

Proposed Rules

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This section of the FEDERAL REGISTER contains notices to the public of the proposed issuance of rules and regulations. The purpose of these notices is to give interested persons an opportunity to participate in the rule making prior to the adoption of the final rules.

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

14 CFR Part 25

[Docket No. NM-133; Notice No. SC-96-6-NM]

Special Conditions: Jetstream Aircraft Limited, Jetstream Model 4100 Series Airplanes, Passenger Airbag Installation

AGENCY: Federal Aviation Administration, DOT.

ACTION: Notice of proposed special conditions.

SUMMARY: This notice proposes to issue special conditions to Jetstream Aircraft Limited of Prestwick, Scotland (formerly British Aerospace Public Limited Company (BAe)) for the Jetstream Model 4100 series airplanes. This airplane series has a novel or unusual design feature associated with the installation of passenger airbags. Since the applicable airworthiness regulations do not contain adequate or appropriate safety standards for this particular design feature, this notice contains the additional safety standards which the Administrator finds necessary to establish a level of safety equivalent to that established by the airworthiness standards for transport category airplanes.

DATES: Comments must be received on or before November 29, 1996.

ADDRESSES: Comments on this proposal may be mailed in duplicate to: Federal Aviation Administration, Transport Airplane Directorate (ANM-100), Attn: Docket No. NM-133, 1601 Lind Avenue SW., Renton, Washington 98055-4056; or delivered in duplicate to the Transport Comments may be inspected in the Rules Docket weekdays, except Federal holidays, between 7:30 a.m. and 4:00 p.m.

FOR FURTHER INFORMATION CONTACT: Jeff Gardlin, Regulations Branch, ANM-114, Transport Airplane Directorate, Aircraft Certification Service, FAA,

1601 Lind Avenue SW., Renton, Washington 98055-4056; telephone (206) 227-2136.

SUPPLEMENTARY INFORMATION:

Comments Invited

Interested persons are invited to participate in the making of these proposed special conditions by submitting such written data, views, or arguments as they may desire. Communications should identify the regulatory docket or notice number and be submitted in triplicate to the address specified above. All communications received on or before the closing date for comments will be considered by the Administrator before taking action on this proposal. The proposal contained in this notice may be changed in light of comments received. All comments submitted 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. Persons wishing the FAA to acknowledge receipt of their comments submitted in response to this notice must submit with those comments a self-addressed, stamped postcard on which the following statement is made: "Comments to Docket No. NM-133." The postcard will be date/time stamped, and returned to the commentator.

Background

On May 24, 1989, BAe Public Limited Company (currently Jetstream Aircraft Ltd.) applied for a type certificate for the BAe Model 4100 (currently Jetstream Model 4101) airplane in the transport airplane category. The Model 4100 was to be derivative of the Model 3100, which is a small airplane and is certificated under the provisions of part 23. Like the Model 3100, the Model 4100 was a low wing, twin engine turbo-prop design. The FAA issued Type Certificate (TC) A41NM for the Jetstream Model 4101 airplane on April 9, 1993. The TC includes Exemption 5587 from compliance with the head injury criteria (HIC) requirements in § 25.562 of the Federal Aviation Regulations (FAR) for the front row of passenger seats.

Section 25.562 of the FAR specifies that dynamic tests must be conducted for each seat type installed in the airplane. The pass/fail criteria for these

seats include structural as well as human tolerance criteria. In particular the regulations require that persons not suffer serious head injury under the conditions specified in the tests, and that a HIC measurement of not more than 1000 units be recorded, should contact with the cabin interior occur. The HIC is based on physiological data, and was first introduced in the automotive industry. At the time the rule was written, compliance with the HIC requirement was expected to involve using energy absorbing pads, upper torso restraints, or increasing spacing between seats and interior features. In the years following publication of the rule, the requirement has proved difficult to comply with using "conventional" means, and there has been commercial resistance to installation of upper torso restraint for passengers. Because of the technical problems, BAe and other manufacturers were granted temporary exemptions to allow certification of their airplanes while design solutions were developed.

