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CRYOGENIC BEHAVIOUR OF AIRWARE 2050 ALUMINIUM ALLOY: APPLICATION FOR SPACE PRODUCTS DOWN TO LH2 ENVIRONMENT

Abstract

This paper is the fruit of a collaborative work between an aluminum alloy developer and manufacturer - Constellium, a specialist in metallic alloys conversion – Aubert Duval, and a space launcher manufacturer - ArianeGroup. The aim of this collaboration is to go further in our experience of aluminum alloys for cryogenic use by finding new solutions coupling alloys, transformation process and heat treatment. 2219 alloy is commonly used and has demonstrated interesting characteristics in the cryogenic domain. In this paper, we focus on 2050, an Al-Cu-Li alloy with a strength level permitting a good compromise between tensile behavior and fracture toughness, even for thick parts, with also an excellent corrosion resistance and a lower density. The purpose of this study is to test and characterize the cryogenic behavior of 2050. In that way, forged blocs and plates are manufactured at different thicknesses and heat treated. Each bloc or plate is cut to sample tensile and fracture toughness specimens that are then tested at room temperature, 77K and 20K. Tensile behavior are presented in L, LT, ST directions, and fracture toughness in different directions. The results show a good compromise between tensile behavior and fracture toughness, with an increase of hardness and toughness when the temperature decreases. Heat treatment of the forged blocs and plates have been designed for room temperature properties and must certainly be optimized for cryogenic needs. This study will be part of another study to go further and deeper.