Federal Aviation Administration
Aviation Rulemaking Advisory Committee

Transport Airplane and Engine Issue Area
Loads and Dynamics Harmonization Working Group

# Task 9 – Shock Absorption Tests

# Task Assignment

## Aviation Rulemaking Advisory Committee; Transport Airplane and Engine Issues

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

**ACTION:** Notice of new task assignments for the Aviation Rulemaking Advisory Committee.

**SUMMARY:** Notice is given of new task assignments for the Loads and Dynamics Harmonization Working Group of the Aviation Rulemaking Advisory Committee (ARAC). This notice informs the public of the activities of the ARAC.

**FOR FURTHER INFORMATION CONTACT:** Michael H. Borfitz, Assistant Executive Director, Aviation Rulemaking Advisory Committee, Transport Airplane and Engine Issues, FAA Engine & Propeller Directorate, 12 New England Executive Park, Burlington, Massachusetts 01803; telephone (617) 238–7110, fax (617) 238–7199.

**SUPPLEMENTARY INFORMATION:** On January 22, 1991 (56 FR 2190), the Federal Aviation Administration (FAA) established the Aviation Rulemaking Advisory Committee (ARAC). The committee provides advice and recommendations to the FAA Administrator, through the Associate Administrator for Regulation and Certification, on the full range of the FAA's rulemaking activities with respect to aviation-related issues..

In order to develop such advice and recommendations, the ARAC may choose to establish working groups to which specific tasks are assigned. Such working groups are comprised of experts from those organizations having an interest in the assigned tasks. A working group member need not be a representative of the full committee. One of the working groups established by the ARAC is the Loads and Dynamics Harmonization Working Group.

The FAA announced at the Joint Aviation Authorities (JAA)-Federal Aviation Administration (FAA) Harmonization Conference in Toronto, Canada June 2–5, 1992, that it would consolidate within the ARAC structure an ongoing objective to "harmonize" the Joint Aviation Requirements (JAR) and the Federal Aviation Regulations (FAR).

### Tasks

The Loads and Dynamics Harmonization Working Group's tasks are as follows:

*Task 1—Interaction of Systems and Structure:* Review existing special conditions for fly-by-wire airplanes and existing requirements for control systems, including automatic and/or power-operated systems, and recommend to the ARAC any new revised general requirements needed for flight control systems and structures affected by those systems (§§ 25.302, 25.671, 25.1329, part 25 appendix K).

*Task 2—Continuous Turbulence Loads:* Review the requirement for the continuous turbulence standard in light of the ARAC proposal for a tuned discrete gust requirement in order to determine whether the continuous turbulence requirement should be revised or removed from the FAR/JAR for better consistency with the new proposed tuned discrete gust criteria (§ 25.305(d)).

*Task 3—Strength and Deformation:* Review the recent requirements adopted in the FAR by Amendment 25–77 (for the design of transport airplanes against buffet and forced structural vibrations) and consider appropriate changes for the JAR and FAR to harmonize these rules (§§ 25.305 (e) and (f)).

*Task 4—Design Flap Speeds:* Review the current flap design loads requirements to resolve differences in interpretation between the FAA and JAA concerning the structural design stall speeds on which the flap design speeds are based. Recent measurements of gust speeds at low altitudes, where flaps are normally extended, indicate a more severe gust environment may be present. Review all aspects of the flap design load requirements, including the design airspeeds, vertical and head-on design gust criteria, and the effects of automatic retraction and load relief systems (§ 25.335(e)).

*Task 5—Residual Strength Loads for Damage Tolerance:* Review the differences in residual strength design load requirements between the FAR and JAR and resolve differences to harmonize this rule. Prepare a Notice of Proposed Rulemaking or make recommendations to other ARAC efforts concerning FAR § 25.571, so that they can be included in rulemaking that may be forthcoming from those efforts (§ 25.571(b)).

*Task 6—Shock Absorption Tests:* Review the changes recently introduced into the JAR that have resulted in differences between the FAR and JAR in regard to the requirement for shock absorption tests. Review those changes in view of harmonizing the FAR and JAR (§ 25.723(a)).

*Task 7—Rough Air Speed:* The ARAC has proposed a new § 25.1517 concerning rough air speed design standards in its proposal for a tuned discrete gust requirement. This action is harmonized with the current JAR 25.1517; however, further changes in the rough air speed requirement may be needed in both the FAR and JAR. Review JAR 25.1517 and the new proposed FAR 25.1517 to determine if further changes are needed. If so, prepare a Notice of Proposed Rulemaking, or, if possible, combine these changes with other rulemaking efforts (§ 25.1517).

*Task 8—Taxi, Takeoff, and Landing Roll:* Prepare an advisory circular that establishes criteria that may be used to calculate rough runway and taxiway loads, as required by §§ 25.491, 25.235, and 25.305.

*Task 9—Braked Roll Conditions:* Review the provisions of § 25.493 of the FAR and JAR concerning the braked roll condition and finalize a harmonized Notice of Proposed Rulemaking.

### Reports

For each task listed, the Loads and Dynamics Harmonization Working Group should develop and present to the ARAC:

1. A recommended work plan for completion of the task, including the rationale supporting such plan, for consideration at the meeting of the ARAC to consider transport airplane and engine issues held following publication of this notice;

2. A detailed conceptual presentation on the proposed recommendation(s), prior to proceeding with the work stated in item 3. below;

3. A draft Notice of Proposed Rulemaking, with supporting economic and other required analyses, and/or any other related guidance material or collateral documents the working group determines to be appropriate; or, if new or revised requirements or compliance methods are not recommended, a draft report stating the rationale for not making such recommendations; and

4. A status report at each meeting of the ARAC held to consider transport airplane and engine issues.

### Participation in Working Group Task

An individual who has expertise in the subject matter and wishes to become a member of the working group should write to the person listed under the caption **FOR FURTHER INFORMATION CONTACT** expressing that desire, describing his or her interest in the task(s), and stating the expertise he or

she would bring to the working group. The request will be reviewed with the assistant chairman and working group leader, and the individual will be advised whether or not the request can be accommodated.

The Secretary of Transportation has determined that the information and use of the Aviation Rulemaking Advisory Committee are necessary in the public interest in connection with the performance of duties imposed on the FAA by law. Meetings of the Aviation Rulemaking Advisory Committee will be open to the public, except as authorized by section 10(d) of the Federal Advisory Committee Act. Meetings of the working group will not be open to the public, except to the extent that individuals with an interest and expertise are selected to participate. No public announcement of working group meetings will be made.

