be misaligned with respect to each other by at least 10° vertically (i.e., pitch out of parallel) and by at least a 10° lateral roll, with the directions optional, to account for possible floor warp.

(c) Compliance with the following must be shown:

(1) The seating device system must remain intact although it may experience separation intended as part of its design.

(2) The attachment between the seating device and the airframe structure must remain intact although the structure may have exceeded its limit load.

(3) The ATD’s shoulder harness strap or straps must remain on or in the immediate vicinity of the ATD’s shoulder during the impact.

(4) The safety belt must remain on the ATD’s pelvis during the impact.

(5) The ATD’s head either does not contact any portion of the crew or passenger compartment or, if contact is made, the head impact does not exceed a head injury criteria (HIC) of 1,000 as determined by this equation.

\[ \text{HIC} = (t_2 - t_1) \left[ \frac{1}{(t_2 - t_1)} \int_{t_1}^{t_2} a(t) \, dt \right]^{2.5} \]

Where: \(a(t)\) is the resultant acceleration at the center of gravity of the head form expressed as a multiple of \(g\) (the acceleration of gravity) and \(t_2 - t_1\) is the time duration, in seconds, of major head impact, not to exceed 0.05 seconds.

(6) Loads in individual shoulder harness straps must not exceed 1,750 pounds. If dual straps are used for retaining the upper torso, the total harness strap loads must not exceed 2,000 pounds.

(7) The maximum compressive load measured between the pelvis and the lumbar column of the ATD must not exceed 1,500 pounds.

(d) An alternate approach that achieves an equivalent or greater level of occupant protection, as required by this section, must be substantiated on a rational basis.

(2) Floats deployed after initial water contact. Each float must be designed for full or partial immersion prescribed in paragraph (b)(1) of this section. In addition, each float must be designed for combined vertical and drag loads using a relative limit speed of 20 knots between the rotorcraft and the water. The vertical load may not be less than the highest likely buoyancy load determined under paragraph (b)(1) of this section.

[Fatigue Evaluation]

§ 29.571 Fatigue evaluation of structure.

(a) General. An evaluation of the strength of principal elements, detail design points, and fabrication techniques must show that catastrophic failure due to fatigue, considering the effects of environment, intrinsic/discrete flaws, or accidental damage will be avoided. Parts to be evaluated include, but are not limited to, 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. In addition, the following apply:

(1) Each evaluation required by this section must include—

(i) The identification of principal structural elements, the failure of which could result in catastrophic failure of the rotorcraft;

(ii) In-flight measurement in determining the loads or stresses for items in paragraph (a)(1)(i) of this section in all critical conditions throughout the range of limitations in §29.309 (including altitude effects), except that maneuvering load factors need not exceed the maximum values expected in operations; and

(iii) Loading spectra as severe as those expected in operation based on loads or stresses determined under paragraph (a)(1)(ii) of this section, including external load operations, if applicable, and other high frequency power cycle operations.

(2) Based on the evaluations required by this section, inspections, replacement times, combinations thereof, or other procedures must be established as necessary to avoid catastrophic failure. These inspections, replacement times, combinations thereof, or other procedures must be included in the airworthiness limitations section of the Instructions for Continued Airworthiness required by §29.1529 and section A29.4 of appendix A of this part.

(b) Fatigue tolerance evaluation (including tolerance to flaws). The structure must be shown by analysis supported by test evidence and, if available, service experience to be of fatigue tolerant design. The fatigue tolerance evaluation must include the requirements of either paragraph (b)(1), (2), or (3) of this section, or a combination thereof, and also must include a determination of the probable locations and modes of damage caused by fatigue, considering environmental effects, intrinsic/discrete flaws, or accidental damage. Compliance with the flaw tolerance requirements of paragraph (b)(1) or (2) of this section is required unless the applicant establishes that these fatigue flaw tolerant methods for a particular structure cannot be achieved within the limitations of geometry, inspectability, or good design practice. Under these circumstances, the safe-life evaluation of paragraph (b)(3) of this section is required.

(1) Flaw tolerant safe-life evaluation. It must be shown that the structure, with flaws present, is able to withstand repeated loads of variable magnitude without detectable flaw growth for the following time intervals—

(i) Life of the rotorcraft; or

(ii) Within a replacement time furnished under section A29.4 of appendix A to this part.

(2) Fail-safe (residual strength after flaw growth) evaluation. It must be shown that the structure remaining after a partial failure is able to withstand design limit loads without failure within an inspection period furnished under section A29.4 of appendix A to this part. Limit loads are defined in §29.301(a).

(i) The residual strength evaluation must show that the remaining structure after flaw growth is able to withstand design limit loads without failure within its operational life.