

Discussion of the Differences Between Fail-Safe and Damage Tolerant Philosophies

(excerpt from Preamble, FAR Amendment 25-72.)

“Fail-safe generally means a design such that the airplane can survive the failure of an element of a system or, in some instances one or more entire systems, without catastrophic consequences. Fail-safe, as applied to structures prior to Amendment 25-45, meant complete element failure or obvious partial failure of large panels. It was assumed that a complete element failure or partial failure would be obvious during a general area inspection and would be corrected within a very short time. The probability of detecting damage during routine inspections before it could progress to catastrophic limits was very high. Damage-tolerance, on the other hand, does not require consideration of complete element failures or obvious partial failures, although fail-safe features may be included in structure that is designed to damage-tolerance requirements. A part may be designed to meet the damage-tolerance requirements of Sec. 25.571(b) even though cracks may develop in that part. In order to ensure that such cracks are detected before they grow to critical lengths, damage-tolerance requires an inspection program tailored to the crack progression characteristics of the particular part when subject to the loading spectrum expected in service. Damage-tolerance places a much higher emphasis on these inspections to detect cracks before they progress to unsafe limits, whereas fail-safe allows cracks to grow to obvious and easily detected dimensions.”