One design solution that appeared to be impractical early in its adaptation to aircraft was airbags, even though airbags are widely used in automobiles as a supplemental restraint system. While the service history in automobiles is quite good, the operating environment and conditions of use in aircraft are quite different from automobiles. The FAA will not enumerate the differences here, but they include exposure to electromagnetic fields, wear and tear considerations, crash sensing systems etc., and did serve to help frame the content of the proposed special conditions. In any case, airbags were not envisioned as a means of compliance with the FAR, and the rules are not adequate to define the necessary criteria. Therefore, special conditions are necessary.

Airbags have two potential advantages over other means of head impact protection. They essentially provide equivalent protection for all sizes of occupants and they can provide significantly greater protection than would be expected with energy absorbing pads, for example. These are significant advantages from a safety standpoint, since airbags will likely provide a level of safety that exceeds the FAR minimum standards. Conversely, airbags are an active system, and must be relied upon to activate properly

when needed, as opposed to an energy absorbing pad or upper torso restraint that is always available. These potential advantages must be balanced against the potential problems in order to develop standards that will provide an equivalent level of safety to that intended by the regulations.

The FAA has considered the installation of airbags to have two primary safety concerns: first, that they perform properly under foreseeable operating conditions and second, that they do not perform in a manner or at such times as would constitute a hazard to the airplane or occupants. This latter point has the potential to be the more rigorous of the requirements, owing to the active nature of the system. With this philosophy in mind, the FAA has considered the following as a basis for the special conditions.

The airbag will rely on electronic sensors for signaling, and pyrotechnic charges for activation so that it is available when needed. These same devices could be susceptible to inadvertent activation, causing deployment in a potentially unsafe manner. The consequences of such deployment must be considered in establishing the reliability of the system. For example, there is subjective evidence that there may be transient overpressure (shock) caused by deployment of the airbag. Jetstream must substantiate that the effects of an inadvertent deployment in flight are either not a hazard to the airplane, or that such deployment is an extremely improbable occurrence (less than 10^{-9} per flight hour). The effect of an inadvertent deployment on a passenger that might be positioned close to the airbag should also be considered. The person could be either standing or sitting. A minimum reliability level will have to be established for this case, depending upon the consequences, even if the effect on the airplane is negligible.

The potential for an inadvertent deployment could be increased as a result of conditions in service. For example, an airbag installed in a galley wall or windscreen will be subjected to wear and tear associated with loading the galley and rough contact from baggage during aircraft boarding etc. Whether or not these conditions are more severe than in the automotive world, the installation must take into account wear and tear so that the likelihood of an inadvertent deployment is not increased to an unacceptable level. In this context, an appropriate inspection interval and self-test capability are considered necessary. Other outside influences are high intensity electromagnetic fields and

lightning. Since the sensors that trigger deployment are electronic, they must be protected from the effects of these threats. Existing Special Conditions No. 25-ANM-48 are therefore incorporated by reference. For the purposes of compliance with those special conditions, if inadvertent deployment could cause a hazard to the airplane, the airbag is considered a critical system; to the extent that injuries to persons could result from inadvertent deployment, the airbag should be considered an essential system. Finally, the airbag installation should be protected from the effects of fire, so that an additional hazard is not created by, for example, a rupture, of the pyrotechnic squib.

In order to be an effective safety system, the airbag must function properly and must not introduce any additional hazards to occupants as a result of its functioning. There are several areas where the airbag differs from traditional occupant protection systems, and requires special conditions to ensure adequate performance.

Because the airbag is essentially a single use device, there is the potential that it could deploy under crash conditions that are not sufficiently severe as to require head injury protection from the airbag. Since an actual crash is frequently composed of a series of impacts, this could render the airbag useless if a larger impact follows the initial impact. This situation does not exist with energy absorbing pads or upper torso restraints, which tend to provide protection proportional to the severity of the impact. Therefore, the airbag installation should be such that the airbag will provide protection when it is required, and will not expend its protection when it is not needed. There is no requirement for the airbag to provide protection for multiple impacts, where more than one impact would require protection.

