THE DEVELOPMENT OF CIVIL ROTORCRAFT WATER IMPACT DESIGN LIMITS

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ABSTRACT

The paper describes the results of an FAA sponsored SBIR effort in which an analytical procedure for developing design limits for ditching (level 1 water impacts) and severe, but survivable water impacts(level 2 water impacts) is discussed. The design limits are presented along with the backdrop of current civil rotorcraft ditching requirements and 95th percentile water and ground accident envelopes. The analysis, utilizing program KRASH, takes into consideration acceptable occupant protection criteria such as allowable lumbar load, seat stroke, and energy absorbing seats. In addition, acceptable structure design criteria with regard to major mass items, like engine and transmission, are accounted for. Both calm sea and rough sea as defined in ditching regulations are considered. Other impact scenarios that are included in the study are: (1) airframe impact, (2) skid or float impact, (3) underside panel design pressures, (4) allowable bulkhead pressures, (5) unsymmetrical impacts, (6) nose-over potential, and (7) floor to seat accelerations. Four BH205 configurations are modeled including; (1) Maximum Gross Takeoff Weight (GTOW), Design Landing Weight (DLW), (3) auxiliary fuel tanks, and (4) amphibious (float) design.

A matrix of all conditions and configurations analyzed is provided. In all approximately 500 scenarios were analyzed. The results are presented in the form of Design Limit Envelopes (DLE) for both level 1 (depicted in Figure 1), and level 2 water impacts (Figure 2). The former provides a level of structural integrity that may exist in current FAR27/29 rotorcraft. The latter compares analytically developed design levels with energy absorbing seats versus current 95th percentile envelopes available from accident data.

