

**DEPARTMENT OF TRANSPORTATION****Federal Aviation Administration****14 CFR Part 25**

[Docket No. FAA-2013-0857; Special Conditions No. 25-528-SC]

**Special Conditions: Learjet Inc., Model LJ-200-1A10 Airplane; Crashworthiness, Emergency Landing Conditions**

**AGENCY:** Federal Aviation Administration (FAA), DOT.

**ACTION:** Final special conditions.

**SUMMARY:** These special conditions are issued for the Learjet Inc. Model LJ-200-1A10 airplane. This airplane will have a novel or unusual design feature when compared to the state of technology envisioned in the airworthiness standards for transport category airplanes. This feature is a hybrid construction that uses both composite and metallic materials in the structure for which the crashworthiness responses for occupant safety may not be equivalent to current all-metallic airplanes. The applicable airworthiness regulations do not contain adequate or appropriate safety standards for this design feature. These special conditions contain the additional safety standards that the Administrator considers necessary to establish a level of safety equivalent to that established by the existing airworthiness standards.

**DATES:** *Effective Date:* March 10, 2014.

**FOR FURTHER INFORMATION CONTACT:** Mark Freisthler, FAA, Airframe and Cabin Safety Branch, ANM-115, Transport Airplane Directorate, Aircraft Certification Service, 1601 Lind Avenue SW., Renton, Washington, 98057-3356; telephone 425-227-1119; facsimile 425-227-1320.

**SUPPLEMENTARY INFORMATION:****Background**

On February 9, 2009, Learjet Inc. applied for a type certificate for their new Model LJ-200-1A10 airplane (hereafter referred to as the "Model LJ-200"). The Model LJ-200 is a business class airplane powered by two high-bypass turbine engines with an estimated maximum takeoff weight of 35,550 pounds and an interior configuration for up to 10 passengers.

The current design includes a skin-stringer fuselage configuration. The pressure fuselage will consist of monolithic carbon fiber reinforced plastic (CFRP) skin, with CFRP and metallic frames above floor level, and CFRP longerons and stringers. All

substructure will be mechanically fastened to the skin. Fasteners for stringers aligned along the length of the co-cured splice will provide fail-safe capability for the splice. Cabin entry door frames, over-wing exit door frames, and frames below floor level will be metallic. Attachment of pressure bulkheads, windshield frame, and splicing concepts will be adjusted for any skin thickness variation that occurs. The wing consists of resin transfer infusion skins with composite spars and metallic ribs. The empennage consists of composite sandwich skins with metallic spars and ribs. The airframe has a sandwich construction for the nose and empennage structures.

There are no existing regulations that adequately address the potential difference between metallic fabricated airplanes and composite fabricated airplanes with regards to impact response characteristics for what are considered survivable crash conditions. The CFRP fuselage constitutes a novel and unusual design feature for a transport category airplane. These special conditions are necessary to ensure a level of safety equivalent to that provided by Title 14, Code of Federal Regulations (14 CFR) part 25.

**Type Certification Basis**

Under the provisions of 14 CFR 21.17, Learjet Inc. must show that the Model LJ-200 meets the applicable provisions of part 25, as amended by Amendment 25-1 through 25-127 thereto.

If the Administrator finds that the applicable airworthiness regulations (i.e., 14 CFR part 25) do not contain adequate or appropriate safety standards for the Model LJ-200 because of a novel or unusual design feature, special conditions are prescribed under the provisions of § 21.16.

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, the special conditions would also apply to the other model under § 21.101.

In addition to the applicable airworthiness regulations and special conditions, the Model LJ-200 must comply with the fuel vent and exhaust emission requirements of 14 CFR part 34 and the noise certification requirements of 14 CFR part 36; and the FAA must issue a finding of regulatory adequacy under § 611 of Public Law 92-574, the "Noise Control Act of 1972."

The FAA issues special conditions, as defined in 14 CFR 11.19, in accordance with § 11.38, and they become part of

the type certification basis under § 21.17(a)(2).

**Novel or Unusual Design Features**

The Model LJ-200 will incorporate the following novel or unusual design feature: Hybrid construction using both composite and metallic materials in the structure for which the crashworthiness responses for occupant safety may not be equivalent to that of all-metallic structure.

**Discussion**

The Model LJ-200 fuselage is fabricated using CFRP skins with aluminum ribs and stringers. This hybrid construction may behave differently from similar, fully-metallic structure due to differences in material ductility, stiffness, failure modes, and energy absorption characteristics. Therefore, the impact response characteristics of the Model LJ-200 must be evaluated to ensure the survivable crashworthiness characteristics are not significantly different than those of a similarly-sized airplane fabricated from traditionally-used metallic materials.

The FAA and industry have been working together for many years to understand how transport airplane occupant safety can be improved for what are considered survivable accidents. This work has involved examining airplane accidents, conducting tests to simulate crash conditions, and developing analytical modeling of a range of crash conditions, all with the purpose of providing further insight into the factors that can influence occupant safety. Results of this on-going effort have enabled specific changes to regulatory standards and design practices to improve occupant safety. This evolution is reflected in changes to the part 25 emergency landing condition regulations. For example, airplane emergency load factors in § 25.561, *General*, have been increased, and passenger seat dynamic load conditions have been added (§ 25.562, *Emergency landing dynamic conditions*).

