Federal Aviation Administration

Memorandum

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From: Kim Smith, Manager, Small Airplane Directorate, ACE-100

To: See Distribution

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Subject: **INFORMATION**: Standardization and Clarification of Application of 14 CFR Part 23, §§ 23.1301 and 23.1309, Regarding Environmental Qualification; PS-ACE100-2005-10039

Summary

This policy statement standardizes and clarifies the Federal Aviation Administration's (FAA's) application of 14 Code of Federal Regulations (CFR) part 23, §§ 23.1301 and 23.1309, Amendment 23-41 or later for environmental qualification. The guidance allows the depth of the environmental qualification to be commensurate with the severity of the hazard. It is based on the five failure condition classifications defined in AC 23.1309-1C ranging from no safety effect to catastrophic. This policy should reduce the amount of environmental qualification, especially for equipment that has no safety effect and equipment that has only minor failure conditions.

Background

For part 23 airplanes, most certification of equipment for environmental qualifications was the same for all the equipment regardless of its failure condition. In the past, applicants and certification authorities interpreted § 23.1301(d), Function properly when installed, from Amendment 23-20, to mean that equipment, even if it was not required or pertinent to safety, should have the same environmental qualification as equipment essential to safe operation. For airplanes with certification basis including § 23.1309, Amendment 23-41 or later, the FAA is clarifying the interpretation of § 23.1301(d) to focus this activity on items either required by the regulations or having an effect on safety. This interpretation is based on the notice for Amendment 23-20 stating that the main purpose of the amendment is to prevent hazards.

In this policy, the environmental qualifications will be determined by the failure conditions of the equipment, as defined in AC 23.1309-1C. Currently, software and hardware developmental assurance levels, probability of failures, and lightning and High Intensity Radiated Fields (HIRF) protection levels are determined by the failure condition classification. This policy is incorporating the same concept.

Acronyms

AC	Advisory Circular
CFR	Code of Federal Regulations
FAA	Federal Aviation Administration
HIRF	High Intensity Radiated Fields
TSO	Technical Standard Order

Definitions

Equipment Essential to Safe Operation: Equipment installed in order to comply with the applicable certification requirements of part 23 or operational requirements of parts 91 and 135. Also, for environmental qualifications, equipment or a system that has a failure or malfunction that results in anything from minor, to major, to hazardous, to catastrophic failure conditions as defined in AC 23.1309-1C.

Hazard: Any condition that compromises the overall safety of the airplane or that significantly reduces the ability of the flight crew to cope with adverse operating conditions.

Current Airworthiness Regulations, Advisory Material of 14 CFR Part 23, and RTCA Documents or the latest version.

§ 23.1301, Function and installation
§ 23.1309, Equipment, systems, and installations

AC 23.1309-1C, Equipment, Systems, and Installations in Part 23 Airplanes
AC 23-17B, Systems and Equipment Guide for Certification of Part 23 Airplanes
AC 21-16E, RTCA Document DO-160E

RTCA/DO-160E, Environmental Test Conditions and Test Procedures for Airborne Equipment or equivalent

POLICY

14 CFR part 23, §§ 23.1301 and 23.1309: These sections contain the general regulatory requirements for the environmental qualifications of installed equipment. The level of qualification depends on the five failure condition classifications, as defined in AC 23.1309-1C. These classifications are no safety effect, minor, major, hazardous, and catastrophic. This policy also applies to Technical Standard Order (TSO) equipment that is installed in part 23 airplanes.

Section 23.1301 requires that the installed equipment perform its intended function. Section 23.1309 requires equipment to not adversely affect equipment essential to safe operation of the airplane or affect other equipment without indicating the effects to the pilot. The following paragraphs provide guidance for environmental qualification for each of the failure condition classifications:

Equipment with major, hazardous, and catastrophic failure conditions: Applicants should design and install the equipment and systems to perform as intended under the anticipated airplane's operating and environmental conditions that the equipment will encounter. For environmental qualification when using RTCA/DO-160 as an acceptable method of compliance, the applicant must determine the appropriate sections and category levels for the airplane installation and environment. Equivalent testing methods, analyses, ground or flight tests, and qualification by similarity are also acceptable.

Following the appropriate levels of RTCA/DO-160 may be the most cost effective means for an applicant to comply, because other means of compliance may require more tests and more difficult testing. Testing for the indirect effects of lightning is also required for all of these failure conditions. For systems that have a catastrophic failure condition, testing for HIRF is required through special conditions. When the proposed regulation is finalized for HIRF, testing for HIRF will also be required for all these failure conditions. For indirect effects of lightning or HIRF, additional guidance is in AC 23.1309-1C and AC 23-17B.

