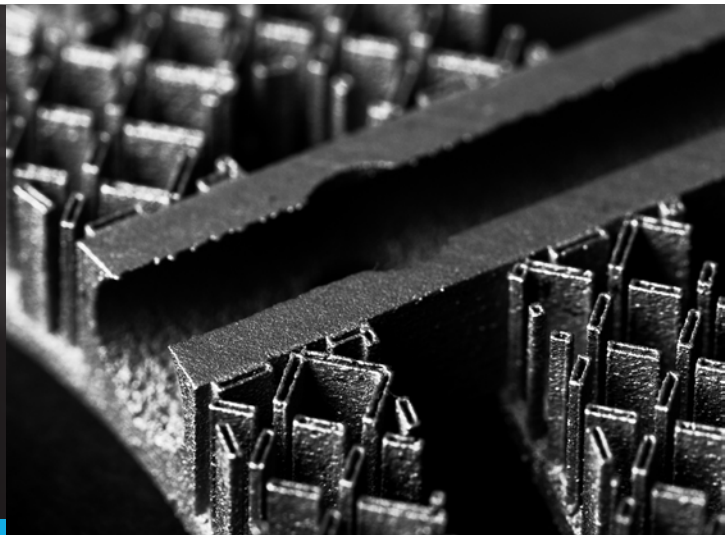
FRAZER-NASH MANUFACTURING

Case Study

Custom parts with Additive Manufacture



Overview

- Custom nozzle assembly designed to extrude two different materials simultaneous.
- The nozzle design includes an internal cavity to create a thermal break between the materials.
- Frazer-Nash showed how the nozzle could more efficiently be 3D-printed in steel and precision-finished.
- The new nozzle can be produced as a single piece, which is quicker and cheaper to manufacture in the low volumes required.

The Challenge

Controlling thermal conduction in tight spaces is a common challenge in the manufacturing industry, and is often overlooked. Designing and making the production processes and machinery to produce the highest quality product calls for a rigorous approach, and can result in complex part geometries.

One of Frazer-Nash's clients, a major food manufacturer, required such a complex part in a specific production process – a cream nozzle, designed for the simultaneous co-extrusion of two materials. It uses an internal cavity to create a thermal barrier between the two materials before they are brought together, reducing heat transfer that could damage the final product.

The co-extrusion process also requires thin structures to avoid defects in the final product, meaning the walls of the nozzle are just 0.4 mm thick. These dimensions also have to be achieved at a tolerance of 0.04 mm to meet the exacting standards of the designer and the client.

Comparing The Manufacturing Options

The nozzle design had previously been manufactured using traditional subtractive techniques. However, Frazer-Nash believed the part could be more efficiently and cost-effectively 3D-printed using the latest metal additive manufacturing technology.

The following comparison of the manufacturing options shows how additive manufacturing with the Renishaw Selective Laser Melting (SLM) machine, in combination with our precision-finishing capabilities, can lead to faster and cheaper production of small-batch parts.

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Traditional Manufacturing Approach

In the traditional approach, creating the internal cavity of the nozzle would be achieved by manufacturing the two pieces, then brazing them together. This two-part construction means the parts can be produced using traditional techniques, but introduces more critical dimensions to the part – the external dimension of the outer part would require a tolerance of just 0.03mm to ensure the vacuum braze forms a good bond. Careful setup and planning would be required to get this right.

Both parts would be turned from S162D maraging steel, a relatively slow process, involving the complex setup and programming of a CNC machine. The inner nozzle would then move on to a wire EDM machine to have the slots cut, before both parts are passed to inspection. After passing post machining inspection, the parts are sent off to be vacuum brazed and heat treated, then returned to us for final inspection and packing.

Modern Approach Using Additive Manufacturing

Integrating metal AM technology into the process accelerates the first steps of manufacture. A digital 3D CAD model of the part is loaded in to QuantAM, the additive manufacturing preparation system. Additional material is added to the design on dimensionally significant surfaces to give a suitable allowance for the final precision-machining.

The Renishaw SLM machine is prepped with maraging steel powder (specified by grain size), and a substrate base-plate that the part will be built up on.

Then the SLM machine gets to work making the part. A powerful laser traces the shape of the first horizontal layer of the part, melting the steel powder as it goes. This solidifies into an ultra-thin 'slice' of the metal part. The base-plate is then lowered, more steel powder is added on top, and the process repeats until the entire metal part is completed.

Precison-Finishing To The Client's Exact Specification

When the part is finished printing, the support structure at the base is removed using wire EDM. The part is cleaned ultrasonically to remove any remaining metal powder. It is then bead blasted to prepare it for heat treatment, before being passed on to inspection.

At this point, the nozzle is close to the required final geometry, but has a finish similar to that of a casting. This is where Frazer-Nash's onsite workshop facilities come into play. The rough parts are precision-finished on the lathe to the exact required tolerances by one of our skilled machinists, then polished internally and externally to give a final finish.

Producing the parts at near-net-shape reduces the time needed for machining, by reducing the material to be removed, the part count, and the number of critical tolerances required. The finished parts are then given a final careful quality inspection before being provided for integration with the client's production machinery.

Conclusion

A good design does not always mean a complex geometry. However, as designs evolve to become more optimised to their task, there is often a point where extra intricacy is essential. For our client's required part in this case study, the nozzle's thin walls, internal cavity and tight tolerances are vital to the production of a high-quality product.

Renishaw AM250 SLM machine

Integrating the latest metal additive manufacturing technologies into the process allows new and small-batch parts to be produced quicker and at lower cost than relying on traditional processes alone. With a partner like Frazer-Nash, having all these capabilities available onsite minimises the time spent shuttling parts between subcontractors, and ensures ISO 9001 quality and excellent reliability.

Learn more about the advantages of metal additive manufacturing – talk to Frazer-Nash today for a demonstration or quote.

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