



Applicability of Part 33 Testing to Part 25 Compliance

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- ✍ Transport airplane manufacturers (airframers) continue to contract with engine manufacturers (EMs) to provide certain components or partial/to complete engine build units (EBUs) .
- ✍ Increasing amounts of the components and attachment structure surrounding and integrated with the engine.
- ✍ Causes confusion among propulsion system installers as to what parts of the EBU are actually certified under part 33 and what parts must be certified under part 25, or if certified under part 33 requirements, is this good enough to obtain part 25 certification for the installation?

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- ✍ As a general “rule of thumb”, where the EM provides additional structure and components beyond the engine case, the EM is effectively performing in the capacity of a vendor or subcontractor to the airframer since such parts historically not included as part of the engine design.
- ✍ In some instances, the EMs have included all the additional components and structure under a single top drawing and submitted the whole package for approval under provisions of part 33.
- ✍ Nothing fundamentally wrong with this approach as long as all the additional items meet the applicable part 33 requirements and it's determined that the certification basis is adequate to cover the additional items, e.g., special condition.

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- ✍ Airframer still responsible for demonstrating compliance to applicable part 25 requirements for all additional hardware included as part of the approved engine type design.
- ✍ All parts of a given type design must meet the standards applicable to that type certificate – all components in an engine bill of material must meet the applicable part 33 standards, and all components in a transport category airplane, including those which are also type certificated under part 33 or TSOs, must meet the applicable part 25 standards.
- ✍ Some part 33 testing may be directly applicable for part 25 compliance, and compliance findings with part 25 should take full advantage of relevant findings made during engine certification.

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- ✍ **Topics for part 33 tests and their potential impact/influence on part 25 compliance**
- ✍ **Engine instability - 33.78, Rain and hail ingestion, vs. 25.939, engine operating characteristics.**
- ✍ **Fire protection - 33.17, Fire prevention, vs. 25.1183, flammable fluid-carrying components.**
- ✍ **Use of component qualifications by vendors (part 33?).**
- ✍ **Inflight engine restart.**

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- ✍ **Engine Instability - 33.78 vs. 25.939**
- ✍ **AC 33.78-1 Acceptance criteria, paragraph 19.f. - Acceptable engine operation excludes flameout, rundown, continued or non-recoverable surge or stall, or loss of acceleration and deceleration capability. A momentary surge or stall that arrests itself without operational interventions (e.g., without throttle manipulation) is usually acceptable.**
- ✍ **25.939 - Turbine engine operating characteristics; AC 25.939-1, paragraph 8.a.(2) - Takeoff: No adverse engine operating characteristics (mild, moderate, or severe) should exist after the power setting phase (no compressor stall/surge permitted).**

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- ✍ **Engine Instability - 33.78 vs. 25.939 cont.’**
- ✍ No requirement in 25.939 for any precipitation conditions for testing (historically, take what you get) – however, Part 33 testing is used as a basis for Part 25 acceptance for operation in adverse weather. Testing for 25.939 in potential icing conditions not permitted due to bleed effects on critical (pinch) point, minimum surge margin requirement.
- ✍ Part 33 (33.68, 33.77, 33.78) considered “extreme” environmental conditions (steady state and transient) and simulates flight conditions; 25.939 requirements intended for demonstrating engine dynamic behavior within the airplane’s flight envelope.

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- ✍ **Fire protection - 33.17 vs. 25.1183**
- ✍ 33.17 is the same as 25.1183(a) except (25.1183 differences shown in red): each line, fitting, and other component carrying flammable fluid in any area subject to engine fire conditions, and each component which conveys or contains flammable fluid in a designated fire zone must be fire resistant... Para. 25.1183(b) states Para. (a) does not apply to-- (1) Lines, fittings, and components which are already approved as part of a type certificated engine...
- ✍ The part 25 requirement covers items adjacent to firewalls, subjected to temperature effects across the firewall when a fire is present. Such items approved with the engine should therefore be part 25 compliant.

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- ✍ **Fire protection - 33.17 vs. 25.1183 cont.’**
- ✍ **Conflict could occur if any item approved as part of the engine, i.e. deemed fire resistant, will be used in a fire zone as addressed in 25.1183(c): all components, including ducts, must be fireproof if, when exposed to or damaged by fire, they could- result in fire spreading to other regions of the airplane; or cause unintentional operation of, or inability to operate, essential services or equipment.**
- ✍ **The installed location and end use of all items included and approved as part of the engine need to be identified upfront to establish if compliance with 33.17 alone will be sufficient to show compliance with the applicable part 25 fire protection requirements in the installed configuration.**

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- ✍ **Use of component qualifications by vendors (part 33?)**
- ✍ **Components in-service on other installations may be qualified based on that application or other requirements identified by the applicant for the new installation.**
- ✍ **If based on previously certified installation, or requires modification, applicant must establish applicability of qualification data to the new installation.**
- ✍ **Vendors’ qualification reports should identify demonstrated duty cycle endurance performance, e.g., maximum temperature and pressure, lightning and HIRF capabilities, etc., and for equipment with high energy rotors, its demonstrated containment capabilities.**
- ✍ **If the current qualification levels are in doubt for the expected application, consult your ACO for resolution.**

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✍ Inflight engine restart

- ✍ Part 33 does not address starting requirements inflight.
- ✍ 33.5 requires starting procedures under normal and extreme ambient conditions be included in engine Instl./Op. Manual; 33.69 requires an ignition system for starting on ground and inflight; the 33.87 endurance test requires 100 start demonstrations.
- ✍ Part 25.903(e)(2) contains requirement for the altitude/airspeed inflight envelope that each engine must demonstrate.
- ✍ Generic issue paper extends policy by addressing common-cause, all engine flameout concerns regarding restart conditions at high power/low altitude, drift-down from cruise altitude, and drift-down from lower power - moderate altitude, holding type scenario.

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✍ Inflight engine restart cont.'

- ✍ Need to maintain an adequate "windmill" relight envelope and adequate start procedures is focus of these conditions.
- ✍ Recognizing the importance of adequate "windmill" capability, the airframer should coordinate early with and insist on assurance (engine specification) from the EM that maximum altitude and minimum "windmill" airspeed are to be achieved for a consistent restart envelope capability.

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