Issued in Washington, DC, on June 3, 1994.

**Chris A. Christie,**

*Executive Director, Aviation Rulemaking Advisory Committee.*

[FR Doc. 94–14147 Filed 6–9–94; 8 45 am]

BILLING CODE 4910–13–M

# Recommendation Letter

400 Main Street
East Hartford, Connecticut 06108

Pratt & Whitney
A United Technologies Company

June 1, 2000

Department of Transportation
Federal Aviation Administration
800 Independence Avenue, SW
Washington, DC 20591

Attention: Mr. Anthony Fazio, ARM-1

Subject: ARAC Disposition of Public Comments

Reference: ARAC tasking, Federal Aviation Administration letter to TAEIG, dated February 8, 2000.

Dear Tony,

In accordance with the reference tasking, the ARAC Transport Airplane and Engine Issues Group is pleased to submit the following reports as ARAC recommendations for the disposition of public comments to recently published NPRM's.

- Revised Landing Gear Shock Absorption Test Requirements - ANM-98-182-A
- Taxi, Takeoff and Landing Roll Design Loads - ANM-94-461-A

These reports have been prepared by the Loads and Dynamics Harmonization Working Group of TAEIG.

Sincerely yours,

Craig R. Bolt

C. R. Bolt
Assistant Chair, TAEIG

Copy: Kris Carpenter - FAA-NWR
*Effie Upshaw - FAA-ARM-209
*Larry Hansen - Gulfstream

*letter only

CRB002_060100

# Recommendation

Boeing Commercial Airplane Group
P.O. Box 3707
Seattle, WA 98124-2207

October 20, 1997
B-T000-ARAC-97-011

Mr. Guy Gardner
Associate Administrator for
Regulation and Certification
Department of Transportation
Federal Aviation Administration
800 Independence Avenue, S.W.
Washington, DC 20591

BOEING

Dear Mr. Gardner:

Subject: Submittal of Proposed Rulemaking and Advisory Circulars

It was brought to our attention that letters for two (2) submittals that should have been sent to the FAA by the Aviation Rulemaking Advisory Committee (ARAC) Transport Airplane and Engine Issues Group (TAEIG) could not be found. The two (2) submittals are as follows:

Proposed AC 25.629-1A, *Aeroelastic Stability Substantiation of Transport Category Airplanes*, submitted by the Loads and Dynamics Harmonization Working Group. This proposed AC was voted upon and accepted unanimously for submittal to the FAA by TAEIG at their meeting of April 15 - 17, 1996.

Draft NPRM for §§25.473 and 25.723 and proposed AC 25.723-1, *Shock Absorption Tests*, submitted by the Loads and Dynamics Harmonization Working Group. These draft NPRM and proposed AC were voted upon and approved unanimously for submittal to the FAA by the TAEIG at their meeting of January 22 - 23, 1997.

Please accept this letter as formal submittal of the above two (2) items. Copies of the submittals have been previously sent to FAA Office of Rulemaking.

The members of ARAC TAEIG appreciate the opportunity to participate in the FAA rulemaking process.

Sincerely,

Ed A. Kupcis
Chief Engineer,
Certification Requirements,
Boeing Commercial Airplane Group
Tele: (425) 234-4304, FAX: (425) 237-4838

cc:

Mr. Joseph Hawkins
Department of Transportation
Federal Aviation Administration - ARM-1
800 Independence Avenue S.W.
Washington, D.C. 20591

Mr. Stewart Miller
Department of Transportation
Federal Aviation Administration - ANM-110
1601 Lind Avenue S.W.
Renton, WA 98055

Mr. Vic Card
UK Civil Aviation Authority
Aviation House
Gatwick Airport RH6 OYR
England

Mr. Thaddée Sulocki
Joint Aviation Authorities
Saturnusstraat 10
2130 KA Hoofddorp
The Netherlands

Mr. Craig Bolt
Pratt & Whitney
400 Main Street
Mail Stop 162-24
East Hartford, CT 06108

[4910-13]

**DEPARTMENT OF TRANSPORTATION**

**Federal Aviation Administration**

**14 CFR part 25**

**[Docket No. ; Notice No. ]**

**RIN**

Revised Landing Gear Shock Absorption Test Requirements

**AGENCY**: Federal Aviation Administration, DOT.

**ACTION**: Notice of proposed rulemaking.

**SUMMARY**: This document proposes to revise the landing gear shock absorption test requirements of the Federal Aviation Regulations (FAR) for transport category airplanes by incorporating changes developed in cooperation with the Joint Aviation Authorities (JAA) of Europe and the U.S. and European aviation industry through the Aviation Rulemaking Advisory Committee (ARAC). This action is necessary because the increasing complexity of landing gear shock absorption systems and the improvements in other requirements concerning landing loads have rendered the current requirements inconsistent and outdated. In addition, differences between the current U.S. and European requirements impose unnecessary costs on airplane manufacturers. These proposals are intended to update the landing gear requirements to be consistent with other requirements, to reflect modern technology, and to achieve common requirements and language between

the requirements of the FAR and the Joint Aviation Requirements (JAR) of Europe without reducing the level of safety provided by the regulations and industry practices.

**DATES**: Comments must be received on or before [insert a date 120 days after the date of publication in the Federal Register]

**ADDRESSES**: Comments on this notice may be mailed in triplicate to: Federal Aviation Administration (FAA), Office of the Chief Counsel, Attention: Rules Docket (AGC-10), Docket No. , 800 Independence Avenue SW., Washington, DC 20591; or delivered in triplicate to: Room 915G, 800 Independence Avenue SW., Washington, DC 20591. Comments delivered must be marked Docket No. . Comments may also be submitted electronically to nprmcmt@mail.hq.faa.gov. Comments may be examined in Room 915G weekdays, except Federal holidays, between 8:30 a.m. and 5:00 p.m. In addition, the FAA is maintaining an information docket of comments in the Transport Airplane Directorate (ANM-100), FAA, 1601 Lind Avenue SW., Renton, WA 98055-4056. Comments in the information docket may be examined weekdays, except Federal holidays, between 7:30 a.m. and 4:00 p.m.

