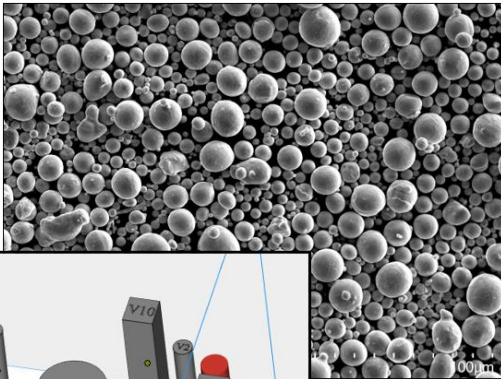


Additive
Manufacturing and
Metal Powders



Qualification of Zr705C Valves by Laser Powder Bed Fusion

The CMQ was contacted by Fluoroseal Valves to develop valves using additive manufacturing via laser powder bed fusion (LPBF) with various materials, including Zirconium 705C. LPBF provides a number of advantages when producing zirconium valves. Due to the high cost of Zr alloys, it is more cost-effective to print only the required volume, rather than casting large quantities of metal. In addition, LPBF consistently produces exceptionally high-quality parts with significantly fewer rejects compared to traditional foundry methods. Zirconium valves must then be produced by investment casting using a vacuum melting furnace. The cost of the alloy, the process used, and the resulting quality make LPBF more cost-effective when producing these high-value-added valves.

The development objective has been achieved. Printing parameters that were previously unavailable on the market were developed for this alloy, a rarity in additive manufacturing. Afterwards, various heat treatment and layer thickness options were evaluated (printing productivity). The properties obtained with stress relaxation (SR) and hot isostatic pressing (HIP) heat treatments were above the requirements by a minimum of 48% for $Re_{0.2}$, 36% for R_m , and 117% for elongation. Using SR alone, the $Re_{0.2}$ was more than 125% above requirements, while R_m and elongation were 87% and 50% above requirements, respectively. Qualification batches have been produced, along with the world's first printed zirconium valves. The mechanical properties, chemical composition (particularly oxygen levels), and non-destructive testing (NDT) by radiography yielded results of the highest quality.

