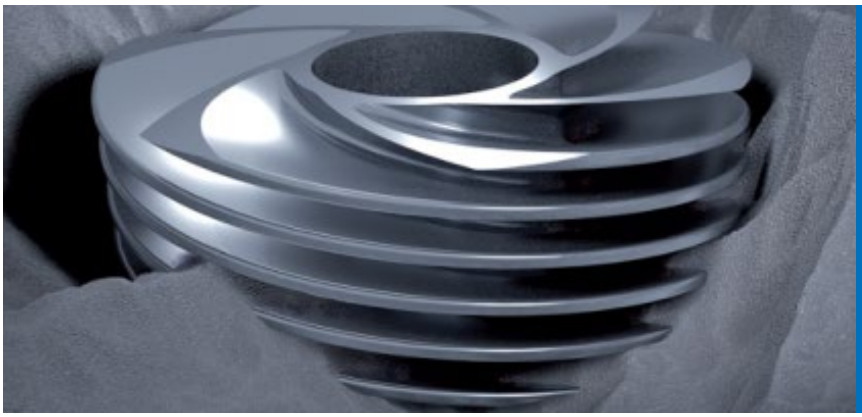

FIRST Newsletter

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Argon Detection in Powder Metallurgy Hot Isostatic Pressing Products – Are You Compliant with the New ISO 5842?

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Hot Isostatic Pressing (HIP) is a process that simultaneously uses high pressure (100 – 200 MPa) and temperature (900 – 1 250 °C) over a set amount of time to improve the material's mechanical properties and workability by reducing the porosity of metals and increasing the density of many materials including metal alloys and ceramics. The HIP process is used as a post-printing step for high-quality additive manufactured parts, but also to build a wide variety of components directly, by a near-net-shape powder metallurgic process (PM-HIP). PM-HIP requires the usage of a capsule to transmit the pressure from the pressure medium and to define the form of the final part. The material produced using the PM-HIP method is corrosion-resistant and withstands high pressure.

However, risks arise during manufacturing. The argon that is used as a pressure medium to press the materials into the desired shape can in some cases leak in and remain present in the form of bubbles in the material. Furthermore, argon can be present in the initial powder particles if the material was produced by argon gas atomization or from residual air if the evacuation/purge steps of the capsule were incomplete. Although the argon bubbles are microscopic, they make the material brittle, which could prove disastrous if defective parts are not identified and rejected. How to control this?

Manifolds, steam chests, wye pieces, turbine rotor shafts, swivel components, compound rings for stressometers, and pump housings are only a few examples of Powder Metallurgical Hot Isostatic Pressing (PM-HIP) products. They are produced in a wide range of materials: austenitic stainless steels, duplex stainless steels, martensitic steels, metal matrix composites (MMC), nickel alloys, and titanium, among others.

It is crucial that reliable and precise detection of argon is done in metal powder-produced components consolidated by hot isostatic pressing, as well as the detection of the impurities in the used argon atmosphere. The penetration of argon in the capsule as well as an incomplete evacuation process affect the solidity of the final product. Flaws of any kind impair its toughness and use. Argon in a component increases the risk of failure due to the influence of different types of corrosion, so its content is an important indicator of the behavior of the material. The same goes for components that are re-densified with impure argon gas and feature surface impurities.

With that in mind, Bruker, together with some of our customers, endeavored and cooperated with Swedish metals research institute Swerim AB, in the creation of the new standard ISO 5842 for argon detection in PM-HIP products using mass spectrometry techniques.

This standard specifies:

- an Inert Gas Fusion Analyzer coupled to a mass spectrometer (MS) as detector for argon determination in specimens and parts produced by PM-HIP;
- the calibration and functionality test for the equipment covered;
- the methods for sampling, sample preparation, and sample test procedure of PM-HIP components to detect the presence of argon.

Note: Components produced by additive manufacturing are not covered in this standard.

G8 GALILEO MS – O, N, H, Ar, TDMS

How to comply with ISO 5842

Bruker G8 GALILEO with Mass Spectrometric detection **is the only commercially available instrument** that complies with ISO 5842.

ONH + Mass Spectrometer + Moisture Sensor = One instrument configuration to monitor the complete HIP process:

- Measurement of the argon concentration in the final solid product down to a very low ppb range.
- Measurement of the Ar content present in the initial powder, in addition to oxygen, nitrogen, and hydrogen.
- Qualitative and quantitative analysis of critical impurities in the used argon gas. These impurities react with the material of the expensive HIP furnace, thus attacking it, which can lead to damage to the plant.
- Possibility to measure the oxygen, nitrogen, and hydrogen concentration also in the final solid product down to a very low ppm range.
- One interface between the HIP system and the instrument configuration for communication and data transfer.
- One final documentation/protocol of all conditions during the HIP process at every time.

The **G8 GALILEO** is a user-friendly instrument with low analysis cost, offering the widest range of analytical performance. Contact us if you want to know more.

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