**FOR FURTHER INFORMATION CONTACT**: James Haynes, Airframe and Propulsion Branch, ANM-112, Transport Airplane Directorate, Aircraft Certification Service, FAA, 1601 Lind Avenue, SW., Renton, WA 98055-4056; telephone (206) 227-2131.

## SUPPLEMENTARY INFORMATION

### Comments Invited

Interested persons are invited to participate in this proposed rulemaking by submitting such written data, views, or arguments as they may desire. Comments relating to any 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 the 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 this proposed rulemaking. The proposals contained in this notice may be changed in light of comments received. All comments received will be available in the Rules Docket, both before and after the comment period closing date, for examination by interested persons. 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 must submit with those comments a self-addressed, stamped postcard on which the following statement is made: "Comments to Docket No. ." The postcard will be date/time stamped and returned to the commenter.

### Availability of NPRM

An electronic copy of this document may be downloaded using a modem and suitable communications software from the FAA regulations section of the Fedworld

electronic bulletin board service (telephone: 703-321-3330), the Federal Register's electronic bulletin board service (telephone: 202-512-1661), or the FAA's Aviation Rulemaking Advisory Committee Bulletin Board service (telephone: 202-267-5948).

Internet users may reach the FAA's web page at http://www.faa.gov or the Federal Register's web page at http://www.access.gpo.gov/su_docs for access to recently published rulemaking documents.

Any person may obtain a copy of this notice by submitting a request to the Federal Aviation Administration, Office of Rulemaking, ARM-1, 800 Independence Avenue SW., Washington, DC 20591; or by calling (202) 267-9680. Communications must identify the notice number of this NPRM. Persons interested in being placed on a mailing list for future rulemaking documents should also request a copy of Advisory Circular No. 11-2A, Notice of Proposed Rulemaking Distribution System, which describes the application procedure.

**Background**

The manufacturing, marketing and certification of transport airplanes is increasingly an international endeavor. In order for U. S. manufacturers to export transport airplanes to other countries the airplane must be designed to comply, not only with the U.S. airworthiness requirements for transport airplanes (14 CFR part 25), but also with the transport airworthiness requirements of the countries to which the airplane is to be exported.

The European countries have developed a common airworthiness code for transport airplanes that is administered by the Joint Aviation Authorities (JAA) of Europe. This code is the result of a European effort to harmonize the various airworthiness codes of the European countries and is called the Joint Aviation Requirements (JAR)-25. It was developed in a format similar to part 25. Many other countries have airworthiness codes that are aligned closely to part 25 or to JAR-25, or they use these codes directly for their own certification purposes.

The Aviation Rulemaking Advisory Committee (ARAC) was established by the FAA on February 15, 1991, with the purpose of providing information, advise, and recommendations to be considered in rulemaking activities. By notice in the Federal Register (59 FR 30081, June 10, 1994), the FAA assigned several new tasks to an ARAC working group of industry and government structural loads specialists from Europe, the United States, and Canada. Task 6 of this charter concerned the shock absorption test requirements for landing gear. The ARAC working group has completed its work for this task and the ARAC has made recommendations to the FAA by letter dated

_____.

Although the requirements for landing gear shock absorption tests are essentially the same between the FAR and JAR, the requirements do not address the capabilities of modern technology and do not take into account other related changes in the requirements for landing gear load conditions that have already been incorporated into other sections of the FAR. When the landing loads requirements for transport airplanes were originally

developed, they required the landing load factors to be determined and applied to the airplane. The airplane was treated as a rigid body and the landing loads were applied to this rigid representation of the airplane for the purpose of structural analysis. For the early landing gear systems, analysis alone, was considered sufficient for determining the landing load factor that would be applied to the rigid airplane. It was only necessary to determine the landing load factor (by analysis or tests) and this load factor would then be used to design and substantiate the airplane for the landing load conditions.

The development of more complex landing gear systems, for which analysis alone was unreliable, led to the adoption of a requirement to verify the landing load factor by actual shock absorption tests. This requirement was added to the Civil Aviation Regulations (CAR) part 4b that was the predecessor to part 25. These shock absorption tests were allowed by CAR 4b.200 to be free drop tests in which the gear alone, could be dropped in free fall to impact the ground. In these tests, mass is added to represent the proportion of the airplane weight on the landing gear unit, and the mass may be reduced to account to the effects of airplane lift acting during the landing impact. Later, the corresponding requirement in part 25, § 25.723(a), was modified to allow the substantiation of some changes to the landing gear shock absorption systems by analysis alone without verification by tests.

The current landing load requirements in part 25 require the landing loads to be determined accounting for the dynamic flexible airplane. In addition, the landing gear shock absorption systems have become even more sophisticated. At the same time, the

ability to develop highly sophisticated computer models of landing gear and airplane structures has also improved. In order to determine the airplane loads from the landing load conditions, it is no longer sufficient to determine just the load factor from a drop test of a landing gear unit. A comprehensive analysis of the combined dynamic systems for the landing gear and airplane are essential in order to determine the structural design loads for the airplane. In developing this dynamic model, it is necessary to provide an accurate representation of all the landing gear dynamic characteristics. This includes the energy absorption characteristics and the time histories of force and displacement during a landing impact. The current §§ 25.473(d) and 25.723(a) for shock absorption tests requires just the determination of the limit landing load factor from the drop test.

**Discussion**

The proposed revisions to §§ 25.473(d) and 25.723(a) would provide for the new objective of the landing gear energy absorption tests which would be to validate the landing gear dynamic characteristics rather than to directly determine landing gear load factors. These revisions would require that these characteristics be substantiated over the range of landing conditions and airplane configurations expected in service. The manufacturer would be expected to substantiate the landing gear dynamic characteristics over the full range of weight conditions and configurations. As a minimum, the energy absorption characteristics would be confirmed by an energy absorption test at the weight condition for landing (maximum takeoff weight or maximum landing weight) which provides the maximum impact energy. This is in contrast to the current §§ 25.473(d) and

25.723(a) that specifically require energy absorption tests at both the maximum landing weight condition and the maximum takeoff weight condition. The proposed rule would continue to provide for the substantiation of minor changes by analyses. To provide guidance in complying with the new proposed rule, a new Advisory Circular 25.723-1 is proposed.