The seat dynamic load conditions were added to the regulations based on FAA and industry tests and a review of accidents. They reflect horizontal and vertical accelerations/time environment generated by previously certificated airplane designs given conditions that were survivable. These tests also demonstrated that the performance of the airframe was acceptable in a dynamic impact event. In the evolution of the regulations, there is at present no specific dynamic regulatory requirement for airplane-level crashworthiness.

However, the FAA requires an assessment of each new model airplane to ensure that the airplane will not significantly depart from typical dynamic characteristics found in previously certificated designs.

The nature of the assessment is largely dependent on the similarities and differences between the new type design and previously certificated airplanes. Such an assessment ensures that the level of safety of the new composite designs corresponds to the level of safety achieved with similar metallic designs around which the existing regulations were written. If significant trends in industry warrant change to the existing regulations, the FAA and industry rulemaking process may be used to develop an appropriate dynamic regulatory requirement for airplane level crashworthiness.

The FAA and industry have collected a significant amount of experimental data as well as data from crashes of transport category airplanes that demonstrated a high occupant survival rate at vertical descent velocities up to 30 ft/sec (on a single aisle airplane). Based on this information, the FAA finds it appropriate and necessary for an assessment of the Model LJ-200 to span a range of airplane vertical descent velocities (up to 30 ft/sec, or that appropriate for a comparable size airplane).

The FAA expects the Model LJ-200 to exhibit similar crashworthiness capabilities under foreseeable survivable impact events as achieved by previously certificated transport category airplanes of similar size and configuration. In order to make this assessment, criteria need to be established by which the similarities and differences between new type designs and previously certificated airplanes may be analytically evaluated. Based on the FAA's evaluation of the intent of existing regulations, the following areas need to be evaluated to demonstrate comparable behavior of the Model LJ-200 design to currently certificated transport category airplanes:

- Retention of items of mass. It must be shown that the occupants, i.e., passengers, flight attendants, and flight crew, will be protected during the impact event from release of seats, overhead bins, and other items of mass due to the impact loads and resultant structural deformation of the supporting airframe and floor structures.
- Maintenance of occupant emergency egress paths. The airframe must not deform such that rapid evacuation of occupants is impeded.

- Maintenance of acceptable acceleration and loads experienced by the occupants.

- Maintenance of a survivable volume. All areas of the airplane occupied for takeoff and landing must be shown to provide a survivable volume during and after the impact event.

#### Discussion of Comments

Notice of proposed special conditions No. 25-13-08-SC for the Learjet Inc. Model LJ-200 airplanes was published in the **Federal Register** on October 31, 2013 (78 FR 65235). No comments were received, and the special conditions are adopted as proposed.

#### Applicability

As discussed above, these special conditions are applicable to the Learjet Inc. Model LJ-200-1A10. Should Learjet Inc. apply at a later date for a change to the type certificate to include another model on the same type certificate incorporating the same novel or unusual design feature, the special conditions would apply to that model as well.

#### Conclusion

This action affects only certain novel or unusual design features on one model of airplanes. It is not a rule of general applicability.

#### List of Subjects in 14 CFR Part 25

Aircraft, Aviation safety, Reporting and recordkeeping requirements.

The authority citation for these special conditions is as follows:

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

#### The Special Conditions

Accordingly, pursuant to the authority delegated to me by the Administrator, the following special conditions are issued as part of the type certification basis for Learjet Inc. Model LJ-200-1A10 airplanes.

#### Crashworthiness, Emergency Landing Conditions

In order to demonstrate an equivalent level of occupant safety and survivability to that provided by previously certificated transport category airplanes of similar size and configuration under foreseeable survivable impact events, Learjet Inc. must demonstrate that the Model LJ-200-1A10 meets the following criteria for a range of airplane vertical descent velocities up to 30 ft/sec:

1. *Retention of items of mass.* The occupants, i.e., passengers, flight attendants, and flightcrew, must be protected during the impact event from

release of seats, overhead bins, and other items of mass due to the impact loads and resultant structural deformation of the supporting airframe and floor structures. The applicant must show that loads due to the impact event and resultant structural deformation of the supporting airframe and floor structure at the interface of the airplane structure to seats, overhead bins, and other items of mass are comparable to those of previously certificated transport category airplanes of similar size for the range of descent velocities stated above. The attachments of these items need not be designed for static emergency landing loads in excess of those defined in § 25.561 if impact response characteristics of the Model LJ-200-1A10 yield load factors at the attach points comparable with those expected for a previously certificated transport category airplane of similar size.

2. *Maintenance of acceptable acceleration and loads experienced by the occupants.* The applicant must show that the vertical acceleration levels experienced at the seat/floor interface and loads experienced by the occupants during the impact event are consistent with those found in § 25.562(b) or with the levels expected for a previously certificated comparable transport category airplane of similar size.

3. *Maintenance of a survivable volume.* The applicant must show that all areas of the airplane occupied for takeoff and landing provide a survivable volume comparable to that of previously certificated transport category airplanes of similar size during and after the impact event. This means that structural deformation will not result in infringement of the occupants' normal living space significantly affecting their survivability or egress.

4. *Maintenance of occupant emergency egress paths.* The applicant must show that the airframe deformation after the vertical impact event does not impede the rapid evacuation of occupants comparable to previously certified transport category airplanes of similar size.

Issued in Renton, Washington, on January 31, 2014.

**John P. Piccola, Jr.,**

*Acting Manager, Transport Airplane Directorate, Aircraft Certification Service.*

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