High Strength Aluminum Investment Casting, using the ‘Sophia® process’

Category: Materials
Reference: TDI0011

Broker Company Name: TNO
Broker Name: Len van der Wal
Telephone: +31 888 666 526
Email: len.vanderwal@tno.nl

Abstract:

Investment casting offers a wide range of process parameters that can be used to meet the requirements of different applications in manufacturing. Investment castings are characterized by a high surface quality, close tolerances and excellent mechanical properties. As such, this casting technology allows the production of large, thin walled castings of high complexity. In the design process, this casting technology offers the designer the opportunity to construct with a high degree of creative freedom. The so-called ‘Sophia® process’ has been developed to increase the mechanical properties while using all the advantages of the investment casting process.

Description:

The demand for lightweight constructions with excellent mechanical properties has been existing in space for decades. Especially aluminum parts are used for many applications, due to their low specific weight and their good mechanical properties. Usually however, parts are either milled from a large body or assembled from many different parts. This approach is both time-consuming and costly. Contrarily, investment casting offers the possibility to produce thin walled castings of high complexity in a single process step. This will e.g. allow for a very fast and reliable method to construct ‘single part’ instrument housings or other complex parts in a reliable and an efficient way.

Innovations and advantages of the offer:

The Sophia® casting process precisely manipulates the micro-structure of the material by controlled cooling after casting. This means that the molten metal solidifies faster and more evenly than in conventional investment casting. Through the targeted control of the cooling process, the thick-walled and thin-walled areas can be cooled in the same amount of time. This produces a fine-grain, dense cast structure with exceptionally good static and dynamic strength properties. Sophia® castings show a higher tensile strength and higher elongation values than conventional investment castings. The process enables the production of thin-walled cast parts with large surfaces as well as extreme leaps in wall thickness at the narrowest tolerances, combined with top surface and material quality. Thus, high-quality complex designs may be produced in mass.

Further Information:

In 2012 Zollern was awarded the European Aluminum Award in the category ‘Consumer products – innovation’ with their rear swing forks made with Sophia® investment casting for BMW racing bikes. The jury gave the following reason for choosing Zollern: “In competitive sports the need for high reliability and rapid development is paramount, yet expensive. This solution is proof to the Jury that both weight and cost reduction can be combined with the necessary reliability and performance
specs while choosing aluminum as lightweight material. A successful combination of process and material.”

The awarded rear swing forks are being used by BMW for its Superbike World Championship bikes since 2011. The rear fork from Zollern replaces the previous year’s milled part, and saves up to 20% of its weight. Other advantages are a better damped suspension and improved handling.

**Application:**

- Aeronautics
- Automotive
- Defence
- Space

**Broker comments:**

Recently, TNO has decided to use the Sophia® casting technology to construct the housings of two prospective space systems: the Integrated Optical Attitude Control Subsystem (IOPACS) and the Small Integrated Navigator for Planetary Exploration (SINPLEX).

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