The proposal for the revised §§ 25.473(d) and 25.723(a) takes into account the potential for sophisticated computer simulations that accurately represent the dynamic characteristics. It is also consistent with improvements in the landing load requirements that necessitate an accurate representation of the landing gear shock absorption characteristics. This proposal also provides more flexibility for the airplane manufacturer to determine the range of conditions and configurations over which to validate the analytical model for the landing conditions. The extent to which this analytical model could be extrapolated to include future design changes would depend on the range of conditions and configurations originally selected by the manufacturer for validation of the model.

The current §§ 25.725 and 25.727 are proposed to be deleted as regulatory requirements and would be set forth in the new proposed Advisory Circular 25.723-1. These criteria would be modified to reflect the advisory nature of the material as well as the revised objective of determining landing gear dynamic characteristics instead of landing gear limit inertia load factors. For the most part, these rules currently provide acceptable means of conducting energy absorption tests by means of a drop test. Section

25.725 provides an acceptable means of conducting a limit drop test for compliance with §§ 25.723(a), and 25.727 provides an acceptable means of conducting a reserve energy drop test in compliance with § 25.723(b). Most of the guidance is limited to a "free" drop test in which a reduced effective weight is used to represent lift during the landing impact. The only item in these two sections that is considered to be regulatory in nature is the current § 25.725(c) concerning the attitude of the landing gear and the representation of drag loads during the tests. Therefore this paragraph has been modified to apply to all types of landing gear energy absorption tests (not just drop tests) and it is now set forth in § 25.723(a)(2) of the proposed rule.

**Regulatory Evaluation Summary**

Regulatory Evaluation Summary, Regulatory Flexibility Determination, and Trade Impact Assessment

Changes to federal regulations must undergo several economic analyses. First, Executive Order 12866 directs Federal agencies to promulgate new regulations or modify existing regulations only if the potential benefits to society outweigh the potential costs. Second, the Regulatory Flexibility Act of 1980 requires agencies to analyze the economic impact of regulatory changes on small entities. Finally, the Office of Management and Budget directs agencies to assess the effects of regulatory changes on international trade. In conducting these assessments, the FAA has determined that this proposed rule: (1) would generate benefits exceeding its costs and is not "significant" as defined in Executive Order 12866; (2) is not "significant" as defined in DOT's Policies and Procedures;( 3)

would not have a significant impact on a substantial number of small entities; and (4) would lessen restraints on international trade. These analyses, available in the docket, are summarized below.

Regulatory Evaluation Summary

The proposed requirements, applicable to future type certificated transport category airplanes, would result in two regulatory changes: (1) utilizing landing gear energy absorption tests to validate the landing gear dynamic characteristics rather than the limit load factor value, and (2) confirming energy absorption characteristics by requiring tests at either the maximum landing weight or maximum takeoff weight condition, whichever provides the maximum landing impact energy. This is in contrast to current requirements which requires tests at both weight conditions.

The test results would be used to develop the analytical modeling of the landing gear dynamic characteristics. These regulatory changes would not result in any physical change in the way landing gears are tested: the attitude of the gear being usually simulated directly by orienting the gear on the rig and drags loads being applied by spinning the wheel up to the ground speed. Therefore, it would not impose additional costs on manufacturers. This was confirmed by two manufacturers.

Significant cost savings may result from not having to test both at maximum landing weight and maximum takeoff weight, but instead, conducting shock absorption tests only for the conditions associated with maximum energy. One manufacturer

estimates that this would result in 15 fewer test conditions per airplane certification. At a cost of $5,000 per condition, the total cost savings would reach $75,000 per airplane certification. Another manufacturer estimates a cost savings of approximately $190,000 for a ten-year period.

Additionally, by harmonizing the standards of the FAR and JAR, the proposed rule would yield cost savings by eliminating duplicate certification activities.

Based on the finding of regulatory cost-savings, coupled with the cost-savings realizable from harmonization, the FAA has determined that the proposed rule would be cost-beneficial.

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 proposed rule would have "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. The Order defines "small entities" in terms of size thresholds, "significant economic impact" in terms of annualized cost thresholds, and "substantial number" as a number which is not less than eleven and which is more than one-third of the small entities subject to the proposed or final rule.

The proposed rule would affect manufacturers of transport category airplanes produced under future new airplane type certifications. For airplane manufacturers, FAA Order 2100.14A specifies a size threshold for classification as a small manufacturer as 75 or fewer employees. Since no part 25 airplane manufacturer has 75 or fewer employees, the proposed rule would not have a significant economic impact on a substantial number of small airplane manufacturers.

International Trade Impact Assessment

The proposed rule would have no adverse impact on trade opportunities for U.S. manufacturers selling airplanes in foreign markets and foreign manufacturers selling airplanes in the U.S. market. Instead, by harmonizing the standards of the FAR and the JAR, it would lessen restraints on trade.

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. Thus, in accordance with Executive Order 12612, it is determined that this proposal does not have sufficient federalism implications to warrant the preparation of a Federalism Assessment.

International Compatibility

The FAA has reviewed corresponding International Civil Aviation Organization regulations and Joint Airworthiness Authority regulations, where they exit, and have identified no differences in these proposed amendments and the foreign regulations.

**Conclusion**

Because the proposed changes to the landing gear shock absorption test requirements are not expected to result in any substantial economic costs, the FAA has determined that this proposed regulation would not be significant under Executive Order 12866. Because this is an issue that has not prompted a great deal of public concern, the FAA has determined that this action is not significant under DOT Regulatory Policies and Procedures (44 FR 11034; February 25, 1979). In addition, since there are no small entities affected by this rulemaking, the FAA certifies that the rule, if promulgated, would not have a significant economic impact, positive or negative, on a substantial number of small entities under the criteria of the Regulatory Flexibility Act, since none would be affected. A copy of the regulatory evaluation prepared for this project may be examined in the Rules 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 Amendments

Accordingly, the Federal Aviation Administration (FAA) proposes to amend 14 CFR part 25 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. 106(g), 40113, 44701, 44702, 44704.

2. Section 25.473 is amended by revising paragraph (d) to read as follows:

§ 25.473 Landing load conditions and assumptions.

* * * * *

(d) The landing gear dynamic characteristics must be validated by tests as defined in § 25.723(a).

* * * * *

3. Section 25.723 is amended by revising paragraph (a) to read as follows:

§ 25.723 Shock absorption tests.

(a) Except as provided in § 25.723(a)(3), the landing gear dynamic characteristics used for design must be validated by energy absorption tests. The dynamic characteristics must be substantiated for the range of landing conditions, airplane configurations, and service variations expected in operation.