The airbag will also potentially serve more than one occupant although, since seats could be unoccupied, this may not always be the case. It will be necessary to show that the required protection is provided for each occupant regardless of the number of occupied seats.

Since a seat could be occupied by a wide range of occupants, the airbag should be effective for a wide range of occupants. The FAA has historically considered the range from the 5th percentile female to the 95th percentile male as the range of occupants that must be taken into account. In a similar vein, these persons could have assumed the brace position, for those accidents where an impact is anticipated. Test data indicate that occupants in the brace position do not require supplemental

protection, and so it would not be necessary to show that the airbag will enhance the brace position. However, the airbag must not introduce a hazard in that case by deploying into the seated, braced occupant.

Since the airbag will be electrically powered, there is the possibility that the system could fail due to a separation in the fuselage. Since this system is intended as crash/post-crash protection means, failure due to fuselage separation is not acceptable. As with emergency lighting, the system should function properly if such a separation occurs, at any point in the fuselage. A separation that occurs at the location of the airbag would not have to be considered.

Since the airbag is likely to have a large volume displacement, the inflated bag could potentially impede egress of passengers. Since the bag deflates to absorb energy, it is likely that an airbag would be deflated at the time that persons would be trying to leave their seats. Nonetheless, it is considered appropriate to specify a time interval after which the airbag may not impede rapid egress. Ten seconds has been chosen as a reasonable time since this corresponds to the maximum time allowed for an exit to be openable. In actuality, it is unlikely that an exit would be prepared this quickly in an accident severe enough to warrant deployment of the airbag, and the airbag will likely deflate much quicker than ten seconds. Since the Jetstream 4101 does not have an airbag installed at an exit passageway, the case where the seats are unoccupied is not critical.

Type Certification Basis

Under the provisions of § 21.101, Jetstream must show that airbag-equipped 4100 series airplanes comply with the regulations in the U.S. type certification basis established for the Jetstream Model 4101 airplane. The U.S. type certification basis for the Model 4101 is established in accordance with §§ 21.29 and 21.17 of the FAR and the type certification application date. The U.S. type certification basis is as follows:

- Part 25 of the FAR dated February 1, 1965, as amended by Amendments 25-1 through 25-66 (based on the BAe application date to CAA-UK for TC), and
- Part 25 of the FAR, Amendments 25-67, 25-68, 25-69, 25-70, and 25-71, and
- Part 25 of the FAR, §§ 25.361, 25.729, 25.571(e)(2), 25.773(b)(2) and 25.905(d), all as amended by Amendment 25-72, and

- Part 25 of the FAR, § 25.1419 as amended by Amendments 25–1 through 25–66 (BAe elected to comply with this requirement), and
- Special Conditions No. 25–ANM–48 issued August 29, 1991, Lightning and High Intensity Radiated Fields (HIRF), and
- Other special conditions
- FAA Exemptions as follows:
 - Exemption No. 5587 issued January 13, 1993, head impact criteria (25.562(c)(5)) for the three most forward passenger seats in the passenger cabin (Note: Exemption number 5587 is a time limited exemption that expires at the date specified therein unless extended by the FAA Transport Airplane Directorate.), and
 - FAA Equivalent Safety Findings
 - Part 34 of the FAR effective September 10, 1990, and
 - Part 36 of the FAR effective December 1, 1969 as amended by Amendments 36–1 through 36–18 including Appendices A, B and C.

If the Administrator finds that the applicable airworthiness regulations (i.e., part 25 as amended) do not contain adequate or appropriate safety standards for Jetstream 4100 series airplanes because of a novel or unusual design feature, special conditions are prescribed under the provisions of § 21.16 of the FAR to establish a level of safety equivalent to that established in the regulations.

Special conditions, as appropriate, are issued in accordance with § 11.49 after public notice, as required by §§ 11.28 and 11.29(b), and become part of the type certification basis in accordance with 21.17(a)(2).

