

EXPLORING THE 3D PRINTING OF METAL VACUUM SEALS

ARTICLE TYPE

RESEARCH ARTICLE
This article reports on a research project that explored the possibilities of 3D printing of metal vacuum seals. The project was funded by the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska Curie grant agreement. The project was part of the 3D printing challenge, which was a part of the 3D printing challenge, which was a part of the 3D printing challenge.

3D printing of metal vacuum seals

3D printing has been on the rise for some time now. Starting from plastic jewellery and car body parts to functional tools and organs can now be printed, with industry experts continuously learning about how to optimise materials, machines, processes and procedures. The 3D printing of metal products for high-tech industrial applications remains quite the challenge however, with very demanding specifications in terms of accuracy, tolerances, surface finish, strength, etc. KMWI SCF joined forces with Settel's Savenije to build up experience in the 3D-printing of metal vacuum seals.

3D printing of metal vacuum seals

Research scope

The KMWI SCF business unit is researching the additive manufacturing, primarily focused on 3D printing, of metal structures and machine tools in collaboration with eight partners in the additive consortium. Initial idea for the 3D printing pilot factory for the production of industrial metal parts in thickness, and it is here that KMWI works on manufacturing for design, parameter optimisation, support strategy, material research and comparison with existing technologies to make world class additively manufactured parts.

The Research & Innovation team of Settel's Savenije development department took part in additive design Challenge 2021 with a well-working vacuum seal designed for reducing construction space in high-tech vacuum systems for vacuum-related and process industries.

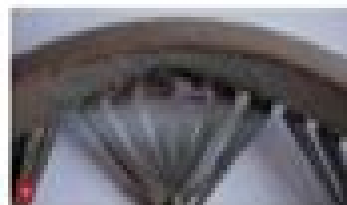
After meeting during the design Challenge finale, KMWI SCF and Settel's started working together to bring this design to reality. KMWI is eager to learn about printing industrial products to machine metal and titanium, while Settel is exploring the opportunities to meet a new standard for vacuum seals.

To kick off the research, a pilot job was built using the original seal design, printed in an upright position and

supported by an added handle. The position was chosen to minimise the total amount of supports and material required, including the machining effort for



1. First test printed in 3D printing process. The seal was printed in an upright position and supported by a handle at the bottom. The seal was printed in an upright position and supported by a handle at the bottom.



removing the structure in an added handle. Figure 1 shows the angle and on the picture after the 3D printing process the limited and most of the printing powder has been removed.

The prototype made during the first pilot job demonstrates the difficulty of printing the design and the need manufacturing because of the choice of support structure for Figure 1. The following observations can be made: a full structure support leads to a strong powder remaining in the structure. It is a lot of post-processing time needed to remove structure and clean up the part.

A new approach leads to: it is enough surface finish because of the absence of support structure has been reached. In Figure 2 an support structure that is not angled has been reached. In Figure 3, a low thermal conductivity in these areas near the surface is needed.

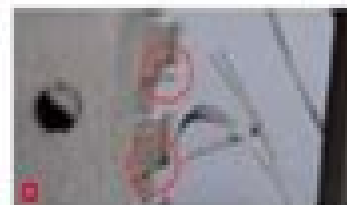
Partners: KMWI and Settel's Savenije

KMWI is a Dutch industrial company focused on the development of a new type of vacuum system. The company operates in high-tech, low-volume, high-complexity manufacturing. It develops and delivers a wide range of complex, customised industrial components, ranging from small components to large-scale industrial machines and systems. The company is focused on the development of new technologies, processes and industrial automation systems.

Settel's Savenije is a group of companies that provides high-tech manufacturing with expertise for people. The group focuses on design, manufacturing, assembly and maintenance of products, machines, tools and equipment. Their international customer base includes the design, construction, medical, aerospace and energy markets.

www.kmwi.nl
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2. The handle is added to the 3D printing process and the seal is supported. 3. The seal is supported by a handle at the bottom. The seal is supported by a handle at the bottom.



it enough handle to the seal structure which has automatically supported for Figure 3.

Examples of support structure

The vacuum seal design was optimised for 3D printing using the lessons learned from the first pilot job. The following principles were applied for the seal design:

1. The product is placed at an angle of 1° off the vertical (upright) orientation with respect to the handle to avoid having to use vertical supports.
2. Additions are incorporated into the support structure, so the structure can be removed easily.
3. The support strategy changed from one supports to multiple supports, so there can be removed more easily (less processing). Changing from a closed to an open support structure means less material is needed.



4. One of the seal parts is shown in a vertical position and the seal is supported by a handle at the bottom.

During the same with the seal design, it was decided to also optimize for seal design built for printing. When a hole is required, most mechanical engineers will almost automatically choose a circular shape, as this can be easily made by machining on a lathe or a milling machine. Different rules apply for 3D printing however: a vertical printed circular hole requires a support structure, while a square hole does not. In such a square hole is cheaper and easier to make using 3D printing than conventional machining. Other constraints were made by reducing the amount of features, while still applying the learning log.

Parker Vacuum Seal Design Guide

R Barnett



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