Aluminum-Lithium Alloys: Chapter 11. Fatigue Behavior of Aluminum-Lithium Alloys

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The low cycle fatigue (LCF) and high cycle fatigue (HCF) properties of Al–Li alloys are influenced by alloy composition, microstructural characteristics, tensile stretching prior to artificial aging, and crystallographic texture. In general the fatigue properties, notably the notched HCF resistances, of Al–Li alloys are similar to those of conventional aerospace aluminium alloys. Alloy development programs on newer Al–Li alloys aim to study further the effects of minor alloying additions (rare earths, beryllium, silver and TiB); various thermomechanical treatments; alloy microstructure, notably crystallographic texture and grain size; and the fatigue load history and environment on the mechanical behavior, including the fatigue properties. It is important to note that the occurrence of bilinearity in LCF life-dependence on strain amplitude in most Al–Li alloys engenders the overestimation of the LCF lives in both the hypo-transition (lower strain amplitudes; longer fatigue lives) and hyper-transition (higher strain amplitudes; shorter fatigue lives) regions if the lives are estimated by extrapolation from either of these regions. Further, in cases such as in Al-Li alloys where there are large differences in strength-based (Basquin-like) and plastic strain – based (Coffin-Manson) power-law relationships, it is appropriate to develop an alloy design philosophy based on either plastic strain energy per cycle (Halford-Morrow) or fatigue toughness (total plastic strain energy to fracture). All of these aspects are discussed in detail in this chapter.

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