for tire inner liners which do not release explosive vapor. It should not preclude solutions which prevent tire temperatures from reaching the temperatures at which outgassing occurs since this would also preclude tire structural damage from overheat." The FAA concurs with the intent of the commenter's suggestion. There is currently no known means to protect transport category airplanes from the hazards associated with tire explosions except through mandatory use of an inert gas for tire inflation. Nevertheless, if a means is found in the future to preclude this hazard, either through the use of different tire materials or via design changes that can be shown to be effective in limiting tire temperatures to safe levels, that means would be acceptable. Section 25.733(e) is changed to reflect such alternative methods of compliance.

This same commenter goes on to state that the proposal "imposes a constraint on design which does not achieve the intended purpose—to ensure that tires are always filled with inert gases during their entire service life." The commenter states that the regulation should address the servicing and maintenance of the aircraft. The FAA infers from this comment that the commenter desires specific wording in the new rule to control maintenance procedures. The FAA does not concur with this comment. The operating rules require that all civil aircraft be operated in accordance with operating limitations specified in the approved Airplane Flight Manual, markings, and placards, or as otherwise prescribed by the certificating authority of the country of registry. Therefore, placing wording to control maintenance procedures in part 25 as suggested by the commenter would be duplicative.

Regulatory Evaluation Summary

This section summarizes the full regulatory evaluation prepared by the FAA that provides more detailed estimates of the economic consequences of this regulatory action. This summary and the full evaluation quantify, to the extent practicable, estimated costs to the private sector, consumers, Federal, State and local governments, as well as anticipated benefits.

Executive Order 12291, dated February 17, 1981, directs Federal agencies to promulgate new regulations or modify existing regulations only if potential benefits to society for each regulatory change outweigh potential costs. The order also requires the preparation of a Regulatory Impact Analysis of all "major" rules except those responding to emergency situations or other narrowly defined exigencies. A "major" rule is one that is likely to have an annual impact on the economy of $100 million or more, a major increase in consumer costs, or a significant adverse effect on competition.

The FAA has determined that this rule is not "major" as defined in the executive order; therefore, a full Regulatory Impact Analysis, which includes the identification and evaluation of cost-reducing alternatives to this rule, has not been prepared. Instead, the agency has prepared a more concise document, termed a regulatory evaluation, that analyzes only this rule without identifying alternatives. In addition to a summary of the regulatory evaluation, this section also contains the Regulatory Flexibility Determination required by the Regulatory Flexibility Act and an International Trade Impact Analysis. If more detailed economic information is desired, the reader may refer to the full regulatory evaluation contained in the docket.

None of the comments on the NPRM for this amendment addressed the evaluation of costs and benefits, and, accordingly, no resulting changes have been made to the evaluation.

Economic Evaluation

It is likely, for reasons of efficiency and practicality, that since air carriers are currently using inert gas, and inert gas tire inflation equipment and procedures on their existing fleets, they will voluntarily employ the same equipment and procedures on airplanes with new type certificates. Since this rule mandates what is already an existing industry practice, as required by airworthiness directive, actual costs and benefits attributable to the rule are expected to be negligible.

Notwithstanding, the FAA has analyzed potential costs by assuming, as a worst-case scenario, that 5 percent of the affected, newly-certificated airplanes would use compressed air to service their tires in the absence of this rule. The evaluation further assumes that nitrogen inflation equipment could be required at as many as 20 destinations not previously served by U.S. operated, large transport category airplanes.

Technically, none of the four new airplane models that are currently scheduled for delivery between 1992 and 2001 will be subject to the rule since their certification bases were established at the time of application. Therefore, this evaluation considers the succeeding 10-year period, 2002 to 2011, and assumes that the same numbers of new-model airplanes will be delivered during that period as are currently forecast for the 1992 to 2001 period.

The following additional factors were used in determining the potential costs of this rule.

- Bottled nitrogen will cost an average of $0.98 per 100 cubic feet.
- Each tire will require approximately 155 cubic feet of nitrogen over its useful life.
- Nitrogen inflation equipment will cost $780 per unit for bottle carts, hoses and fittings.

Under these assumptions, the present-value equivalence of $1,300 in operating costs and $5,468 in equipment costs could be expended over the period from 2002 to 2011 as a result of this rule.

The primary benefit of the rule is the elimination of any remaining possibility of tire explosions caused by tire inflation with compressed air. The FAA is unable to predict the probability that a tire autoignition accident would occur in the absence of this rule. However, the discounted present value of averting an accident similar to the 1973 crash at Dulles would equal $190,000. If the probability of averting a single noncatastrophic accident is only 3.6 percent ($6,768/$190,000), this rule will prove to be cost beneficial. Accordingly, the FAA believes that the potential benefits of this rule will exceed the potential costs.

Regulatory Flexibility Determination

The Regulatory Flexibility Act of 1980 (RFA) was enacted by Congress to ensure that small entities are not unnecessarily or disproportionately burdened by Government regulations. The RFA requires a Regulatory Flexibility Analysis if a rule has a significant economic impact, either detrimental or beneficial, on a substantial number of small entities. FAA Order 2100.14A, Regulatory Flexibility Criteria and Guidance, establishes threshold cost values and small entity size standards for complying with RFA review requirements in FAA rulemaking actions. Based on these factors, the FAA has determined that this rule will not have a significant economic impact on a substantial number of small entities.

International Trade Impact Analysis

The provisions of this rule will have little or no impact on trade for both U.S. firms doing business in foreign countries and foreign firms doing business in the United States. In the United States, foreign manufacturers will have to meet the U.S. requirements, and thus would gain no competitive advantage. In foreign countries, U.S. manufacturers are not bound by Part 25 requirements and could, therefore, implement the provisions of this rule solely on the basis of competitive considerations.

Federalism Implication

The regulations adopted herein will 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 final rule will not have sufficient federalism implications to warrant the preparation of a Federalism Assessment.

Conclusion

Because the requirement to use inert gas in lieu of air for tire inflation is not expected to result in a substantial cost, the FAA has determined that final 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 final 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 final rule, at promulgation, will not have a significant economic impact, positive or negative, on a substantial number of small entities. A copy of the final 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 Amendment

Accordingly, Part 25 of the Federal Aviation Regulations (FAR) (14 CFR Part 25) is amended as follows:

PART 25—AIRWORTHINESS STANDARDS: TRANSPORT CATEGORY AIRPLANES

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

Authority: 49 U.S.C. app. 1344, 1354(a), 1355, 1421, 1423, 1424, 1425, 1428, 1429, 1430; 49 U.S.C. 106(g).

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, unless it can be shown that the tire liner material will not produce a volatile gas when heated or that means are provided to prevent tire temperatures from reaching unsafe levels.

Issued in Washington, DC, on February 22, 1993.

Joseph Del Balzo,

Acting Administrator.

[FR Doc. 93–4506 Filed 2–25–93; 8:45 am]

BILLING CODE 4910–13–M