Equipment with minor or no safety effect failure conditions: Applicants should design and install the equipment and systems so they perform as intended under the airplane's operating and environmental conditions that the equipment will encounter. The applicant should install the equipment and systems in a way that does not adversely affect equipment essential to safe operation. In some cases, the FAA would only accept a ground or flight installation evaluation, or both. If the applicant is using ground or flight installation evaluation for compliance, instructions for these evaluations should consist of good engineering practices. It should include the appropriate operations modes and phases of flight. Although, the FAA would still accept qualitative evaluations for the specific airplane, but it may be more efficient to address the environmental requirements by complying with the appropriate sections and levels of RTCA/DO-160. Testing for HIRF and the indirect effects of lightning is not required.

Equipment with no safety effect failure conditions: The primary purpose for environmental testing is to determine the performance characteristics of the equipment. The equipment should function when installed as intended by the manufacturer's instructions; however, the focus should not be on the reliability of its operation for all installation environments.

Ground and flight evaluations for all equipment installations: The equipment and systems should be installed in a way that does not adversely affect equipment essential to safe operation. The evaluations should determine that neither normal operation nor failure of the equipment would pose a hazard.

Similarity: For any failure condition it is acceptable for all equipment to show compliance without the need for additional tests by similarity. Only slight differences may exist between the previously certified system and installation and the new system and installation. To use similarity, there must be adequate service history. If there were any problems reported, there should be an adequate history with the product with the changed design to ensure the problems were resolved. A qualitative demonstration of similarity may be acceptable. The applicant is responsible for showing there are only slight differences between the products. If uncertainty exists about the effects of the differences, either additional tests or analysis, or both, should be

conducted as necessary to resolve the open issues. Similarity may not apply for a combination of a new aircraft design and a new system design including approved model list.

Conformity: The product or part must have the appropriate design data, approved procedures, and processes to determine conformity of the product or part. Conformity should be established for all parts with major, hazardous, and catastrophic failure conditions. For parts with minor or no safety effect failure conditions, conformity is recommended. However, if there is no conformity of the parts, when the part is replaced, the new part should be tested for its performance characteristics.

For additional specific environmental qualification guidance, see AC 23.1309-1C, AC 23-17B, AC 21-16E, and the applicable TSO. The next revision to AC 23-17B will include this policy. Until that revision occurs, this policy memo supersedes the guidance in AC 23-17B where there is a conflict.

The following table summarizes the environmental qualification process for each failure condition.

Table 1. A Summary for Environmental Qualification as Related to Failure Condition Classifications.

Failure Condition Classification	Environmental Qualification
Catastrophic	Must function properly when installed. Does not affect other equipment essential to safe operation. HIRF is required for all equipment through special conditions. Testing for indirect effects of lightning is required. Normally, environmental testing using, RTCA/DO-160, or similarity.
Hazardous	Must function properly when installed. Does not affect other equipment essential to safe operation. Testing for the indirect effects of lightning is required. Normally, environmental testing using RTCA/DO-160, or similarity.
Major	Must function properly when installed. Does not affect other equipment essential to safe operation. Testing for the indirect effects of lightning is required. Normally, environmental testing using RTCA/DO-160, or similarity.

Minor	Must function properly when installed. Does not affect other equipment essential to safe operation. It may comply by ground or flight evaluation, or both, or similarity. If several airplane models are involved, it may be more efficient to use RTCA/DO-160.
No safety effects	Must function properly when it is installed. Does not affect other equipment essential to safe operation. It may comply by ground or flight evaluation, or both, or similarity. If several airplane models are involved, it may be more efficient to use RTCA/DO-160.

Effect of this Policy

The general policy stated in this document does not constitute a new regulation or create what the courts refer to as a "binding norm." The FAA Aircraft Certification Offices (ACOs) should implement this policy when applicable to the specific project. Whenever an applicant's proposed method of compliance is outside this established policy, it must be coordinated with the policy issuing office as a standard practice, for example, through the issue paper process or equivalent. Similarly, if the implementing office becomes aware of reasons that an applicant's proposal that meets this policy should not be approved, the office must coordinate its response with the policy issuing office.

Applicants should expect certificating officials to consider this information when making findings of compliance relevant to new certificate actions. Also, as with all advisory material, this policy statement identifies one means, but not the only means, of compliance.

Contact

For questions and assistance regarding this policy, please contact Mr. Ervin Dvorak at (816) 329-4123, by fax (816) 329-4090, or by email at erv.dvorak@faa.gov.

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