(1) The configurations subjected to energy absorption tests must include at least the maximum landing weight or the maximum takeoff weight, whichever produces the greater value of landing impact energy.

(2) The test attitude of the landing gear unit and the application of appropriate drag loads during the test must simulate the airplane landing conditions in a manner consistent with the development of rational or conservative limit loads.

(3) Changes in previously approved design weights and minor changes in design may be substantiated by analyses based on previous tests conducted on the same basic landing gear system that has similar energy absorption characteristics.

* * * * *

§ 25.725 [RESERVED]

3. By removing § 25.725 and marking it reserved.

§ 25.727 [RESERVED]

4. B removing § 25.727 and marking it reserved.

Issued in Washington D.C. on

Record of Changes:

| | |
|---|---|
| March 10, 1995 | First Draft (Jim Haynes) |
| September 19, 1995 | Revised to add 25.473(d) per WG meeting in toronto. |

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TRANSFERRED TO:

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revised 10-18-95 (JT editorial changes)

revised 10-30-95 (NS edits)
revised 1-11-96 (DA, ANM-7 edits)
revised 5-9-96 (add regulatory evaluation summary, and new boilerplate information)
revised 5-14-96 (minor edit on page 6)

U.S. Department
of Transportation

**Federal Aviation
Administration**

# Advisory Circular

SHOCK ABSORPTION TESTS | **Date:** | **AC No. 25.723-1**
**Initiated by: ANM-110** | **Change:**

1. PURPOSE. This advisory circular (AC) sets forth an acceptable means, but not the only means, of demonstrating compliance with the provisions of part 25 of the Federal Aviation Regulations (FAR) related to the use of landing gear shock absorption tests and analyses to determine landing loads for transport category airplanes.

2. RELATED FAR SECTIONS. Part 25, Section 25.723 "Shock absorption tests" and Section 25.473 "Ground load conditions and assumptions."

3. BACKGROUND. The requirement concerning energy absorption tests for landing gear units existed in the earliest versions of the Civil Aeronautics Regulations (CAR) Part 04. Questions concerning the need for the tests and the use of analyses in lieu of tests have existed since the CAR 04 and have resulted in revisions to the successor regulations CAR 4b, which replaced CAR 04, and later in the Federal Aviation Regulation (FAR), Part 25, which replaced CAR 4b.

a. Section 04.34 of CAR 04 (July 1944) allowed analyses in lieu of tests when the landing gear structure conformed to conventional types for which reliable analytical methods were available. With the advancing complexity of landing gear units, the rule was revised (CAR 4b, Section 4b.332) to require energy absorption tests to determine the landing load factors both at maximum landing weight and maximum takeoff weight. Although this rule did not specifically provide for analyses in lieu of tests, it was common practice to allow later changes in design weights to be substantiated by analytical methods which were validated by the results of the earlier tests.

b. Recognizing the need to provide for subsequent growth in the design weights, the Federal Aviation Administration (FAA) revised § 25.723 (Amendment 25-46) to clarify that analyses could be used to substantiate changes in the takeoff and landing weights provided these analyses were validated by the results of tests conducted on identical landing gear units.

c. Although the rule referred to tests on the "identical" landing gear units, subsequent changes in the design weights often are accompanied by minor changes in other parameters affecting the landing gear energy absorption characteristics. These included changes in the shock absorber orifice size and metering pins shape, and changes in tire inflation limits. The FAA revised § 25.723 (Amendment 25-72) to further clarify that the analyses could be based on tests performed on the same basic landing gear system with similar energy absorption characteristics.

d. In the mean time, other requirements have resulted in changes in the way the test and analytical data are used. The shock absorption tests are no longer used just to determine the

landing load factors. It is now necessary to account for dynamic landing conditions in which the dynamic characteristics of the airplane and landing gear acting together are used to determine the landing loads. As a practical matter, the analytical modeling of the landing gear dynamic characteristics is indispensable in determining the landing loads, and the shock absorption tests are needed in order to validate the mathematical modeling of the landing gear units.

4. SHOCK ABSORPTION TESTS.

a. Validation of the landing gear characteristics. Shock absorption tests are necessary to validate the analytical representation of the dynamic characteristics of the landing gear unit that will be used to determine the landing loads. A range of tests should be conducted to ensure that the analytical model is valid for reasonable extrapolations to other design conditions and configurations expected in service. In addition, consideration should be given to ensuring that the range of test configurations are sufficient for justifying the analytical model for foreseeable future growth versions of the airplane.

b. Recommended test conditions for new landing gear units. The maximum takeoff weight and the maximum landing weight conditions should both be included as configurations subjected to energy absorption tests. However, in cases where the manufacturer has previous experience in validating the analytical model using landing gear units of similar design concept, it may be sufficient to conduct a single shock absorption test of the new landing gear for the condition associated with maximum energy. The similar landing gear used to provide the additional supporting data may be from another model aircraft but the landing gear unit should be of approximately the same size with similar components.

c. Changes to type designs. Subsequent changes to the landing conditions or to the landing gear units may be substantiated by analyses based on tests of the same basic landing gear unit with similar dynamic characteristics, provided the design concept has not changed and the results of the previous energy absorption tests are sufficient to realistically validate the analytical results for the design changes. For example, the following changes may be acceptable without further tests:

(1) Airplane sprung mass (effective weight) variations, including extrapolation from maximum landing weight to maximum take-off weight conditions.

(2) Changes in shock absorber characteristics including pre-load, compression ratio, orfice sizes.

(3) Changes in tire characteristics.

(4) Changes in unsprung mass (e.g. brakes).

(5) Local strengthening or minor sizing changes to the landing gear.

5. LIMIT FREE DROP TESTS.

(a) Compliance with § 25.723(a) may be shown by free drop tests, provided they are made on the complete airplane, or on units consisting of a wheel, tire, and shock absorber, in their proper positions, from free drop heights not less than--

(1) 18.7 inches for the design landing weight conditions; and

(2) 6.7 inches for the design takeoff weight conditions.

