AC 20-146A Methodology for Dynamic Seat Certification by Analysis for Use in Part 23, 25, 27, and 29 Airplanes and Rotorcraft

Change 1

Presented to: *Use of Dynamic Analysis Methods in Aircraft Certification Workshop*

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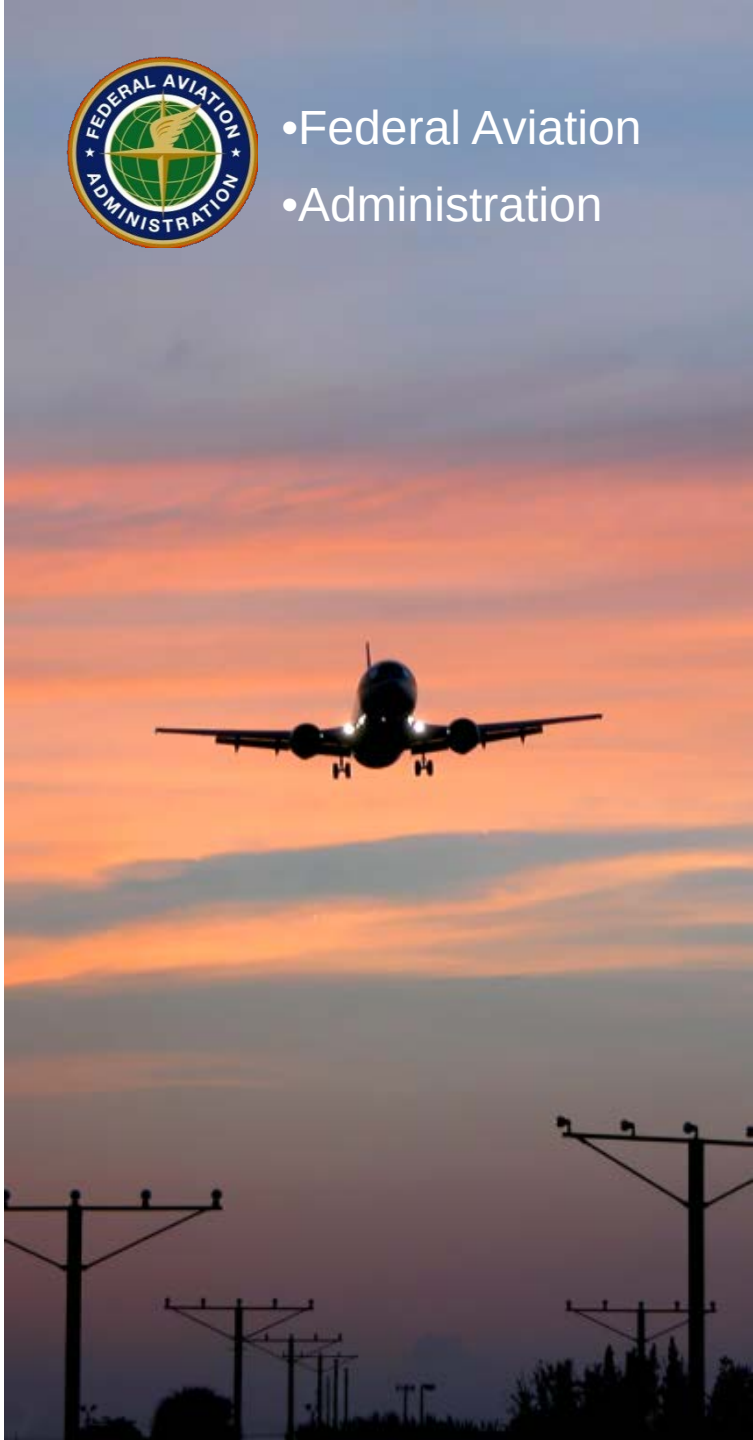

Overview

- **The advisory circular (AC) sets forth an acceptable means, but not the only means, for demonstrating compliance with Title 14, Code of Federal Regulations (14 CFR) 23.562, 25.562, 27.562, and 29.562, as well as Technical Standard Order (TSO) TSO-C127a, and TSO-C127b.**

