When high strength aluminum alloys are subjected to liquid metals, physical and chemical reactions ensue resulting in what is known as liquid metal embrittlement (LME). A subset of environmentally-assisted cracking, LME is exhibited when a liquid metal, e.g. Hg or Ga, comes into intimate contact with a solid metal having significant susceptibility. As mechanical loads are applied, the interaction between the two metals results in a reduction in the flow properties of the solid metal. Several theories have been proposed to identify the underlying microstructural failure mechanism; however, none have been widely accepted, as failures can typically incorporate features common to several failure theories. In an effort to confirm, extend or replace the physically-based theories, fracture mechanic experiments on Al 7075-T651 in liquid mercury have been conducted. Experiments were conducted in a custom environmental chamber capable of exposing specimens to liquid environments while applying a mechanical load. Through both plane-strain fracture and stress intensity factor-dependent (SIF) tests, fracture toughness values along with incubation periods were analyzed and provided data for a load-based theory of LME. These mechanical test data, along with metallographic analysis, show that the phenomena of LME is both strongly time- and SIF-dependent.