

Measurement of thermal conductivity of aluminium samples at cryogenic temperatures

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Within the framework of the research and development activities on the cryogenic activity of the Air Liquide company, it appeared essential to measure precisely the thermal conductivity of the aluminium alloys used for the manufacture of elements subjected to temperatures around 80K. To this end, a collaboration was initiated between Air Liquide and THEMACS Ingénierie in order to determine the thermal conductivity of different aluminium alloys in different metallurgical states.

It was found that the literature data [1-4] differed from the experimental measurements by more than 30%. The reasons for this may be multiple. Indeed, the composition of alloys is standardised but only by guaranteeing ranges in the composition. These ranges of mass percentages provide a guarantee of mechanical properties and machinability. However, the thermal properties are very much impacted by the exact composition of the alloy and the presence or absence of impurities (which are not detrimental to the other properties). Another unknown is the metallurgical state of the alloy. Indeed, depending on whether the metal has been rolled, forged or melted, its thermal properties can vary greatly. The thermal history (quenching, annealing, ...) of the alloy has a strong influence on these properties. The data in the literature, although reliable in origin, do not provide an exact knowledge of the thermal conductivity of a given aluminium.