

# Federal Aviation Agency



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AIRCRAFT

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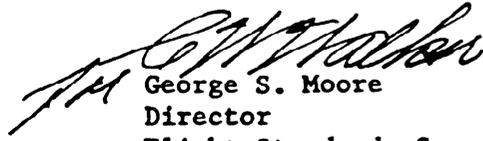
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**SUBJECT :** QUALIFICATION TESTING OF TURBOJET ENGINE THRUST REVERSERS

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1. PURPOSE. This circular discusses the requirements for the qualification of thrust reversers and sets forth an acceptable means of compliance with the tests prescribed in Federal Aviation Regulations, Part 33, when run under non-standard ambient air conditions. It is not the purpose of this circular to discuss additional requirements for thrust reversers contained in other parts of the Federal Aviation Regulations.
  2. CANCELLATION. Advisory Circular 20-18.
  3. REFERENCE. Federal Aviation Regulations, Sections 33.87 and 33.97, establish tests for substantiating thrust reverser endurance and functional properties, and operating compatibility with the engine.
  4. BACKGROUND. When conducting thrust reverser testing under ground static conditions with non-standard and varying atmospheric conditions, appreciable variations from standard rated severity levels may occur. The factors of actual thrust levels and engine exhaust gas temperature are of particular importance in this respect for reverser cyclic testing. In connection with a reverser substantiation program conducted under warm weather testing conditions, when it is not feasible to attain maximum thrust, a question has arisen in regard to what minimum severity is required.
  5. DISCUSSION.
    - a. The thrust reverser endurance and functional testing of FAR, Part 33, may be accomplished in conjunction with the official engine endurance test or by additional tests if so desired. Any manufacturer desiring to develop and obtain approval of a thrust reverser is required to subject it to these endurance and functional tests, or their equivalent, in conjunction with the particular engine with which it will be used.
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- b. For the thrust reverser cyclic and endurance tests, if the limiting engine operating parameters are not maintained to at least 100 percent of their specified values, additional substantiating evidence may be submitted as mentioned in FAR, Section 33.87. Substantiating evidence for thrust reverser loading parameters may include alternate tests or acceptable analyses. Such analyses should establish the overall critical strength, and the severity imposed during the actual testing.
  - c. Oftentimes, during stand testing, it is difficult to maintain the maximum specified gas temperature and thrust level simultaneously. These engine output parameters are of particular importance for reversers when operating with reverse thrust, but are usually of minor importance with the reverser in "stowed" position. Portions of the stand testing for the 200 required operating cycles will normally be accomplished during the cooler portions of a day, which usually results in achieving rated engine thrust or higher with gas temperatures at, or possibly below, maximum. During the warmer portions of a day, the maximum gas temperature should always be achieved, although usually with reduced thrust. It is considered satisfactory, however, that thrust reverser cyclic testing include some operation at reduced thrust conditions because of compensating severity achieved by operation with maximum exhaust gas temperatures.
  - d. While it has been suggested that an arbitrary ratio could be established for test cycles run at full thrust compared to cycles at reduced thrust and maximum gas temperature, this is believed to be unnecessarily restrictive. Similarly, an arbitrary maximum ambient temperature limit for testing is unnecessary, as these factors and other test criteria should be rationalized with respect to the thrust reverser design features.
6. ACCEPTABLE MEANS OF COMPLIANCE. The following basis for complying with §§ 33.87 and 33.97, under non-standard ambient air testing conditions, is acceptable for a reverser unit:
- a. The required 200 reverser operation cycles conducted should average no less than 100 percent of the specified maximum thrust conditions for maximum forward and maximum reverse. While some reverser operating cycles are acceptable with operation below the specified thrust values, to be credited the gas temperature should be maintained at least to the specified 100 percent value.

- b. Test stand endurance operation may be supplemented by stress and load analyses, or by acceptable aircraft flight tests conducted which meet the foregoing test severity limits for the 200-cycle operation testing, and when at least one reverser is operated through the equivalent of a 150-hour endurance test with the cyclic testing.
- c. For acceptable reliability, the reversers should be in a serviceable condition following the required testing.
- d. Thrust reverser compatibility with the engine should be established on the basis of satisfactory engine and reverser performance during these tests, with no adverse effects on the engine.

  
George S. Moore  
Director  
Flight Standards Service