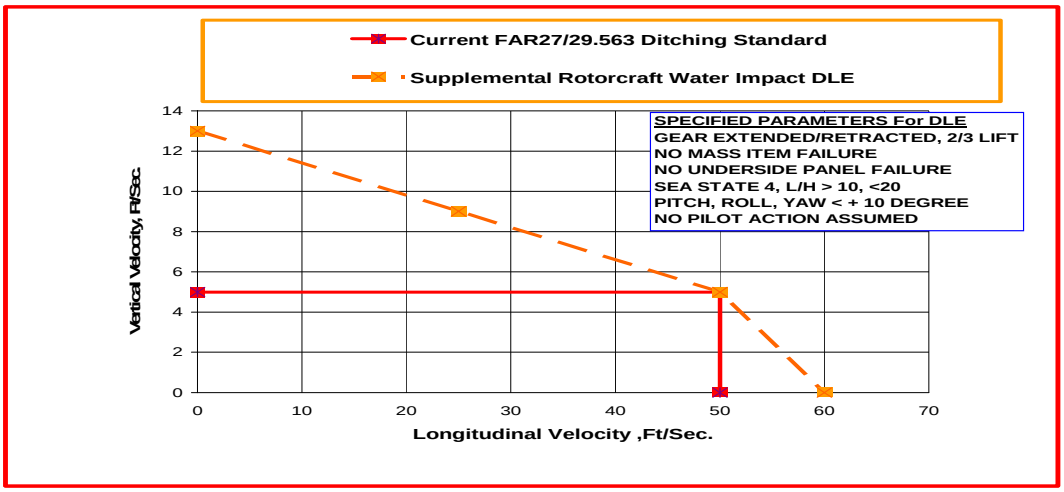

FIGURE 1 FAR 27/29.563 WATER IMPACT LEVEL 1 DLE FOR GTOW CONFIGURATION

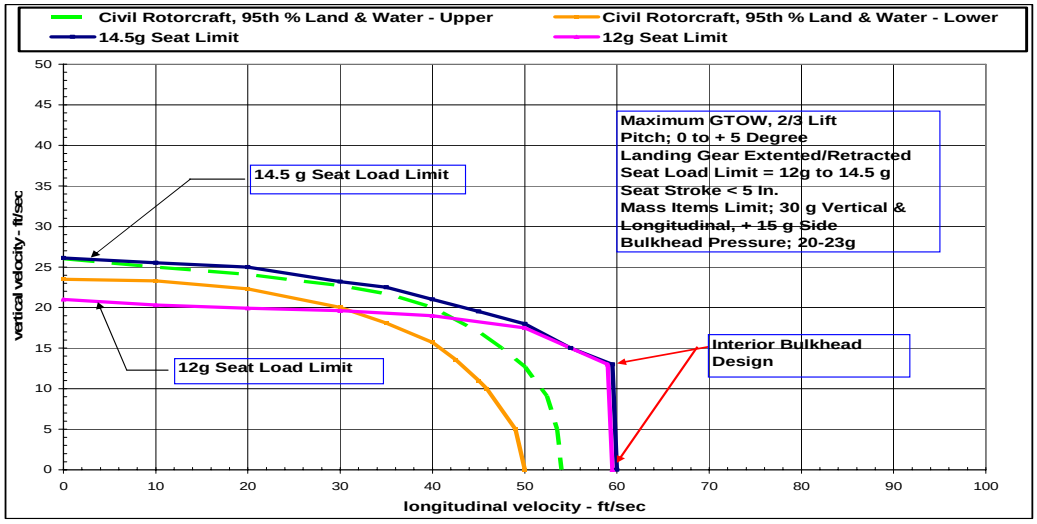

FIGURE 2 WATER IMPACT LEVEL 2 DLE vs. CIVIL ROTORCRAFT 95th PERCENTILE LIMITS

In addition to DLE, floor and cg acceleration pulses for both short term transient and long duration, in the form of acceleration vs. time, are presented. These pulses are for vertical, longitudinal, and lateral directions and are compared to current seat dynamic test requirements. A sample floor longitudinal response that might affect side facing seats is noted in Figure 3.

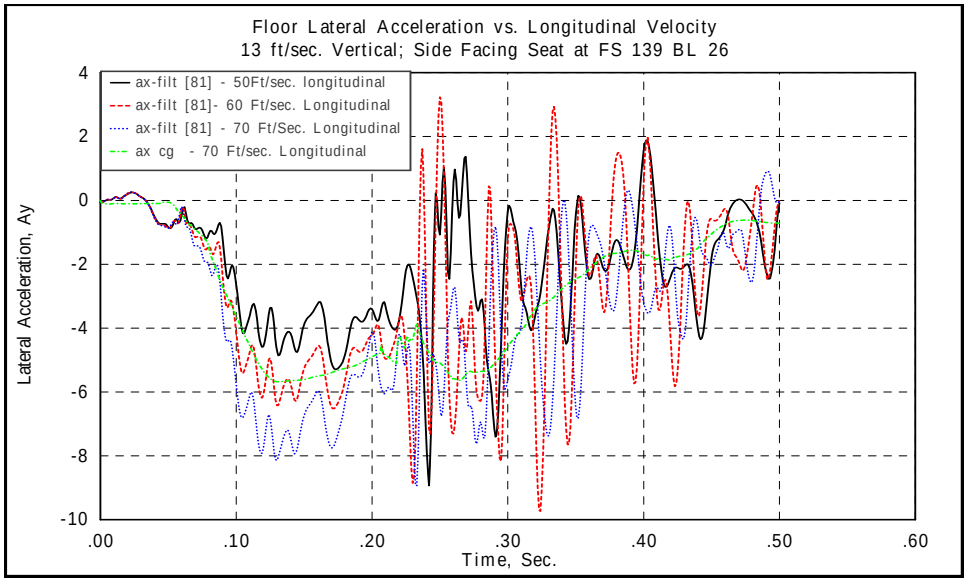

FIGURE 2 FLOOR and CG LATERAL ACCELERATION FOR SIDE FACING SEAT; WATER IMPACT

All floor pulses that are presented are described with regard to pulse characteristics such as shape and duration, peak directional and resultant acceleration, rise time, and velocity change.