Special conditions are initially applicable to the model for which they are issued. Should the type certificate for that model be amended later to include any other model that incorporates the same novel or unusual design feature, or should any other model already included on the same type certificate be modified to incorporate the same novel or unusual design feature, the special conditions would also apply to the other model under the provisions of § 21.101(a)(1).

Novel or Unusual Design Features

The Jetstream Model 4100 series airplanes will incorporate the following novel or unusual features:

The Jetstream Model 4100 series airplanes will utilize airbags to provide head injury protection for occupants seated behind interior walls and furnishings. The airbags will be activated by acceleration sensors that integrate the acceleration time history to

determine whether the bag should be deployed. Inflation of the bag is accomplished by firing of a small pyrotechnic device.

The FAR state the performance criteria for head injury protection in objective terms, and contain more specific criteria for systems and equipment. None of these criteria are adequate, however, to address the specific issues raised by airbags. The FAA has therefore determined that, in addition to the requirements of part 25, special conditions are needed to address requirements particular to an airbag installation.

From the standpoint of a passenger safety system, the airbag is unique in that it is both an active and entirely autonomous device. While the automotive industry has good experience with airbags, the conditions of use and reliance on the airbag as the sole means of injury protection are quite different. In automobile installations, the airbag is a supplemental system and works in conjunction with an upper torso restraint. In addition, the crash event is more definable and of typically shorter duration, which can simplify the activation logic. The airplane operating environment is also quite different from automobiles and includes the potential for greater wear and tear, and unanticipated abuse conditions (due to galley loading, passenger baggage, etc.); airplanes also operate where exposure to high intensity electromagnetic fields could affect the activation system.

The following proposed special conditions can be characterized as addressing either the safety performance of the system, or the system's integrity against inadvertent activation. Because a crash requiring use of the airbags is a relatively rare event, and because the consequences of an inadvertent activation are potentially quite severe, these latter requirements are probably the more rigorous from a design standpoint.

Conclusion: This action affects only certain novel or unusual design features on one model of airplanes. It is not a rule of general applicability, and it affects only the manufacturer who applied to the FAA for approval of these features on the airplane.

List of Subjects in 14 CFR Part 25

Air transportation, Aircraft, Aviation safety, Safety.

The authority citation for these proposed special conditions is as follows:

Authority: 49 U.S.C. 106(g), 40113, 44701, 44702, 44704.

The Proposed Special Conditions

Accordingly, the FAA proposes the following special conditions as part of the type certification basis for the Jetstream Aircraft Limited, Jetstream Model 4100 Series Airplanes:

1. It must be shown that inadvertent deployment of the airbag, during the most critical part of the flight, will either not cause a hazard to the airplane or is extremely improbable.

2. It must be shown that an inadvertent deployment that could cause injury to a standing or sitting person, is improbable.

3. For the purposes of complying with Special Conditions No. 25–ANM–48, high intensity radiated fields (HIRF), the airbag system is considered a “critical system” if its deployment could have a hazardous effect on the airplane; otherwise it is considered an “essential” system.

4. It must be shown that the airbag system is not susceptible to inadvertent deployment as a result of wear and tear or inertial loads resulting from inflight or ground maneuvers (including gusts and hard landings) likely to be experienced in service.

5. It must be shown that the airbag will deploy and provide protection under crash conditions where its use is necessary to prevent serious head injury.

6. It must be shown that the airbag will not be a hazard to occupants that are in the brace position when it deploys.

7. The airbag must provide adequate protection for each occupant regardless of the number of occupants of the seat assembly.

8. It must be shown that the airbag will not impede rapid egress of occupants after 10 seconds following its deployment.

9. It must be shown that the airbag will not release hazardous quantities of gas or particulate matter into the cabin.

10. The airbag must function properly after loss of normal electrical power, and after a transverse separation of the fuselage at the most critical location.

11. The airbag installation must be protected from the effects of fire such that no hazard to occupants will result.

12. There must be a means, that is operable by a crewmember, to verify the integrity of the airbag activation system.

Issued in Renton, Washington, on October 4, 1996.

Darrell M. Pederson,

Acting Manager, Transport Airplane Directorate, Aircraft Certification Service, ANM–100.

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