

MATERIALS AND STRUCTURES SYMPOSIUM (C2)
New Materials and Structural Concepts (4)

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MICROSTRUCTURE AND MECHANICAL PROPERTIES OF LASER BEAM WELDED T JOINT
ALUMINUM ALLOYS

Abstract

Fabricating the fuselage panels of aircraft structures with the laser beam welding (LBW) technique possesses the advantages of weight reduction and high production rate than the traditional riveting techniques. Besides, the welded joints with this technique present higher resistance against corrosion and improved behavior under fatigue than riveting joints. 6xxx (Al-Mg-Si) alloy is an age hardenable alloy possessing enhanced strength due to the precipitation of Mg₂Si phase upon solutionizing and artificial aging. Alloys of this class are extensively employed in aircraft applications. The main goal of this research is to evaluate the relationship between the microstructure and the mechanical properties of the 6xxx alloys T joint laser welds. 1.8 mm thick laminated skins of AA6156 alloy and extruded stringers of AA6056 alloy were T-jointed by laser beam welding using a CO₂ laser with a maximum power of 3 kW. The two weld seams with AA4047 filler material between the stringers and the fuselage skin were welded from the two sides of the stringer in sequence. The microstructure and the tensile properties of the welded joints are studied by means of optical and electronic microscope, and tensile testing. The quality of the T-joint laser welds is good, since no obvious defects are present. Microstructure observations of the joints show that there are three distinct zones from the centre of the fusion zone to the base region: at the centre of the fusion zone, cellular dendrites are present; near the fusion line in the fusion region, a chill zone and parallel dendrite arms are found; and an evident heat-affected zone is observed between the fusion line and the parent material. T-pull testing exhibits that the fracture took place near the fusion line at the partially melted zone on the stringer side. The maximum stress achieved in each T-pull test is 540 N/mm.