

§ 29.571 Fatigue Tolerance Evaluation of Metallic Structure.

(a) A fatigue tolerance evaluation of each principal structural element (PSE) must be performed, and appropriate inspections and retirement time or approved equivalent means must be established to avoid catastrophic failure during the operational life of the rotorcraft. The fatigue tolerance evaluation must consider the effects of both fatigue and the damage determined under paragraph (e)(4) of this section. Parts to be evaluated include PSEs of the rotors, rotor drive systems between the engines and rotor hubs, controls, fuselage, fixed and movable control surfaces, engine and transmission mountings, landing gear, and their related primary attachments.

(b) For the purposes of this section, the term—

(1) *Catastrophic failure* means an event that could prevent continued safe flight and landing.

(2) *Principal structural element (PSE)* means a structural element that contributes significantly to the carriage of flight or ground loads, and the fatigue failure of that structural element could result in catastrophic failure of the aircraft.

(c) The methodology used to establish compliance with this section must be submitted to and approved by the Administrator.

(d) Considering all rotorcraft structure, structural elements, and assemblies, each PSE must be identified.

(e) Each fatigue tolerance evaluation required by this section must include:

(1) In-flight measurements to determine the fatigue loads or stresses for the PSEs identified in paragraph (d) of this section in all critical conditions throughout the range of design limitations required by § 29.309 (including altitude effects), except that maneuvering load factors need not exceed the maximum values expected in operations.

(2) The loading spectra as severe as those expected in operations based on loads or stresses determined under paragraph (e)(1) of this section, including external load operations, if applicable, and other high frequency power-cycle operations.

(3) Takeoff, landing, and taxi loads when evaluating the landing gear and other affected PSEs.

(4) For each PSE identified in paragraph (d) of this section, a threat assessment which includes a determination of the probable locations, types, and sizes of damage, taking into account fatigue, environmental effects, intrinsic and discrete flaws, or accidental damage that may occur during manufacture or operation.

(5) A determination of the fatigue tolerance characteristics for the PSE with the damage identified in paragraph (e)(4) of this section that supports the inspection and retirement times, or other approved equivalent means.

(6) Analyses supported by test evidence and, if available, service experience.

(f) A residual strength determination is required that substantiates the maximum damage size assumed in the fatigue tolerance evaluation. In determining inspection intervals based on damage growth, the residual strength evaluation must show that the remaining structure, after damage growth, is able to withstand design limit loads without failure.

(g) The effect of damage on stiffness, dynamic behavior, loads, and functional performance must be considered.

(h) Based on the requirements of this section, inspections and retirement times or approved equivalent means must be established to avoid catastrophic failure. The inspections and retirement times or approved equivalent means must be included in the Airworthiness Limitations Section of the Instructions for Continued Airworthiness required by Section 29.1529 and Section A29.4 of Appendix A of this part.

(i) If inspections for any of the damage types identified in paragraph (e)(4) of this section cannot be established within the limitations of geometry, inspectability, or good design practice, then supplemental procedures, in conjunction with the PSE retirement time, must be established to minimize the risk of occurrence of these types of damage that could result in a catastrophic failure during the operational life of the rotorcraft.