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REDUCING CORROSION FATIGUE AND SCC FAILURES IN 300M STEEL LANDING GEAR USING LOW PLASTICITY BURNISHING

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300M steel is often used in landing gear because of its high strength and high fracture toughness. Conversely, 300M steel is highly susceptible to corrosion fatigue and stress corrosion cracking (SCC), which can lead to catastrophic consequences for aircraft landing gear. Shot peening and plating of the landing gear are used to suppress corrosion fatigue and SCC with limited success. A method that will produce deeper compression in critical regions of landing gear will provide a dramatic improvement in foreign object damage (FOD) tolerance, corrosion fatigue strength and SCC susceptibility. This paper discusses the use of low plasticity burnishing (LPB) to provide a deep layer of residual compression to improve damage tolerance and mitigate SCC of 300M steel.

The fatigue performance of LPB processed 300M steel test samples were compared to those in a shot peened or low-stress-ground (LSG) condition. LPB produced a depth of compression on the order of 1.27 mm (0.05 in.), compared to only 0.127 mm (0.005 in.) depth of compression for the shot peening process. LPB treatment dramatically improved the high cycle fatigue (HCF) and corrosion fatigue performance with and without a simulated defect. LPB treated specimens, containing a 0.51 mm (0.02 in.) deep defect, exhibited corrosion fatigue strength of nearly a factor of 10 greater than shot peened treated specimens containing the same size defect. Despite the existence of similar corrosion conditions, the deep compressive surface residual stresses from LPB treatment mitigated both the individual and synergistic effects of corrosion fatigue and FOD.

LPB reduced the surface stress well below the SCC threshold for 300M, even under high tensile applied loads, effectively suppressing the SCC failure mechanism. SCC testing of LPB treated landing gear sections at tensile stresses ranging from 1030 to 2270 MPa (150 to 180 ksi) was terminated after 1500 hrs without failure, compared to failure in as little as 13 hours without LPB treatment.