(b) If airplane lift is simulated by air cylinders or by other mechanical means, the weight used for the drop must be equal to W. If the effect of airplane lift is represented in free drop tests by a reduced mass, the landing gear must be dropped with an effective mass equal to

$$W_e = W\left[\frac{h+(1-L)d}{h+d}\right]$$

where—

$W_e$ = the effective weight to be used in the drop test (lb);
$h$ = specified free drop height (inches);
$d$ = deflection under impact of the tire(at the approved inflation pressure) plus the vertical component of the axle travel relative to the drop mass (inches);
$W$ = $W_M$ for main gear units (lb), equal to the static weight on that unit with the airplane in the level attitude (with the nose wheel clear in the case of nose wheel type airplanes);
$W$ = $W_T$ for tail gear units (lb), equal to the static weight on the tail unit with the airplane in the tail-down attitude;
$W$ = $W_N$ for nose wheel units (lb), equal to the vertical component of the static reaction that would exist at the nose wheel, assuming that the mass of the airplane acts at the center of gravity and exerts a force of 1.0 $g$ downward and 0.25 $g$ forward; and
$L$ = ratio of the assumed airplane lift to the airplane weight, but not more than 1.0.

(c) The drop test attitude of the landing gear unit and the application of appropriate drag loads during the test must simulate the airplane landing conditions in a manner consistent with the development of a rational or conservative limit loads.

(d) The value of $d$ used in the computation of $W_e$ in paragraph (b) of this section may not exceed the value actually obtained in the drop test.

6. RESERVE ENERGY FREE DROP TESTS.

(a) Compliance with the reserve energy absorption condition specified in § 25.723(b) may be shown by free drop tests provided the drop height is not less than 27 inches.

(b) If airplane lift is simulated by air cylinders or by other mechanical means, the weight used for the drop must be equal to W. If the effect of airplane lift is represented in free drop tests by an equivalent reduced mass, the landing gear must be dropped with an effective mass,

$$W_e = \frac{Wh}{h+d}$$

where the symbols and other details are the same as in paragraph 5 above.

# Recommendation

# Loads and Dynamics Harmonization Working Group

## Disposition of Comments

ANM-98-A

**Date:** 5/19/00

**Document:** Notice 99-08 "Revised Landing Gear Shock Absorption Test Requirements"

**Published:** Federal Register, Vol 64, No 117, June 18, 1999

**Date comment period closed:** October 18, 1999

**General assessment of comments:**

There were 6 commenters from aviation manufacturers and foreign airworthiness authorities. Although one commenter objected to the proposed rule, most of the commenters supported the proposed changes. Several of the commenters provided suggestions for clarity, consistency and organization. Because of the substantive nature of some of the comments, the FAA requested the ARAC Loads and Dynamics Working Group by letter dated February 8, 2000 to consider the comments and provide recommendations for the disposition of the comments along with any recommendations for changes to the proposal. Comments are summarized as follows along with recommended disposition text for the final rule.

**1) Object to change in basic purpose of the shock absorption tests**

One commenter objected to the proposed change in the basic purpose of the shock absorption test from the validation of the load factors to the validation of the dynamic characteristics of the landing gear. The commenter believes that the new proposal has the potential for requiring a significant volume of re-calculation for refinement of load values and this would be neither productive nor cost effective. Furthermore, the commenter believes that this approach would not fit well in the timeline between design concept and the development of the first prototype and so would bring the potential for discovering a different answer for the completed product late in the design process. Finally, the commenter believes the existing regulations are sufficient. The FAA agrees that validation of dynamic characteristics by test always brings a risk if the assumptions made in the prediction of these characteristics are not sufficiently accurate or conservative. However, the process of prediction, design, and validation are normal, and expected, in the development of aircraft and the risks can be minimized by the use of conservative assumptions. Furthermore, the FAA does not agree that the existing shock absorption test requirements are sufficient. The development of airplane loads for dynamic landing conditions requires a valid analytical model of the landing gear which includes a valid representation of the energy absorbing characteristics of the gear. The dynamic landing requirement has existed in CFR 14 for a number of years but the validation shock absorption test requirement has remained outdated, since it requires only the validation of a simple static landing load factor which may not even be used in design of the airplane. Because of the existing dynamic landing requirement, it has become a standard practice

to develop the design loads for the airplane structure based on a mathematical model of the airplane and landing gear and to validate the assumed gear characteristics by shock absorption tests. Therefore, the requirement is being updated to be consistent with the related design landing load requirements and also to be consistent with standard practice.

**2) Recommend consistent terminology.**

One commenter pointed out that the terminology used in the proposed 25.723(a)(1) for design weight conditions were inconsistent with those used in § 25.473 "Landing load conditions and assumptions", which are the same as those used in the proposed AC 25.723-1. The FAA agrees, and the language in the new paragraph 25.723(a)(1) has been changed to use the same terms "design landing weight" and "design takeoff weight" as currently used in § 25.473.

**3) Objects to implication that tests would be required for unsymmetrical landing conditions.**

One commenter was concerned that the proposed location of the requirement for shock absorption tests in 25.473(d) implies that the individual tests would be required for each of the landing conditions and configurations specified in § 25.473 including unsymmetrical conditions. The FAA does not agree since the specific landing conditions are referenced in paragraph 25.473(a) while the requirement related to validating landing gear dynamic characteristics, potentially of use in some or all conditions, is set forth in a separate paragraph 25.473(d). Validation is intended to mean that the adequacy of the dynamic characteristics would be confirmed by shock absorption tests to whatever extent necessary to provide confidence in the analysis of the specified landing conditions.

**4) Recommend that the specific "dynamic characteristics" be listed in the rule.**

The same commenter suggested that the terms, "dynamic characteristics", are ambiguous and that the rule should completely define dynamic characteristics and specify which dynamic characteristics must be validated by tests. The FAA agrees that these terms are general. However, the FAA does not agree that an exhaustive list of dynamic characteristics or shock absorption characteristics can be provided in the rule. The landing gear dynamic characteristics depend on the parameters chosen by the applicant for use in the analysis. The analysis must represent the full energy absorbing characteristics of the landing gear and it would be impossible to provide an exhaustive list of characteristics that would apply to all designs. Typically the manufacturer will validate the dynamic characteristics used in the analysis in a gross fashion by using the analytical mathematical model to predict the shock absorption response time histories in the test for a range of test conditions. In response to this comment, changes have been made to the proposed advisory material to identify some of the energy absorption components and characteristics that are usually of significance and the extent that they could be changed or revised without additional testing.