Overview

- **AC 20-146 was signed on May 19, 2003 and is superseded**
- **Revision A was signed on 29 June, 2018 and is available for use**
  - Intended as a minor revision with an eye on a future, more significant revision/creation of a general M&S AC
- **Revision A change 1 is being considered now**

Order 1320.46D

When to Revise or Change an AC.

a. A revision modifies an entire AC. The new version has a new issue date and letter designation in the document number (see paragraph 5.c of this chapter). It is always preferable to issue a revision, rather than a change. A revision results in a document that you consider completely updated.

b. When you cannot update an entire AC but need to incorporate new information, a change is appropriate. In a change, only the new information is annotated with the new date. The OPR must include a vertical change bar in the left or right margin to identify changes to the text of the AC. The header of each change page must have the change number and new date.

c. An editorial change is a minimal, non-substantive change to an AC, such as a change in an address or the name of the responsible office or fixing a typographical error. Editorial changes do not change the number or date of the AC.

d. Whenever possible, revise the AC rather than issue a change. If the change affects more than 35 percent of the AC, it must become a revision.

Why Change 1?

- **Incorporate some lessons learned**
- **Fix some typos**
- **Only a change and not a new revision**
  - Limits the scope of the changes

Revision A Highlights

- **Language clean up**
- **Added verification section**
- **Removed list of codes**
- **Added reference SAE ARP 5765 Rev A**
  - v-ATD calibration
- **Added reference to ASME V&V 10**
- **Revised acceptance criteria**
  - Building block approach
  - Updated Appendices A and B
  - Some new acceptance levels
    - HIC and Lumbar Load

6 Definitions

- **Definitions will be updated to correspond with current terminology**
  - ASME V&V 10 revision

8.3 Application-Specific Validation Criteria

- **The applicant should validate relevant parameters to the application of the model. The applicant and the ACO should identify and agree on the validation criteria specific to the application, and the certification plan should list those criteria. The applicant and the ACO should negotiate any additional validation criteria not listed in this AC. The following paragraphs provide guidance on the validation parameters to consider; however, the final levels should be coordinated with the ACO. If no acceptable rationale is available to make this determination, then the details listed in the following paragraphs may be followed:**

8.3.2.1 Structural Response – Internal Loads

- **The peak critical floor reaction loads between the analysis and test data should correlate to within 10 percent unless a different level of correlation was determined prior to the initiation of any program.**

- **Other subsections in 8.3 do not include the red text, but the intent was to follow that (per preamble of 8.3)**

- **Subsections in 8.3 will be modified to include the red text**

Model Conservatism

- **"Conservative simulation results are encouraged, but not required"**
- **Can use conservative inputs**
  - More stringent sled pulse
  - Conservative material properties
    - May need to run more than one simulation
- **Can use conservative limits model use**
  - Similar to HIC and lumbar load "factor of safety"

HIC – Model Use Limits

- **For modified configuration/installation, only model predictions ≤ 890 eligible**
- **Extrapolation limit a function of the degree of conservatism seen in validation**
- **For model that under-predicts the test result with the Hybrid II, the predicted HIC must not exceed 890 minus the magnitude of the under-prediction.**

	Validation	Model Use Hybrid II	Model Use FAA Hybrid III
Model under predicts	Test = 850, Model = 800	Model = 840 or less	Model = 890 or less
Model over predicts	Test = 850, Model = 900	Model = 890 or less	Model = 890 or less

Lumbar Load – Model Use Limits

- **For modified configuration/installation, only model predictions ≤ 1430 lb eligible**
- **Extrapolation limit a function of the degree of conservatism seen in validation**
- **For model that under-predicts the test result with the Hybrid II, the predicted load must not exceed 1430 pounds minus the magnitude of the under-**

	Validation	Model Use Hybrid II	Model Use FAA Hybrid III
Model under-predicts	Test = 1400, Model 1350	Model ≤ 1380 lb	Model ≤ 1430 lb
Model over-predicts	Test = 1400, Model 1450	Model ≤ 1430 lb	Model ≤ 1430 lb

TSO Process Clarification

- **Add a paragraph on how to use this in the TSO, i.e. requesting a deviation for initial qual?**

Conclusion

- **AC 20-146a is released and ready for use**
- **Change 1 being coordinated now**
  - Please send any suggestions for consideration now