

maintain the test airplane during the airplane demonstrate test in paragraph II(b)(7) using the recommended operations and maintenance manual procedures, are part of the FAA's overall regulatory objective to minimize human errors in the ETOPS rule. The FAA intends that the proposed ETOPS type design requirements would result in an airplane entering service with validated maintenance and operational procedures that minimize the possibility of human error in ETOPS operations.

II(b)(4) Propulsion System Validation Test

This paragraph would require the applicant for an early ETOPS airplane to comply with the 3,000-cycle engine test in the proposed new § 33.200(c) with the installed engine configuration. The test engine would have to be configured with a complete airplane nacelle package, including engine-mounted equipment except for any configuration differences necessary to accommodate test stand interfaces with the engine nacelle package. At the conclusion of the test, the test hardware would have to be:

- (i) visually inspected in accordance with the applicant's on-wing inspection recommendations and limits; and
- (ii) completely disassembled and inspected in accordance with the service limits submitted in compliance with § 25.1529.

Explanation

Proposed paragraph II(b)(4) would codify paragraphs (e)(3) and (e)(6) of the Boeing Model 777 ETOPS special conditions for the airplane propulsion system installation. These special conditions paragraphs require vibration testing and a 3,000-cycle engine demonstration test on the installed engine configuration. The proposed § 33.200(c) would combine these two special conditions test requirements into one test based on how Boeing complied with these paragraphs for the Model 777 airplane.

The original ARAC recommended rule draft proposed the following wording for the first sentence of this paragraph: "The *propulsion system* for which approval is being sought * * *". The FAA defines the airplane propulsion system based on the definition of the powerplant installation contained in § 25.901(a), which states:

"For the purpose of this part, the airplane powerplant installation includes each component that—

- (1) Is necessary for propulsion;
- (2) Affects the control of the major propulsive units; or

(3) Affects the safety of the major propulsive units between normal inspections or overhauls."

The components and systems covered by the overall definition of "propulsion system" include the fuel system and the engine and fuel system flight deck controls. We do not intend that the proposed propulsion system validation test in paragraph II(b)(4) would include any propulsion system components outside of the airplane nacelle package. We have made two changes to the original ARAC wording in order to clarify the intended test configuration. We have replaced "propulsion system" with "installed engine configuration" in the first sentence. We have changed the second sentence to clarify that the test engine must be configured with a complete airplane nacelle package, including engine-mounted equipment except for any configuration differences necessary to accommodate test stand interfaces with the engine nacelle package. These proposed changes are consistent with a recent revision of the Boeing Model 777 ETOPS special conditions.

The Boeing Model 777 ETOPS special conditions did not originally require a post-test teardown inspection. However, all three-engine companies, in cooperation with Boeing, conducted post-test teardown inspections on the original baseline engines installed on the Model 777 series airplanes based on their own experience of what would constitute an adequate evaluation.

The FAA reviewed the data from the 3,000-cycle tests for the three original engine types installed on the Model 777 and found that most of the early in-service 777 engine failure modes could have been discovered with additional inspection and analysis of the 3,000-cycle test engine and propulsion system hardware. Part conditions noted in the teardown inspection reports for the three baseline 777 engine types did later occur in service, and they resulted in engine in-flight shutdowns or airplane diversions.

In order to provide a consistent standard for a post-test evaluation of the 3,000-cycle test hardware, the FAA is proposing an enhanced 3,000-cycle test requirement in proposed paragraph II(b)(4) of Appendix L and § 33.200(c). The standard would require a complete teardown inspection of the engine and airplane nacelle test hardware after completion of the test. The FAA intends that the enhanced teardown inspection requirement for the 3,000-cycle test hardware would catch potential sources of engine in-flight shutdowns or diversions.

An enhanced post-test teardown inspection requirement is part of a revision to the Boeing Model 777 ETOPS special conditions that the FAA developed for the Model 777-300ER program. The ARAC ETOPS Working Group had knowledge of our intent to revise the Model 777 ETOPS special conditions in this manner as they developed their recommendations.

Even though paragraphs II(b)(4) and § 33.200(c) address the same proposed post-test teardown inspection requirement, the wording for the requirement in paragraph II(b)(4) is different from that in § 33.200(c). The FAA considers that the intent of the proposed post-test teardown and inspection requirement in parts 25 and 33 to be identical. However, the specific language used in each part is tailored to the unique aspects of the engine and airplane type certification processes used to show compliance with this requirement.

See the discussion for the proposed new § 33.200(c) for a complete explanation of the proposed 3,000-cycle engine test requirement.

Proposed paragraph II(b)(4) is largely a "pointer" to the proposed requirements to perform an engine cyclic endurance test in part 33. The purpose of this paragraph in the rule is to assure that the entire installed engine configuration (engine accessories, nacelle, thrust reverser, etc.) is installed on the test vehicle during the part 33 testing. Since the proposed part 33 requirement only covers the engine type design, this proposed rule is necessary.

II(b)(5) New Technology Demonstration Testing

The applicant would have to conduct testing to demonstrate the suitability of any technology new to the applicant.

Explanation

This paragraph would codify paragraph (e)(4) of the Boeing Model 777 ETOPS special conditions. The ARAC left this requirement from the special conditions out of its recommended rule proposal, even though the associated part 25 draft advisory circular provided with their recommendation refers to this as a requirement. We propose to add the new technology demonstration testing requirement to the notice for completeness.

II(b)(6) APU Validation Test

This paragraph would require an applicant to complete a test consisting of 3,000 equivalent airplane operational cycles on an auxiliary power unit that the applicant uses to comply with the