**5) Object to elimination of the reserve energy shock absorption tests 25.723(b).**

One commenter was concerned that the elimination of 25.723(b) meant that the reserve energy shock absorption tests would no longer be required. Removal of 25.723(b) was not a proposal of notice 99-08. The commenter failed to recognize that the paragraph is represented in the notice as a set of asterisks at the end of 25.723(a) signifying that that the remaining paragraphs of § 25.723 would remain unchanged. However, consideration of the commenters concern brought to light the fact that the allowance provided in 25.723(a) for using analysis in lieu of tests, would not necessarily apply to the reserve energy drop test of paragraph 25.723(b). In order to correct this oversight, paragraph 25.723(b) is clarified, and the allowance in the proposed paragraph 25.723(a) is now set forth in a separate paragraph 25.723(c) and made applicable to both paragraphs 25.723(a) and (b).

**6) Object to eliminating of the reserve energy free drop tests (25.725 and 25.727).**

One commenter was concerned that the removal of the free drop test requirements in 25.725 and 25.727 from the rules meant that these tests would no longer be required and that this could result in a reduction in the degree of safety. These specific types of tests, known as free drop tests, have never been required. They have always been a means of compliance to the general requirement to conduct shock absorption tests. This general requirement for conducting shock absorption tests remains in the revised § 25.723. The free drop test criteria are provided for the manufacturer that chooses to use this particular method of performing the required shock absorption tests. In the free drop test, the manufacturer may represent the airplane lift by using a reduced effective weight for the test. However many manufacturers represent the lifting force directly in a drop test or perform other types of shock absorption tests. The criteria for establishing the effective drop weight is applicable to only this one means of compliance and more appropriately presented in an Advisory Circular (AC). To this end AC 25.723-1 "Shock absorption tests" has been made available to provide this means of compliance.

Two commenters were concerned that the removal of the free drop test criteria from the regulation would result in the loss of the current method for establishing the effective mass over the nose gear for the free drop test. As stated above, this information is not being lost but is being moved to an Advisory Circular as acceptable means of compliance.

**Conclusions:**

Except for the minor editorial and organizational changes mentioned above, the amendment and advisory circular are acceptable as proposed.

**Recommended revised proposal:**

**§ 25.473 Landing load conditions and assumptions.**

* * * * *

(d) The landing gear dynamic characteristics must be validated by tests as defined in § 25.723(a).

* * * * *

**§ 25.723 Shock absorption tests.**

(a) The analytical representation of the landing gear dynamic characteristics that is used in determining the landing loads must be validated by shock absorption tests. A range of tests must be conducted to ensure that the analytical representation is valid for the design condtions specified in 25.473~~The landing gear dynamic characteristics used for design must be validated by energy absorption tests. The dynamic characteristics must be valid for all design conditions~~.

(1) The configurations subjected to energy absorption tests at limit design conditions must include at least the design landing weight or the design takeoff weight, whichever produces the greater value of landing impact energy.

(2) The test attitude of the landing gear unit and the application of appropriate drag loads during the test must simulate the airplane landing conditions in a manner consistent with the development of rational or conservative limit loads.

~~(3) In lieu of the tests prescribed in this section, changes in previously approved design weights and minor changes in design may be substantiated by analyses based on previous tests conducted on the same basic landing gear system that has similar energy absorption characteristics.~~

(b) The landing gear may not fail in a test, demonstrating its reserve energy absorption capacity, simulating a descent velocity of 12 f.p.s. in a level attitude at design landing weight, assuming airplane lift not greater than the airplane weight acting during the landing impact.

(c) In lieu of the tests prescribed in this section, changes in previously approved design weights and minor changes in design may be substantiated by analyses based on previous tests conducted on the same basic landing gear system that has similar energy absorption characteristics.

§ 25.725 [Removed and Reserved]

§ 25.727 [Removed and Reserved]

**Draft Advisory Circular 25.723-1 (attached)**

Revised April 118 ~~Feb~~ 2000 in ~~Phoenix~~

U.S. Department
of Transportation
**Federal Aviation**
**Administration**

# Advisory Circular

| SHOCK ABSORPTION TESTS | **Date:** | **AC No. 25.723-1** |
|---|---|---|
| | **Initiated by: ANM-110** | **Change:** |

1. PURPOSE. This advisory circular (AC) sets forth an acceptable means, but not the only means, of demonstrating compliance with the provisions of part 25 of the Federal Aviation Regulations (FAR) related to the use of landing gear shock absorption tests and analyses to determine landing loads for transport category airplanes.

2. RELATED FAR SECTIONS. Part 25, Section 25.723 "Shock absorption tests" and Section 25.473 "Ground load conditions and assumptions."

3. BACKGROUND. The requirement concerning energy absorption tests for landing gear units existed in the earliest versions of the Civil Aeronautics Regulations (CAR) Part 04. Questions concerning the need for the tests and the use of analyses in lieu of tests have existed since the CAR 04 and have resulted in revisions to the successor regulations CAR 4b, which replaced CAR 04, and later in the Federal Aviation Regulation (FAR), Part 25, which replaced CAR 4b.

a. Section 04.34 of CAR 04 (July 1944) allowed analyses in lieu of tests when the landing gear structure conformed to conventional types for which reliable analytical methods were available. With the advancing complexity of landing gear units, the rule was revised (CAR 4b, Section 4b.332) to require energy absorption tests to determine the landing load factors both at design landing weight and design takeoff weight. Although this rule did not specifically provide for analyses in lieu of tests, it was common practice to allow later changes in design weights to be substantiated by analytical methods which were validated by the results of the earlier tests.

b. Recognizing the need to provide for subsequent growth in the design weights, the Federal Aviation Administration (FAA) revised § 25.723 (Amendment 25-46) to clarify that analyses could be used to substantiate changes in the design takeoff and design landing weights provided these analyses were validated by the results of tests conducted on identical landing gear units.

c. Although the rule referred to tests on the "identical" landing gear units, subsequent changes in the design weights often are accompanied by minor changes in other parameters affecting the landing gear energy absorption characteristics. These included changes in the shock absorber orifice size and metering pins shape, and changes in tire inflation limits. The FAA revised § 25.723 (Amendment 25-72) to further clarify that the analyses could be based on tests performed on the same basic landing gear system with similar energy absorption characteristics.

d. In the mean time, other requirements have resulted in changes in the way the test and analytical data are used. The shock absorption tests are no longer used just to determine the landing load factors. It is now necessary to account for dynamic landing conditions in which the dynamic characteristics of the airplane and landing gear acting together are used to determine the landing loads. As a practical matter, the analytical modeling of the landing gear dynamic characteristics are indispensable in determining that landing loads and the shock absorption tests are needed in order to validate the mathematical modeling of the landing gear units.

4. SHOCK ABSORPTION TESTS.

a. Validation of the landing gear characteristics. Shock absorption tests are necessary to validate the analytical representation of the dynamic characteristics of the landing gear unit that will be used to determine the landing loads. A range of tests should be conducted to ensure that the analytical model is valid for all ~~for reasonable extrapolations to other~~ design conditions. ~~and configurations expected in service.~~ In addition, consideration should be given to ensuring that the range of test configurations ~~are~~is ~~sufficient~~ for justifying ~~the~~the use of the analytical model for foreseeable future growth versions of the airplane.

b. Recommended test conditions for new landing gear units. The design takeoff weight and the design landing weight conditions should both be included as configurations subjected to energy absorption tests. However, in cases where the manufacturer has supporting data from previous experience in validating the analytical model using landing gear units of similar design concept, it may be sufficient to conduct ~~a single shock absorption test~~ tests of the new landing gear at only~~for~~ the condition associated with maximum energy. The ~~similar~~ landing gear used to provide the ~~additional~~ supporting data may be from another model aircraft but ~~the landing gear unit~~ should be of approximately the same size with similar components.

c. Changes to type designs. ~~Subsequent changes to the landing conditions or to the landing gear units may be substantiated by analyses based on tests of the same basic landing gear unit with similar dynamic characteristics, provided the design concept has not changed and the results of the previous energy absorption tests are sufficient to realistically validate the analytical results for the design changes. For example, the following changes may be acceptable without further tests:~~ Section 25.723(c) allows changes in previously approved design weights and minor changes in design to be substantiated by analyses based on tests of the same basic landing gear unit with similar energy absorption characteristics.

A landing gear unit would be considered to be of "the same basic landing gear system" when the design concept has not been changed. "Similar energy absorption characteristics" means that the changes to the landing gear unit, either taken individually or as a whole, would not have a significant effect on the validation of the analytical results for the modified airplane. Changes that may be acceptable without further energy absorption tests include minor changes and adjustments incorporated in the landing gear unit to maintain similar energy absorption characteristics with changes in design weight and landing speeds.

~~(1) Airplane sprung mass (effective weight) variations, including extrapolation from maximum landing weight to maximum take-off weight conditions.~~

~~(2) Changes in shock absorber characteristics including pre-load, compression ratio, orfice sizes.~~

~~(3) Changes in tire characteristics.~~

~~(4) Changes in unsprung mass (e.g. brakes).~~

~~(5) Local strengthening or minor sizing changes to the landing gear.~~

For example, the following changes may be acceptable without further tests:

- Minor changes in shock absorber details including pre-load, compression ratio, orifice sizes, metering pin profiles.
- Minor changes in tire characteristics.
- Minor changes in unsprung mass (e.g. brakes).
- Local strengthening or minor sizing changes to the landing gear.

To allow justification by analysis for the reserve energy requirement, ~~the principal components of the landing gear should not be exhausted of energy absorbing capacity~~ neither the shock strut nor the tires should bottom during the reserve energy analysis or the tests upon which the analysis is correlated.

5. LIMIT FREE DROP TESTS.

(a) Compliance with § 25.723(a) may be shown by free drop tests, provided they are made on the complete airplane, or on units consisting of a wheel, tire, and shock absorber, in their proper positions, from free drop heights not less than--

(1) 18.7 inches for the design landing weight conditions; and

(2) 6.7 inches for the design takeoff weight conditions.

(b) If airplane lift is simulated by air cylinders or by other mechanical means, the weight used for the drop must be equal to W. If the effect of airplane lift is represented in free drop tests by a reduced weight, the landing gear must be dropped with an effective weight equal to

$$W_e = W\left[\frac{h+(1-L)d}{h+d}\right]$$

where—

$W_e$ = the effective weight to be used in the drop test (lb);
$h$ = specified free drop height (inches);
$d$ = deflection under impact of the tire(at the approved inflation pressure) plus the vertical component of the axle travel relative to the drop weight (inches);
$W$ = $W_M$ for main gear units (lb), equal to the static weight on that unit with the airplane in the level attitude (with the nose wheel clear in the case of nose wheel type airplanes);
$W$ = $W_T$ for tail gear units (lb), equal to the static weight on the tail unit with the airplane in the tail-down attitude;
$W$ = $W_N$ for nose wheel units (lb), equal to the vertical component of the static reaction that would exist at the nose wheel, assuming that the mass of the airplane acts at the center of gravity and exerts a force of 1.0 $g$ downward and 0.25 $g$ forward; and
$L$ = ratio of the assumed airplane lift to the airplane weight, but not more than 1.0.

(c) The drop test attitude of the landing gear unit and the application of appropriate drag loads during the test must simulate the airplane landing conditions in a manner consistent with the development of a rational or conservative limit loads.

(d) The value of $d$ used in the computation of $W_e$ in paragraph (b) of this section may not exceed the value actually obtained in the drop test.

6. RESERVE ENERGY FREE DROP TESTS.

(a) Compliance with the reserve energy absorption condition specified in § 25.723(b) may be shown by free drop tests provided the drop height is not less than 27 inches.

(b) If airplane lift is simulated by air cylinders or by other mechanical means, the weight used for the drop must be equal to W. If the effect of airplane lift is represented in free drop tests by an equivalent reduced weight, the landing gear must be dropped with an effective weight,

$$W_e = \frac{Wh}{h+d}$$

where the symbols and other details are the same as in paragraph 5 above.

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TRANSFERRED TO:

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revised 10-18-95 (JT editorial changes)
revised 10-30-95 (NS edits)
revised 3/11/96 (ACO comments)
revised 2/8/00 (LCH – L&DHWG reponse to public comments)
revised 4/11/00 (J. Haynes to reflect Boeing Comments) See changes in blue color.
revised 5/2/00 (LCH to remove Boeing suggested paragraph 6.(c) )

FAA Action: Revised Landing Gear Shock Absorption Test Requirements and proposed Advisory Circular 25.723-1, Shock Absorption Test; NPRM -- FAA-1999-5835